Hong Kong
8 - 10 February

2019

# ICEDUTECH

International Conference on Educational Technologies

# PROCEEDINGS

Edited by:
Piet Kommers
Tomayess Issa
Pedro Isaías
Wendy Hui

iadis
international association for development of the information society

# 6th INTERNATIONAL CONFERENCE
# on
# Educational Technologies 2019
# (ICEduTech 2019)

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# 6th INTERNATIONAL CONFERENCE
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**HONG KONG**

**8 – 10 FEBRUARY, 2019**

Organised by
**IADIS**
**International Association for Development of the Information Society**

Co-organised by

Lingnan University 嶺南大學 香港 Hong Kong

Edited by Piet Kommers, Tomayess Issa, Pedro Isaías and Wendy Hui

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# FOREWORD

These proceedings contain the papers and poster of the 6th International Conference on Educational Technologies 2019 (ICEduTech 2019), which has been organised by the International Association for Development of the Information Society and co-organised by the Lingnan University, in Hong Kong, 8 - 10 February 2019.

ICEduTech is the scientific conference addressing the real topics as seen by teachers, students, parents and school leaders. Scientists, professionals and institutional leaders are invited to be informed by experts, sharpen the understanding what education needs and how to achieve it.

Topics for the ICEduTech Conference:

- **Education in Context:** Education in the Network Society, Educational Games, Social Media in Education, Home Schooling, Students' Rights, Parents' Rights, Teachers' Rights, Student-Safe Searching, School Violence, Education and Tolerance for Peace and Education in Developing Countries.
- **Education as Professional Field:** Teacher Education, Teachers' Professional Development, Teachers' Workload, Teacher Support for Grading, Time Tabling, Grading, Learning Tools, and Online Learning Software, Teachers' learning in Communities of Practice, Web-based Communities for Teacher Support, Teachers' Career Planning, Legal and Financial Issues, Conflict Resolution and Mediation, Governance and Servant Leadership and Educational Policies.
- **Curricular Evolution:** Problem-based Learning, Critical Thinking Skills, Creativity Skills, Learning Citizenship, Global Education, Media Literacy / Pedagogy, Multicultural Education and Alternative Assessment Methods.
- **Learner Orientation:** Student-Oriented Learning, Peer- and Collaborative Learning, Learning Strategies: Learn how to Learn, Motivating Students, Recognizing Students' Learning Styles and Special Education.
- **Integrating Educational Technologies:** Social Media and Social Networking, The Semantic Web 3.0, Podcasting for Broadcasting Video Lectures, Podcasting feedback to students, Wiki and blogs in Higher Education, Mobile, Virtual and Vicarious Learning and Simulations and Modeling.
- **International Higher Education:** Marketing Higher Education as a Business Case, Pitfalls and Solutions in Joint and Double Degree Programs, Enculturation and International Teacher Accreditation, Web-based, Mobile, Virtual Presence and Social Media to Overcome Student Mobility, Blended Learning and Student Assessment at a Distance, Student Mobility and Distance Education, New-Emerging Standards and Benchmarks for Higher Education, Education, Research, Exchange an Capacity Building, 21st Century Academic and Industrial Brain Exchange, Academic Salaries, Faculty Contracts, Residence Permits and Legal Issues, International Student Exchange Funding Programs: Erasmus Mundus, the U.S. Council on International Educational Student Exchange, and the Euro-American "Atlantis" program, Networks for International Higher Education in the Pacific, Australia, Europe, Asian and European countries and Higher Education, Cultural Diversity, Tolerance and Political Conflict.

The International Conference on Educational Technologies 2019 (ICEduTech 2019) received 124 submissions from more than 22 countries. Each submission was reviewed in a double-blind review process by an average of four independent reviewers to ensure quality and maintain high standards. Out of the papers submitted, 18 got blind referee ratings that published them as full papers, which means that the acceptance rate was 15%. Some other submissions were published as short papers, poster and tutorial formats.

Best paper authors from the ICEduTech 2019 conference will be asked to extend their papers to be published in the IADIS International Journal on WWW/Internet (ISSN: 1645-7641), the IADIS Journal on Computer Science and Information Systems (ISSN: 1646-3692) and also in Interactive Technology and Smart Education (ITSE) journal (ISSN: 1741-5659).

Besides the papers' presentations, the conference also includes two keynote presentations from internationally distinguished researchers. We would therefore like to express our gratitude to Professor Patrick C. K. Hung, University of Ontario Institute of Technology, Canada, Cathie Norris, Regents Professor, University of North Texas, USA and Elliot Soloway, Arthur F. Thurnau Professor, University of Michigan, USA.

The conference also includes a tutorial presented by Dr. Dennis Foung from The Hong Kong Polytechnic University, Hong Kong and a workshop by Profs. Cathie Norris and Elliot Soloway.

A successful conference requires the effort of many individuals. We would like to thank the members of the Program Committee for their hard work in reviewing and selecting the papers that appear in this book. We are especially grateful to the authors who submitted their papers to this conference and to the presenters who provided the substance of the meeting. We wish to thank all members of our organizing committee.

Last but not least, we hope that participants enjoyed Hong Kong and their time with colleagues from all over the world.

Piet Kommers, University of Twente, The Netherlands
Wendy Hui, Lingnan University, Hong Kong
*Conference Co-Chairs*

Tomayess Issa, Curtin University, Perth, Australia
Pedro Isaias, The University of Queensland, Australia
*Conference Program Co-Chairs*

Hong Kong
February 2019

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# KEYNOTE LECTURES

## USING COMPANION ROBOTS FOR RESEARCH AND EDUCATION

**By Patrick C. K. Hung,**
**Faculty of Business and IT,**
**University of Ontario Institute of Technology, Canada**

**Abstract**

The concept of robots, or other autonomous constructions, can be found in many different cultures dating back to ancient times. A companion robot is defined as a device consisting of a physical robot component that connects to Cloud services to improve the ease and productivity of activities through networking, multi-media and sensory technologies. It is believed that robotic computing can provide a good experience to engage university and pre-university students in Science, Technology, Engineering, and Mathematics (STEM) education. Many studies found out that anthropomorphic designs of what robots are, what they can do, and how they should be understood resulted in greater user engagement within the history of Western countries. Humanoid robots usually behave like natural social interaction partners for human users, with features such as speech, gestures, and eye-gaze, in referring to the personal data and social background of the users. Cultural differences may influence human-robot interaction with different social norms and cultural traits, especially in West and East. In contrary to the Western image of robots as frightening machines, there is a different culture in the East. This talk discusses several research and education studies on companion robots from this socio-technical perspective.

# THE DIGITAL TRANSFORMATION OF K-12: FROM DIGITIZED CURRICULUM TO DEEPLY-DIGITAL CURRICULUM

**By Cathie Norris, Regents Professor,**
**University of North Texas, Denton, TX. USA**
**&**
**Elliot Soloway, Arthur F. Thurnau Professor,**
**University of Michigan, Ann Arbor, MI, USA**

## Abstract

Music industry – disrupted by Apple. Motion picture industry – disrupted by Netflix. Computer manufacturing – disrupted by Dell. Mention virtually any industry – and it has been disrupted by a digital transformation. Except one industry: education. Primary and secondary education continues to bump along much as it has always done since the 19th century. But there are signs that change – digital change – is coming. From Nevada to Kenya; from Singapore to Dallas. Paper-based textbooks are seeing major declines. 1-to-1 pencil-based classrooms are being converted to 1-to-1 computer-based classrooms. And the students in those classrooms, who have been video gamers and who can be seen everywhere wearing headphones, 24/7, are no longer content to sit quietly and listen to the teacher at the front of the room drone on and on. In 1-to-1 computer classrooms direct instruction is being replaced by inquiry, monologue is being replaced by dialogue. But curriculum still remains the heartbeat of the classroom; the new new is the old old: curriculum, curriculum. In our presentation, we will describe the transition – the digital disruption – that curriculum is undergoing – from digitized curriculum to deeply-digital curriculum – as schools move into the Digital Age.

# TUTORIAL

## A TASTE OF CLASSIFICATION TECHNIQUES – AN EDUCATIONAL DATA MINING TUTORIAL FOR BEGINNERS

**By Dr. Dennis Foung,**
**The Hong Kong Polytechnic University, Hong Kong**

### Abstract

Educational Data Mining (as a subfield of learning analytics) is an emerging field of interest and one popular application is to predict student success using classification techniques. Despite the predictive power of the classification techniques, these techniques are often perceived to be highly statistical and can only be understood by data scientists and computer scientists. In fact, some techniques used in this field were introduced in the 1960s and only became popular in recent decades due to the advancement of computer technologies. This tutorial aims to unravel the mystery in the field and introduce the basic concepts and applications of classification techniques to beginners who do not have any statistical or technical background. The session will start with a general introduction of a range of commonly-used classification techniques, including Classification Tree, Logistic Regression, Artificial Neural Network and Market-basket Analysis. These techniques will be presented in layman terms, within the teaching and learning context. The introduction is followed by hands-on practice for participants to get a taste of some techniques (e.g. Classification Trees and Market-basket Analysis). Readily-prepared code of R Studio (a statistical software) will be provided to participants to try out these techniques. The facilitators will explain how to evaluate the effectiveness of them and how these techniques can be adapted in different educational contexts. The facilitators will also explore how these techniques can be applied in different sectors in higher education, such as frontline teachers, subject leaders, programme leaders, researchers, and student services providers. The session will conclude with some tips and recommendations for starting a project in the field.

# WORKSHOP

## MANAGING DIGITAL CURRICULA USING THE FREE, DEVICE-INDEPENDENT COLLABRIFY ROADMAP SYSTEM

**By Cathie Norris, Regents Professor, University of North Texas, Denton, TX. USA**
**and**
**Elliot Soloway, Arthur F. Thurnau Professor, University of Michigan, Ann Arbor, MI, USA**

**Abstract**

"There's never been a better time to be a worker with special technological skills or education" observe Brynjolfsson and McAfee in their recent book, The Second Machine Age. And there's never been a better way to acquire those skills and education than to use instructional materials developed by expert teachers. Towards reducing the challenges of developing and using deeply-digital, highly-interactive curriculum, we have developed the Collabrify Roadmap System (CoRS).

In our hands-on workshop – Managing Digital Curricula – attendees will use the free, device-independent, tools in the Collabrify Roadmap System to manage the full life-cycle of a "Roadmap" – a sequence of digital objects that support learners – children to adults – in developing the skills and understanding that are increasingly needed in our digital world. The CoRS supports educators in:

- creating Roadmaps from OER – Open Education Resources that are available on the Internet;
- distributing Roadmaps to learners for use on their mobile devices;
- monitoring learners, in real-time, as they move through the Roadmaps;
- assessing the artifacts developed by learners during Roadmap enactment;
- and, sharing Roadmaps in a professional community.

The CoRS is being used by teachers and students in U.S. (Michigan, Texas, California, Wisconsin).

The CoRS supports educators working in real-time, co-located or not, collaborating synchronously in creating the device-independent, deeply-digital, highly-interactive Roadmaps. Virtually any URL – any digital element on the Internet – can be included as a resource in a Roadmap. And, virtually any application, e.g., word processor, game, simulation can also be included in a Roadmap. Roadmaps also support learners working in real-time, co-located or not, collaborating synchronously. We will also show how SEL – socio-emotional learning – skills can be integrated into Roadmaps. And, unlike more traditional "authoring" environments (e.g., Blackboard), CoRS is easy to learn and easy to use.

During the workshop, attendees will build, deliver, enact, and share Roadmaps collaboratively. We urge attendees to bring with them the outline of a lesson that they will then cast in the form of a deeply-digital Roadmap. It is our intention that attendees will leave our workshop with the skills and understanding needed to continue using the Collabrify Roadmap System to develop exciting curriculum to support digital learners.

# Full Papers

# DEVELOPING A PRODUCTIVE KNOWLEDGE-BUILDING DISCOURSE THROUGH JUDGMENTS OF PROMISING IDEAS AND EPISTEMIC REFLECTION

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**ABSTRACT**

This study investigated whether elementary students could collectively advance a knowledge-building discourse through judgments of promisingness and epistemic reflection. Supported by the Promising Idea Tool and its accompanying pedagogical design, 32 grade six students were involved in judging the promisingness of their community ideas, refining ideas iteratively, and explicitly reflecting on their knowledge-building discourse using knowledge-building principles. We analyzed students' online discourse using multivariate methods, including socio-semantic network analysis and content analysis. Socio-semantic network analysis indicated that the students progressively advanced their community ideas and the community became more connected over time. Content-analysis results indicated that sixth graders could collectively improve their discourse by contributing diverse ideas, negotiating a fit, and generating questions, using problem-centered uptake moves and synthesis notes. The study's findings have important implications for the design of technology-rich environments, and shed light on how teachers can use them to help learners engage in productive collaborative inquiries.

**KEYWORDS**

Knowledge Building, Promising Ideas, Epistemic Reflection, Metacognition

## 1. INTRODUCTION

Helping students develop higher-order skills such as knowing how to inquire and collaborate, cultivate agency and metacognition, and create knowledge is an educational mission. Preparing students for collaborative, sustained and creative scientific practices that advance their higher-order competencies is therefore essential (Bransford et al., 1999; Zhang et al., 2018). Collaborative knowledge building, an influential pedagogical model in learning sciences, shows great potential for helping students develop these higher-order competencies.

Collaborative knowledge building, pioneered by Scardamalia and Bereiter (Scardamalia & Bereiter, 2014) emphasizes collective responsibility, improvable ideas, student agency and metacognition, and creative and promising ideas. In knowledge building, students' work is supported by Knowledge Forum, an online platform that facilities their knowledge building. The knowledge-building process is so emergent and complex that students, as active agents, need to continually identify promising ideas and evaluate the promisingness of ideas (Chen et al., 2015). To meet their emergent goals and invent new goals (Yang et al., 2016), they must reflect on the process, based on their assessments of the state of the learning process and its products (Zhang et al., 2018). The ability to judge the promisingness of community ideas and continuously reflect on the knowledge-building process to identify knowledge gaps and high points for further inquiry is critical to productive knowledge building. However, most Chinese elementary school students tend to receive teachers' instructions rather than participate as active players in learning. They generally lack the skills to judge the promisingness of ideas or engage in metacognitive reflection.

To address this challenge, this study designed a knowledge-building environment, augmented by judgments of promising ideas and epistemic reflection. To help students engage in productive judgments of promising ideas, students were provided with the Promising Ideas Tool, an analytic tool developed by Chen et al. (2015) and now embedded in Knowledge Forum. The Promising Ideas Tool can help students select

promising ideas from their community's ideas and support collective decision making to identify promising directions for further inquiry (Chen et al., 2015; Chen, 2016).

The purpose of this study was to investigate whether sixth graders could collectively improve their knowledge-building discourse in a knowledge-building environment augmented by judgments of the promisingness of ideas and epistemic reflection. The study addressed the following research questions. (1) Did students' contributions and collaboration change during the knowledge-building process? (2) What was the nature of the knowledge-building discourse? (3) To what extent did students improve their discourse?

# 2. METHODS

## 2.1 Research Context and Participants

This study was conducted in an elementary school in Wuhan, China, with students mostly coming from middle- or upper-middle-class families. Thirty-two grade six (11-12 year old) students from one class participated in the study. The students studied the unit "shapes & structures" for eight weeks, with three 45-minute science lessons each week. They had no previous experience of knowledge building. The teacher was an expert in teaching science, with five-years of teaching experience. However, this was the first time the teacher had adopted a knowledge-building pedagogy.

## 2.2 Pedagogical Design

To help students engage in productive knowledge building, the teacher adopted the following components from the knowledge building pedagogical design proposed by van Aalst and Chan (2012):

*Component 1: Creating a collaborative classroom culture and helping students develop competencies of inquiry-and-explanation and collaboration.* To help students develop inquiry, explanation, and collaboration competencies, the teacher created several opportunities for student groups to engage in hands-on experiments, and for whole class discussions. For example, students in small groups collaborated to explore the effects of width and thickness on the resistance of materials to bending, built bridges using newspapers, and made towers using bottles and tubes (Figure 1). These activities helped them not only to learn to collaborate and communicate, but to develop the ability to inquire by asking questions, proposing hypotheses, designing and conducting experiments, and drawing conclusions through discussions and negotiations over the fit of diverse ideas. More important, these principle-based activities created a collaborative-inquiry ethos and norms for democratic participation.

*Component 2: Advancing inquiry-oriented and idea-centered discussion through the Knowledge Forum discourse*. The students shared their questions and ideas and discussed their initial experiments and findings in small groups and whole-class conversations. Focusing on the questions, the student groups conducted research with the help of books, experiments, online resources, and materials from their teacher. Extending their face-to-face knowledge building talks and interactions, the students recorded their questions, experimental findings, and ideas in Knowledge Forum to produce an ever-deepening online discourse (Figure 1). Knowledge Forum provided students with epistemic scaffolds such as "My idea," "My theory," "My evidence," "My conclusion," and "I need to understand" to help them develop the ability to inquire and explain.

*Component 3: Deepening knowledge advances through judgments of promising ideas and explicit epistemic reflection*. After the students had contributed a reasonable number of notes to Knowledge Forum, they were instructed to use the Promising Idea Tool. To help students engage in productive judgments of promising ideas, they were provided with metacognitive prompt sheets (e.g., including prompts like "My Analysis," "My Problem," "My Plan"). These helped them reflect on and monitor their discussions and plan the future direction of discussions. We also provided students with prompt sheets to help them synthesize their clusters of notes.


Figure 1. Knowledge Forum Views and Notes, and Hands-on Activities

## 3. DATA ANALYSIS AND RESULTS

The data sources for this study were primarily the computer notes the students posted on Knowledge Forum. The students contributed 247 notes in total.

### 3.1 Research Question 1

Research Question 1: *Did students' collaborations and contributions change during the knowledge-building process?*

To reveal the patterns of students' collaborations and contribution, we used a socio-semantic network analysis tool: Knowledge Building Discourse Explorer (KBDex, Oshima, Oshima, & Matsuzawa, 2012). KBDex was developed to analyze knowledge-building discourse, and it could support the metrics of the three different networks: degree centrality, betweenness centrality, and closeness centrality. Therefore, it could be used for visual inspections of semantic relationships, analyses of pivotal points and phases, and trend analysis. We selected 85 words from students' online discourse for analysis. The agreement between the two raters was 83%, and disagreements were resolved through discussion. We argued that the keywords could represent the discourse content, so the closeness of keywords' links and the quantity of keywords could represent the density and diversity of discourse content respectively.

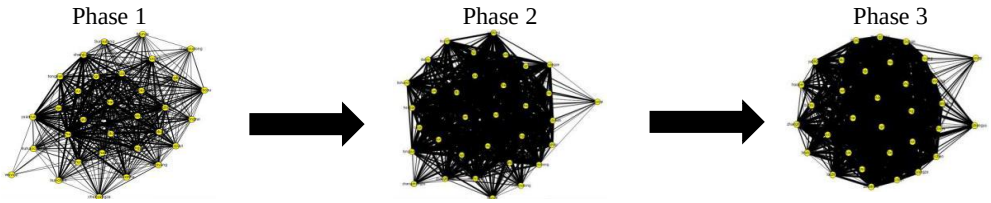


Figure 2 (a). Snapshots of the network of students over time

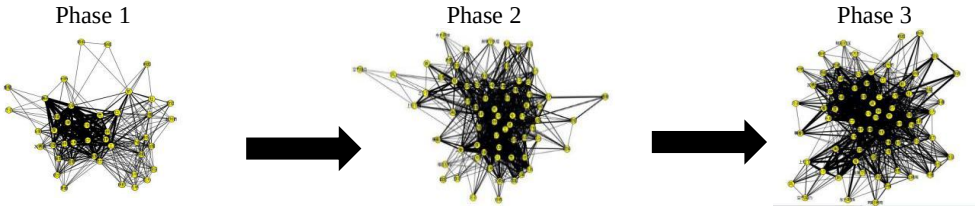


Figure 2 (b). Snapshots of the network of keywords over time

Figure 2. Snapshots of the network of students and keywords over time. Notes: The circle represented the student/keyword, and the connection between the two circles represented the relationship between them. The thickness of the line between the two circles represented the degree of correlation between them.

To investigate the changes of students' contributions and collaborations, we first identified two pivotal points to divide the knowledge-building process into three phases. Figure 2(a) shows that the density between the students increased from Phase 1 to Phase 3. Figure 2(b) shows that the keywords network structure was becoming denser, and extremely different keywords appeared from Phase 1 to Phase 3. These results suggested that the community was becoming interactive over time, and that students were engaged in productive knowledge building.

We further analyzed the patterns of contribution of students in the community through the changes to each student's sum degree coefficients in the three phrases (Figure 3). The gaps in the sum degree coefficients between students in Phase 1 indicated that their individual contributions were not democratic. However, the gap of the sum degree coefficients among individual students became smaller in Phase 3, indicating that they had progressively taken collective responsibility for advancing community knowledge.

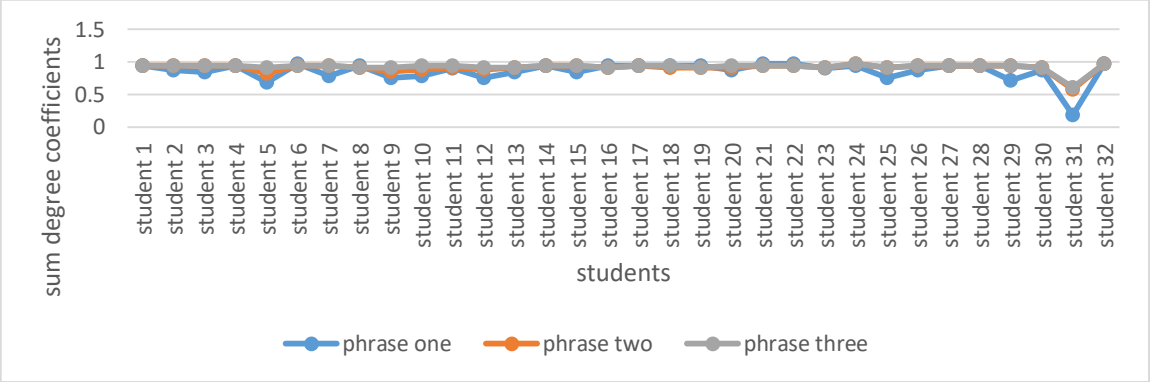


Figure 3. The changes of Sum Degree Coefficients of Individual Students in Three Phrases

## 3.2 Research Question 2

Research Question 2: What was the nature of the knowledge-building discourse?

To characterize the students' online knowledge-building discourse, we first pre-processed their notes into inquiry threads. This provided context for the subsequent content analysis of the notes within each inquiry thread. An inquiry thread was defined as a sequence of notes addressing a single problem (Zhang et al., 2007). Two hundred and forty-seven notes were put into 12 inquiry threads through inquiry thread analysis. To check the coding reliability of the inquiry thread analysis, two raters independently completed the task on 30% of the notes, resulting in an inter-rater reliability of .80 (Cohen's kappa).

After pre-processing the students' notes, we conducted content analysis using the inquiry thread as the unit of analysis. We developed a coding framework with coding examples to code the notes in each inquiry thread. The development of the coding framework involved an iterative coding process of theory- and data-driven approaches. The coding schemes (Table 1) included four main categories and corresponding subcategories, and drew upon theoretical frameworks for social, cognitive and meta-cognitive processes of knowledge construction (Authors, 2016; van Aalst, 2009). Two raters independently coded 30% of the notes. The inter-rater reliability was .78 for questions, .83 for scientificness of ideas, .78 for complexity of ideas, and .79 for community (Cohen's kappa).

We selected nine large inquiry threads and presented the numbers of questions, ideas and collective responsibility in them. The inquiry threads defined as large included more than 10 notes each. Table 2 shows that the elementary students in this class were engaged in explanation-oriented discourse: they focused more on explanatory than factual questions (24 compared with 7). They also generated more notes with elaborations than notes with simple claims (72 compared with 39). This result indicated that the students engaged in a deep rather than a superficial knowledge-building process.

Table 2 also shows that students invested a lot of effort in collectively advancing their community ideas. For example, they contributed many notes to negotiating a fit between diverse ideas (65 notes), showing idea uptake (41 notes), and rising above the community's ideas (17 notes). These results indicated that students in this class could take collective responsibility to improve their ideas progressively.

Overall, the above results suggested that elementary students in this class were able to assume high-level responsibility to collectively accomplish a knowledge-building discourse. They engaged in productive collaborations and gradually improved ideas in the communal space.

Table 1. Coding framework for content analysis of students' online discourse

| Categories | Subcategories | Definitions | Examples |
|---|---|---|---|
| Question | Fact-seeking | Questions can be answered by factual information | *Please discuss those shapes such as "—","W", "口","工" which impacts the material most?* |
| | Explanation-seeking | Open-ended question that can only be answered by elaborative explanations | *Why shape "W" is the the most resistant to bending?* |
| Scientificness of ideas | Naive | Absolutely incorrect conceptions or theories, or naive ideas. | *The combination of arch, sphere, and frame structure don't have any drawbacks.* |
| | Hybrid | Ideas are basically wrong, but the understanding and explanation of the ideas are scientific under certain restrictions. | *I think shape "W" has a greater impact. Because shape "W" paper is wider so it's more durable than other shapes.* |
| | Basically scientific | The understanding and explanation of the concepts and theories in the discussion topics and issues are basically correct, but are not comprehensive and precise enough. | *I think the impact of shape "W" is even greater. Because "Thickness has a greater influence on the bending resistance of the beam." The thickness of shape "W" is thicker than other shapes. So the influence of shape "W" is greater.* |
| | Scientific | There is clear, scientific, and comprehensive understanding and elaboration of the concepts and theories of the discussion topics and issues, and the scientific theories contained in the discussion can be applied to practice. | *In response to the question "Shape W is not the thickest, why is the strongest resistance to bending?" One student responses that "because of the triangular structure, this is the most stable form".* |
| Epidemic complexity of ideas | Unelaborated facts | A description of terms/phenomena/experiences/simple judgments of a problem/idea without elaboration. | *Shape "M" has the strongest resistance to bending.* |
| | Elaborated facts | Elaboration of terms/phenomena/experiences in detail. | *The thickness has a greater influence on the resistance to bending of beams. Like the ruler we use, it is not easy to bend vertically.* |
| | Unelaborated explanations | Mention reasons, relationships, and mechanisms without elaboration. | *I have done experiments today. When the material is flat, the gravity coincides. When the material is folded, gravity is dispersed. So the resistance to bending is good in "U","T","O" and other shapes.* |
| | Elaborated explanations | Provide sufficient theories and evidences to elaborate reasons/ relationships/mechanisms. | *The shape of the tower plays a vital role. In our lives, we can see that the towers are generally small and light on the top while large and heavy on the bottom as a triangle. This is made to make the tower's chassis solid and firm, preventing the tower from falling. To make a triangle is because the tower is stable on the ground.* |
| Collective responsibility | Creating shared understanding | Creating elaboration or explanations of concepts or ideas to address the central problem; reformulating problems or focus. | *I think the resistance of bending of material is related to material, thickness and width.* |
| | Negotiating a fit | Constructing arguments or explanations in favor of; challenging the ideas brought in. | *Although there is a business certificate, if there is no application, the "W" beam is still useless. Only the "W" beam will be used on the construction.* |

| | | |
|---|---|---|
| | | *Therefore, there are various problems in the beam. The beam of "W" is not only difficult to do, but also unstable.* |
| Problem-centred idea uptake | Building up on peers' ideas to provide explanations in addressing the central problem and to deepen the inquiry including co-elaborating. | *I agree with your opinion. Because shape "W" is really difficult to do, and it is not easy to fix it on the ceiling. However, I have to add that the "W" shape of the beam is not beautiful, and the home will be a bit strange. But what shape can the beam make?* |
| Synthesizing notes | Summarizing ideas from multiple notes by creating hyperlinks to a small number of notes relevant to it, extending the referenced ideas and introducing a new level of conceptualization. | *The arch can be placed at the bottom because it can withstand the weight of the dispersing force; the sphere can be placed on top because it cannot be placed underneath; the frame structure is played both in the building of the bridge and in the building of the tower. In summary, these three can be put together. The drawbacks are still there. The sphere does not play much role and can only play an aesthetic role if used improperly, because it will waste building materials.* |

Table 2. Number of different categories of questions, epistemic complexity of ideas and collective responsibility in inquiry threads

| | | | **Question** | | **Epidemic complexity of ideas** | | | | **Collective responsibility** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Students | Notes | Fact-seeking | Explanation - seeking | Unelaborated facts | Elaborated facts | Unelaborated explanations | Elaborated explanations | Creating shared understanding | Negotiating a fit | Problem-centred idea uptake | Synthesizing notes |
| Total notes (9 inquiry thread) | 32 | 197 | 7 | 24 | 39 | 49 | 27 | 23 | 35 | 65 | 41 | 17 |
| Mean | 15.67 | 24.33 | 0.89 | 2.89 | 5.22 | 7.56 | 3.56 | 2.89 | 4.56 | 9.78 | 5.11 | 2.22 |
| SD | 4.92 | 9.81 | 2.00 | 1.61 | 5.04 | 5.34 | 2.13 | 2.61 | 5.00 | 3.93 | 3.18 | 1.30 |
| #1 | 17 | 21 | 1 | 4 | 10 | 3 | 6 | 3 | 9 | 8 | 3 | 4 |
| #2 | 13 | 20 | 6 | 2 | 17 | 8 | 2 | 4 | 15 | 10 | 11 | 2 |
| #3 | 13 | 18 | 0 | 3 | 0 | 2 | 2 | 6 | 0 | 4 | 4 | 4 |
| #4 | 26 | 42 | 0 | 4 | 2 | 4 | 1 | 1 | 1 | 6 | 3 | 1 |
| #5 | 12 | 16 | 0 | 2 | 3 | 18 | 3 | 1 | 2 | 17 | 5 | 1 |
| #7 | 11 | 20 | 0 | 3 | 1 | 9 | 6 | 6 | 1 | 14 | 6 | 2 |
| #8 | 13 | 25 | 0 | 6 | 7 | 5 | 3 | 5 | 6 | 9 | 8 | 2 |
| #9 | 21 | 40 | 1 | 1 | 6 | 12 | 1 | 3 | 6 | 12 | 2 | 3 |
| #10 | 15 | 17 | 0 | 1 | 3 | 6 | 4 | 0 | 0 | 11 | 3 | 0 |

Notes: Inquiry threads defined as large included at least ten notes each. #1—Shape and its resistance to bending, #2—Beam and its resistance to bending, #3—The secret of arch bearing, #4—W shape and its resistance to bending, #5—Beam and W shape, #6—Overview of bridge and frame structure, #7—The structure of tower and stability, #8—Combination of arch, sphere and frame structure, #9—The placement of beam, #10—Column and W shape. Note: #6, #11 and #12 are not included because they were not large inquiry threads.

## 3.3 Research Question 3

Research Question 3: To what extent did the students improve their discourse?

To investigate the extent to which the students advanced their knowledge-building discourse, we first presented discourse advancement for each selected inquiry thread, followed by a demonstration of the characteristics of discourses before (Stage 1) and after (Stage 2) promisingness judgments and epistemic reflection.

### 3.3.1 Idea Improvement within Inquiry Threads

We rated students' personal ideas on a continuum from naive to scientific understanding, and from unelaborated facts to elaborated explanations, respectively, coding their personal ideas at different levels to distinguish the depth and epistemic complexity of them.

We first sequenced students' notes in the large inquiry threads based on the time of the last modification. Then we divided the notes into two stages (Stage 1 and 2, before and after judgments of promisingness and epistemic reflection). Finally, we compared the mean value of scientificness and the complexity of all ideas in the two stages. Table 3 shows that the scientificness and complexity of ideas improved from 2.95 to 3.25 and from 2.02 to 2.43, respectively. The results indicated that the students progressively generated ideas related to scientificness and they elaborated their ideas with increasing epistemic complexity.

### 3.3.2 Changes to Questioning, Ideation and Collective Knowledge Building

The characteristics of the students' knowledge-building discourse in the two stages were compared with the aggregated results for each stage (Table 3). Table 3 shows that there were differences between the two phases for questions, ideas and community knowledge. The students' notes in the later stage showed greater explanatory power, and focused much more on theory building (e.g., problem-centered idea uptake) and the review and 'rise-above' of ideas.

Table 3. Changes of Question, Idea and Collective Responsibility Over Time

| Total notes | | Stage 1 | | Stage 2 | |
|---|---|---|---|---|---|
| | | 108 | | 89 | |
| | | Frequency | Percentage | Frequency | Percentage |
| Question | Fact-seeking | 8 | 7.41 | 0 | 0.00 |
| | Explanation -seeking | 15 | 13.89 | 9 | 10.11 |
| Scientificness of ideas | Naive | 2 | 1.85 | 0 | 0.00 |
| | Hybrid | 15 | 13.89 | 8 | 8.99 |
| | Basically scientific | 42 | 38.89 | 39 | 43.82 |
| | Scientific | 15 | 13.89 | 26 | 29.21 |
| Epidemic complexity of ideas | Unelaborated facts | 36 | 33.33 | 9 | 10.11 |
| | Elaborated facts | 25 | 23.15 | 40 | 44.94 |
| | Unelaborated explanations | 10 | 9.26 | 17 | 19.10 |
| | Elaborated explanations | 14 | 12.96 | 13 | 14.61 |
| Collective knowledge building | Creating shared understanding | 29 | 26.85 | 8 | 8.99 |
| | Negotiating a fit | 40 | 37.04 | 48 | 53.93 |
| | Problem-centred idea uptake | 20 | 18.52 | 23 | 25.84 |
| | Synthesizing notes | 9 | 8.33 | 9 | 10.11 |
| Scientificness (Mean) | | 2.95 | | 3.25 | |
| Epidemic complexity (Mean) | | 2.02 | | 2.43 | |

## 4. DISCSSION AND CONCLUSION

This study investigated whether sixth graders could collaboratively develop a knowledge-building discourse. We primarily analyzed the students' online discourse on Knowledge Forum, using multifaceted methods such as socio-semantic network analysis and content analysis. Socio-semantic network analysis suggested that students engaged in productive collaboration and made democratic contributions. They could advance their

community's ideas collectively by generating explanatory-oriented discourse, negotiating a fit between diverse ideas, focusing on problem-centered idea uptake and synthesizing ideas.

This study has contributed to the literature in two ways. First, it showed that elementary students in an examination culture could identify and evaluate promising ideas and carry out metacognitive reflection. These skills are critical for productive knowledge building, and can help students develop agency and self-direction in their ongoing knowledge building work within a supportive learning environment. In prior research, many teachers and scholars have expressed doubt that Chinese elementary students could do such higher-order work (van Aalst & Chan, 2007). Second, the pedagogical design (including the three components of collaborative ethos, staging principle-based tasks for collaboration and reflection, and promisingness judgments supported by the Promising Idea Tool in the community context) was conducive to elementary-school students. Thus, it could have important implications for the design of technology-rich environments to support learners.

This study had some limitations. One important limitation was that the study focused on discourse, and did not investigate changes in the domain knowledge of individual students. The findings provided evidence of idea improvement within the discourse, but it is unclear how widespread these changes were among the participants, or whether the changes were *transferable*. Another limitation was that we did not include or analyze classroom data sources such as classroom videos and observations. Nonetheless, such data is critical for a better understanding of students' online knowledge-building discourse and what contributes to their productive knowledge building. We are now conducting an analysis of classroom data sources to understand classroom processes and dynamics conducive to productive knowledge building.

## ACKNOWLEDGEMENT

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# USING PHYSICAL LOGIC GATES TO TEACH DIGITAL LOGIC TO NOVICE COMPUTING STUDENTS

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**ABSTRACT**

One of the challenges that commencing university students in computing degree programs face is the difficulty in engaging with the abstract and complicated theories in the computing discipline. In particular, it is hard for beginner computer architecture students to visualise the link between the theory of digital logic and the behaviour of the digital circuitry. Studies have shown that improving disciplinary engagement can lead to lower student attrition rates. We aim to increase student engagement in an introductory computer architecture course by employing oversized physical logic gates in the form of logic blocks in several digital logic experiments. Using these digital logic blocks students will be able to physically interact with the circuitry and observe the outcomes of their solutions directly. Student survey results indicate that using the physical logic blocks was helpful to beginner computing students in gaining a better understanding of digital logic and digital circuits. The use of physical logic blocks was also helpful in transitioning to a more abstract digital logic drawing environment later in the course for building more advanced digital circuits.

**KEYWORDS**

Digital Logic Gates, Digital Circuits, Logicblocks, Logisim

## 1. INTRODUCTION

Commencing university students face a multitude of challenges (Baik, Naylor, & Arkoudis, 2015). A successful transition to university can be facilitated by supporting students across a number of common issues as outlined in Lizzio's Five Senses of Success model (Lizzio, 2006; Lizzio & Wilson, 2010). Supporting students at the start of their academic career is particularly important in computing fields where student attrition rates are typically higher than other Science Technology Engineering and Mathematics (STEM) fields (US Department of Education, 2013). One of the issues identified in (Lizzio, 2006) relates to the level of disciplinary engagement. Resilience can be developed by students through improved disciplinary engagement, and this can have a positive flow-on effect on student attrition. In this paper we examine the impact of using a physical computing environment on student engagement with digital logic theory in a first-trimester introductory computer architecture course.

Based on previous student feedback we believe that one of the challenges facing students in engaging with the digital logic component of the course relates to the abstract nature of the theory. Students learning about digital logic in this course will be exposed to a number of digital logic gates (AND, OR, NOT, NAND, NOR, XOR) and how these logic gates are combined to create more complex digital logic circuits such as a simple addition circuit. A significant barrier to student understanding of the workings of the individual logic gates is that it is not possible to see inside a digital logic gate to understand how it works. Instead, the student must develop a linkage between the behaviour of the circuit and its name and symbol. Students then use these symbols to chain together multiple logic gates to build more complex circuitry. In past iterations of the course, logic gates and circuits of this type could either be drawn on paper or using a digital logic drawing program that can simulate electrical current flowing through the circuit and test the circuit. The benefit of the digital logic drawing program approach is that the student can experiment and test their circuit. However, past student feedback has indicated frustration with the drawing program which is considered too abstract and complicated when students have only just learnt the digital logic concept. Frustration at this early part of the course can lead to disengagement with the topic.

There is growing evidence that using some form of physical computing modules in addition to the more traditional approaches is beneficial to the learning experience of beginner computing students (Richard, 2010; Rubio, Romero-Zaliz, Manoso, & de Madrid, 2014; Maia, da Silva, de S. Rosa, Queiroz-Neto, & de Lucena, 2009). In a similar vein, we believe that the use of physical logic blocks may also be beneficial when these students learn about digital logic. In support of this belief, a study in a digital design course using a programmable logic device (Radu & Cole, 2008) has indicated that using these types of hands-on devices has had a positive impact on the development of discipline specific skills and student intention of continuing with their program of study. Having access to a physical unit can give less abstract feedback to the student on the behaviour of the logic gate and circuit. This can help to reduce some of the uncertainty of the beginning student.

The focus of this paper is improving disciplinary engagement in the teaching of digital logic in a computing degree. We aim to achieve this by using popular low cost physical digital logic blocks (LogicBlocks, n.d.) that can be connected to each other to build moderately complex circuits. Using these digital logic blocks students will be able to physically observe the outcomes of their solutions to problems, rather than as static written text on a page or as a graphical representation on a screen. They will be able to interact with the circuitry and observe the outcome of their solution directly. This hands-on approach will facilitate experimentation, allow students to evaluate the effectiveness of the solution, and aid in the development of alternate solutions.

We have incorporated several experiments using the digital logic blocks into the laboratory classes at the start of the course to reinforce the digital logic theory introduced in lectures. The use of digital logic blocks is intended as a scaffold for the more abstract digital logic drawing program (Logisim n.d.) used in subsequent laboratories and in the main course assignment. The results indicate that the LogicBlocks activity was generally successful in helping the novice students gain a better understanding of digital logic and digital circuits, with some limitations related to the complexity of circuits that can be built due to the size of the LogicBlocks kit.

The remainder of this paper is organised as follows. In Section 2, we describe the digital logic teaching tools used in the course as well as the experiments using the digital logic blocks. In Section 3 we give an overview of the methodology. We present and discuss the student feedback on the experiments in Section 4 and offer our conclusions in Section 5.

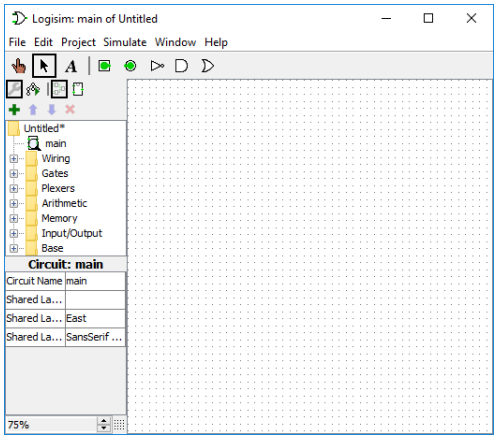


Figure 1a. Logisim Simulator

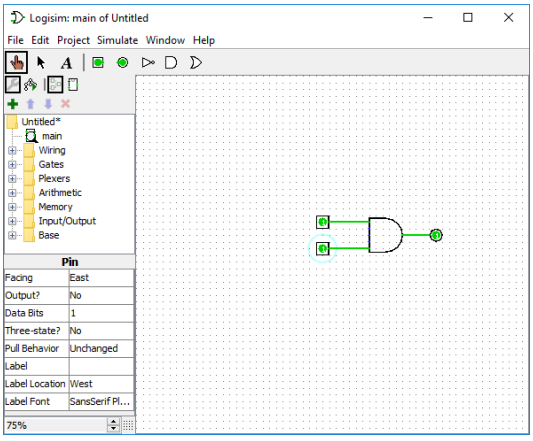


Figure 1b. AND Gate in Logisim

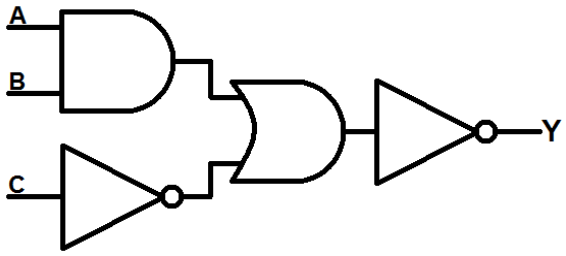


Figure 2. Combinatorial Digital Logic Experiment on Logisim

# 2. DIGITAL LOGIC TEACHING TOOLS

In the introductory computing course on computer architecture, students are introduced to the underlying digital components and logic that define a computer. The basic logic gates (AND, OR, NOT, NAND, NOR, XOR) and their corresponding truth tables are presented and then used to construct more advanced digital circuits such as combinatorial and sequential logic circuits. These topics are first taught in lectures, and then practised and reinforced during exercises in laboratory classes.

In previous offerings of the course, students have used the Logisim simulator tool (Logisim, n.d.) for designing and simulating digital logic circuits. The laboratory exercises use Logisim to build and evaluate basic logic gates (see Figure 1) as well as more advanced circuits (see Figure 2). Indicative student comments related to the digital logic component focus on the lack of "*hands-on practical experience with hardware*", with suggestions of incorporating "*more practical stuff with gates – using gates & how they work with binary*" and "*more kinaesthetic learning resources when covering logic gates would have been great since the concept was quite difficult for many people*". These comments have been sourced from formal university-wide anonymous end-of-trimester course evaluations in previous offerings of the course.

To address the students' need for practical hands-on exercises with logic gates, we have introduced the SparkFun LogicBlocks electronic kit (LogicBlocks, n.d.) into the course. The LogicBlocks electronic kit (see Figure 3) allows the students to play and experiment with physical logic gates, thereby enabling them to see how the output of the digital circuit reacts to the inputs. We have incorporated a set of laboratory exercises using the LogicBlocks electronic kits to scaffold the students' learning and understanding of the theory and practical aspects of digital logic gates. The teaching of digital logic is structured so that students first work on these LogicBlocks laboratory exercises (see Sections 2.1, 2.2, 2.3). After having been exposed to LogicBlocks, students continue their study of digital logic in the following weeks with the Logisim simulator tool and its associated laboratory exercises. Logisim allows students to create more complex and advanced circuits that would be challenging to create with LogicBlocks due to the limitation on the number of available components in the physical kits. In Sections 2.1, 2.2, and 2.3 we discuss the LogicBlocks experiments in more detail.

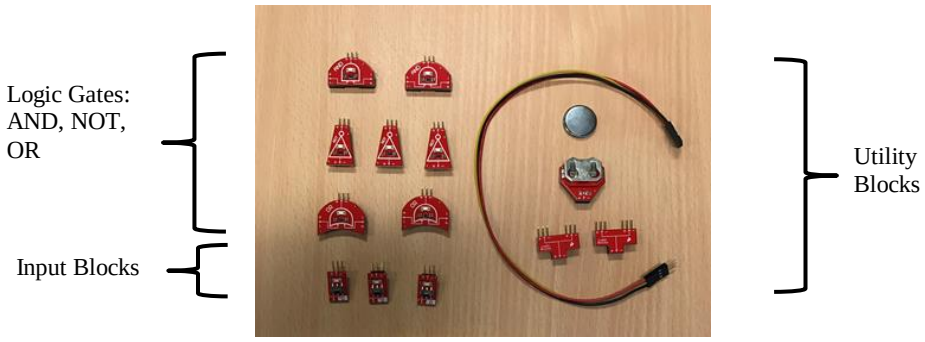


Figure 3. LogicBlocks Kit: Logic Gates, Input Blocks, and Utility Blocks

## 2.1 Basic Digital Logic Gate Experiments

In this laboratory exercise, students are asked to construct an AND gate logic circuit shown in Figure 4, experiment with different combinations of input signals (0 = OFF, 1 = ON) and fill up the truth table for an AND logic gate. A truth table is a tabular representation of the possible input states and their corresponding output state. Students are also asked to repeat the same exercise for different logic gates (OR, NOT, NAND, NOR). This laboratory exercise is designed to reinforce the students' understanding of the basic logic gate functions and characteristics.

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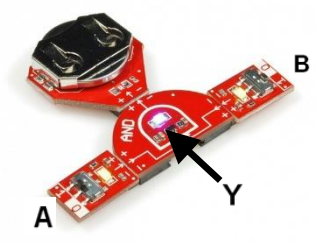


| Input A | Input B | Output Y |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

Figure 4. AND Logic Gate and its Truth Table

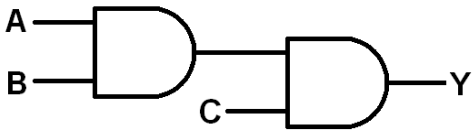


Figure 5. Combinatorial Digital Logic Experiment

## 2.2 Combinatorial Digital Logic Circuit Experiment

In this laboratory exercise, students are asked to construct a more advanced combinatorial digital logic circuit (see Figure 5) with the LogicBlocks kit. Students are asked to try out all possible input combinations for A, B and C, and construct the truth table for the circuit. This exercise trains the students to follow the progression of the input signals to the output signal Y, as well as help the students take the first step in understanding how more complicated circuits are essentially constructed from simple basic logic gates.

## 2.3 Oscillator Digital Logic Circuit Experiment

In this laboratory exercise, students are asked to construct the oscillator circuit shown in Figure 6, and explain what they see when the battery power is plugged in. Similar to the exercise in Section 2.2, this exercise requires the students to follow the progression of the input signals to the output signal, and additionally gives the students an opportunity to see for themselves how a sequential logic circuit works with the output signal feedback into the circuit input. One benefit of using LogicBlocks is that this type of oscillating circuit can easily be created, whereas in the Logisim simulator this may not be able to be implemented correctly if the simulation is not completely accurate.

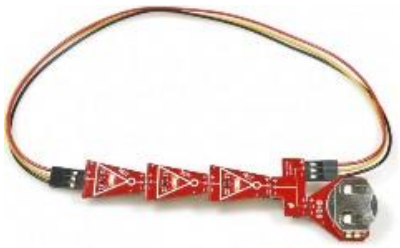

Figure 6. Oscillator Digital Logic Experiment

# 3. METHODOLOGY

In the introductory computing course on computer architecture students attend two hours of lectures and 2 hours of laboratories during each of the 12 teaching weeks. The 377 enrolled students are distributed across two campus offerings with identical content, assessment, and delivery modes. The LogicBlocks experiments discussed in Sections 2.1, 2.2 and 2.3 were completed by students at both campuses in their week 4 laboratory class after having completed three hours of digital logic lectures covering the basic logic gates. After completing the LogicBlocks activity, students used the Logisim simulator to develop more advanced digital logic circuits from week 5 onwards.

Students were surveyed twice to better gain an understanding of their experience with both LogicBlocks and Logisim. Survey 1 was held in the laboratory class in week 5, one week after the week 4 LogicBlocks

experiments outlined in Sections 2.1, 2.2, and 2.3. Survey 2 was held in week 6 after students had used the Logisim simulator to develop the digital logic circuit in Figures 1 and 2 for their week 5 activity.

The questions for Survey 1 were developed to gain an understanding of how effective students perceived the LogicBlocks activities to be in reinforcing their understanding of the basic digital logic gates. For Survey 2, the questions were aimed at understanding if the LogicBlocks activities were successful in preparing students for the use of the Logisim simulator. The survey questions are shown in Table 1 and Table 2. For Survey 1, Questions 1, 2, and 3 in Table 1 ask students to grade their experience on a 5-point Likert-style scale ranging from Strongly Agree through to Strongly Disagree. In Table 1, Questions 4 and 5 are open-ended questions where students can give a more detailed textual response. For Survey 2, Questions 1, 2, 3, and 4 in Table 2 ask students to grade their experience on a 5-point Likert-style scale ranging from Strongly Agree through to Strongly Disagree with the option for Q2 and Q4 to give an open-ended textual response if they chose a negative response. Student responses were anonymous and there were 140 and 187 responses for Survey 1 and Survey 2, respectively.

Table 1. Survey 1 Questions on the LogicBlocks Experiments

| Question | Description |
|---|---|
| Q1 | Do you have any prior knowledge of digital logic and digital circuits before taking this course? |
| Q2 | After attending and revising Lecture 3, I am confident in my knowledge of digital logic and digital circuits |
| Q3 | The hands-on LogicBlocks activity in Workshop 4 helped me gain a better understanding of digital logic and digital circuits |
| Q4 | What did you like the most about the LogicBlocks activity? |
| Q5 | What did you like the least about the LogicBlocks activity? |

Table 2. Survey 2 Questions on the LogicBlocks and Logisim Experiments

| Question | Description |
|---|---|
| Q1 | The hands-on LogicBlocks activity in Workshop 4 helped me gain a good understanding of digital logic and digital circuits |
| Q2 | Completing the hands-on LogicBlocks activity in Workshop 4 was a useful preparation for working with the Logisim simulator in Workshop 5 |
| Q3 | The Logisim simulator activity in Workshop 5 was a useful way to build on the understanding of logic circuits that was developed using LogicBlocks in Workshop 4 |
| Q4 | The hands-on LogicBlocks activity was more helpful to me in gaining a good understanding of digital logic and digital circuits, compared to the Logisim simulator |

# 4. RESULTS AND DISCUSSION

In Survey 1, 99 out of 140 students (~71% of respondents) indicated that they did not have any prior knowledge of digital logic and digital circuits before taking the course (Figure 7). From these 99 students, 44% answered that they were confident (Agree and Strongly Agree) in their knowledge of digital logic learnt in the lecture before undertaking the LogicBlocks activity (Q2 in Figure 8). In contrast, only 9% of the 99 students felt that they were not confident (Disagree and Strongly Disagree) in their knowledge even after the lecture but before the LogicBlocks activity. 47% of the 99 students gave a Neutral response to Q2 indicating uncertainty about their level of confidence. After the hands-on LogicBlocks activity, 68% of the 99 respondents who said No in Q1 agreed in Q3 that the LogicBlocks activity was helpful in them gaining a better understanding of digital logic. Only 6% felt that the activity didn't help them (Q3 in Figure 8).

Looking at the responses in more detail, of the 9 out of 99 respondents (1 respondent ~= 1% of this study group) who Disagreed with Q2 in Survey 1, 4 of these respondents now agreed in Q3 that LogicBlocks helped them to better understand digital logic. 3 people responded with Neutral for Q3, and 2 disagreed that LogicBlocks helped them to better understand digital logic. The 2 negative respondents indicated that they felt the content was moving too fast and that they would like a lecture specifically on LogicBlocks to prepare for the LogicBlocks activity.

From the 44 respondents who were confident in their knowledge of digital logic in Q2, 1 person responded with Strongly Disagree to Q3 with the comment that the LogicBlocks were flimsy. It is possible that their response regarding the utility of LogicBlocks was negative partly due to build quality issues with

the kits. Another 4 of these students who agreed to Q2, responded with Neutral to Q3. Their comments indicated that they felt that the activity was rushed and that they felt constrained in what they could build due to the small number of gates available in the kits.

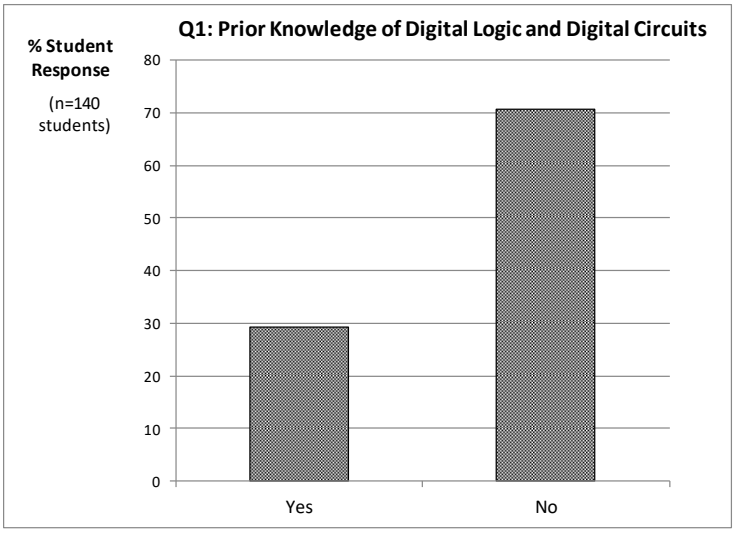


Figure 7. Student Responses to Survey1:Q1 on Prior Knowledge of Digital Logic and Digital Circuits

Of the 46 respondents who answered with Neutral to Q2, 3 of these respondents disagreed with Q3 that the LogicBlocks activity helped them to gain a better understanding of digital logic. Their comments indicated that they did not like the activity, felt it was pointless and that it "*did not help my understanding at all*". These 3 students were in the minority (3% of the 99 respondents).

Survey 1 responses also revealed that 41 students (~29% of respondents) indicated that they have had some prior knowledge of digital logic and digital circuits before taking the course (Figure 7). From these 41 students, 80% of them answered that they were confident in their knowledge of digital logic before undertaking the LogicBlocks activity (Q2 in Figure 9) and 78% of the students agreed that the LogicBlocks activity helped them gain a better understanding of digital logic and digital circuits (Q3 in Figure 9). This shows that even those students who already had prior knowledge of digital logic before the course, felt that they benefited from the hands-on LogicBlocks activity.

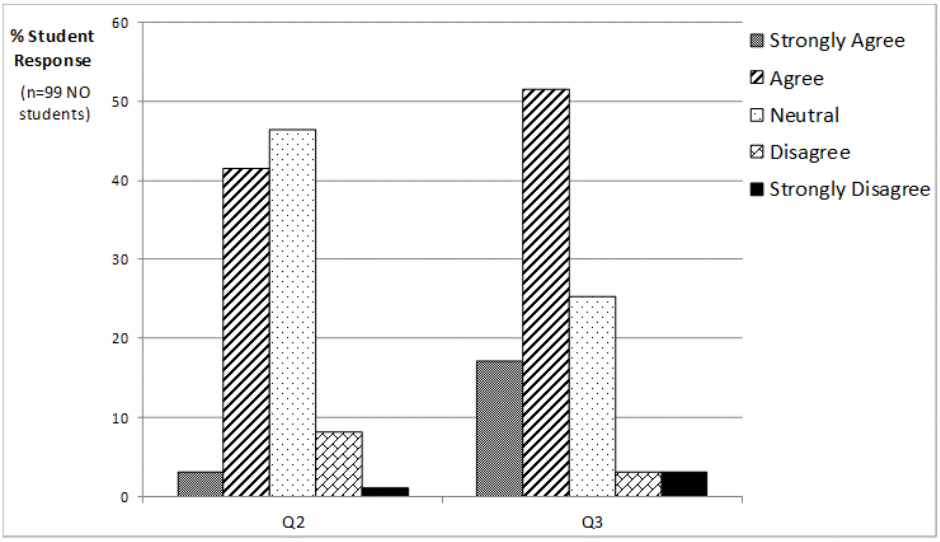


Figure 8. Responses to Survey1:Q2 and Q3 from Students without Prior Knowledge of Digital Logic

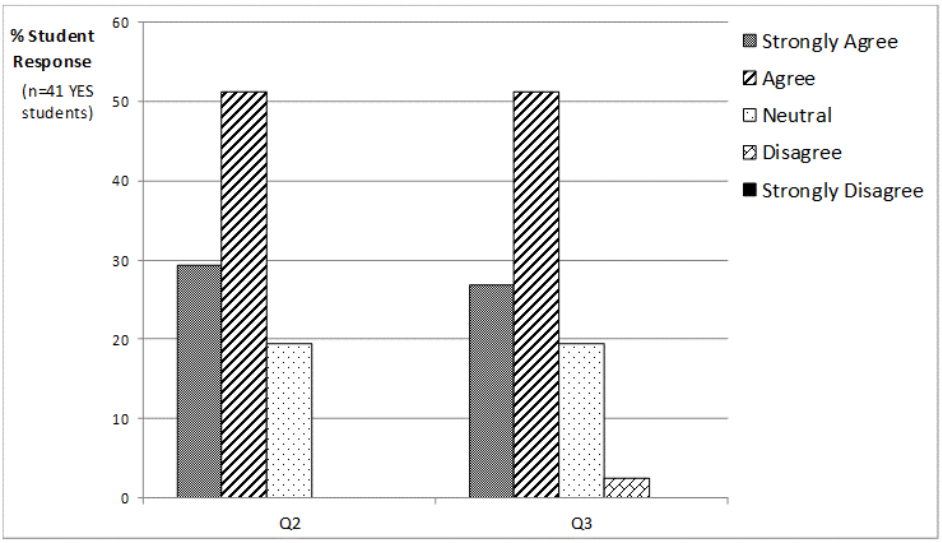


Figure 9. Responses to Survey1:Q2 and Q3 from Students with Prior Knowledge of Digital Logic

Overall when combining the responses from both sets of students (those with and without prior knowledge of digital logic and digital circuits), we found that 71% of the students agreed that the LogicBlocks activity was helpful to them while only 5% of the students disagreed. Student comments were very positive, with many of them stating that they found it useful being able to physically work with the logic gates and circuits, and visually see how the circuits work and respond to different input combinations. Some sample student comments: "*It gave us hands on, practical experience with circuits and logic gates*" and "*The Logic Block gate kit used in one of the computer labs was exceedingly useful in promoting understanding of how logic gates work and interactive together to form a single circuit*". These results indicate that the LogicBlocks activity was generally successful in helping the novice students gain a better understanding of digital logic and digital circuits.

For Survey 2 in Q1, students were again asked whether they felt the LogicBlocks activity was helpful to them in gaining a better understanding of digital logic and digital circuits. The responses reveal that 71% of the students agreed (Q1 in Figure 10), which is a similar percentage of students who agreed in Q3 of Survey 1. In addition, 66% of the students agreed that the LogicBlocks activity was a useful preparation for working with the Logisim simulator, while only a small number (7.5%) of students disagreed (Q2 in Figure 10). These results are further proof that the LogicBlocks activity was beneficial to the majority of students.

The Survey 2 responses also show that 79% of the students agreed that the Logisim simulator activity was a useful way to build on their understanding of logic circuits that was developed with the LogicBlocks activity (Q3 in Figure 10). Finally, when comparing LogicBlocks and the Logisim simulator in Q4, 47.5% of the students felt that LogicBlocks was more helpful to them in gaining an understanding of digital logic and digital circuits, while 19.2% of the students disagreed (Q4 in Figure 10). The reasonably high percentage of disagreeing students can be at least partially attributed to the fact that the LogicBlocks kit was fairly restricted in the types of complex digital circuits that can be constructed, compared with what is possible with the Logisim simulator. This view is supported by some open-ended comments such as "*with logicblocks we were limited in what we could do whilst we had all of Logisim at our disposal.*" and "*the simulator provides more opportunities to make your own circuits, thus gain a more comprehensive understanding without limitations of the Logic-Block activity*". This could in part be addressed in future offerings of the course by expanding the size of the LogicBlocks kits available to each student and developing activities and experiments for more complex circuitry.

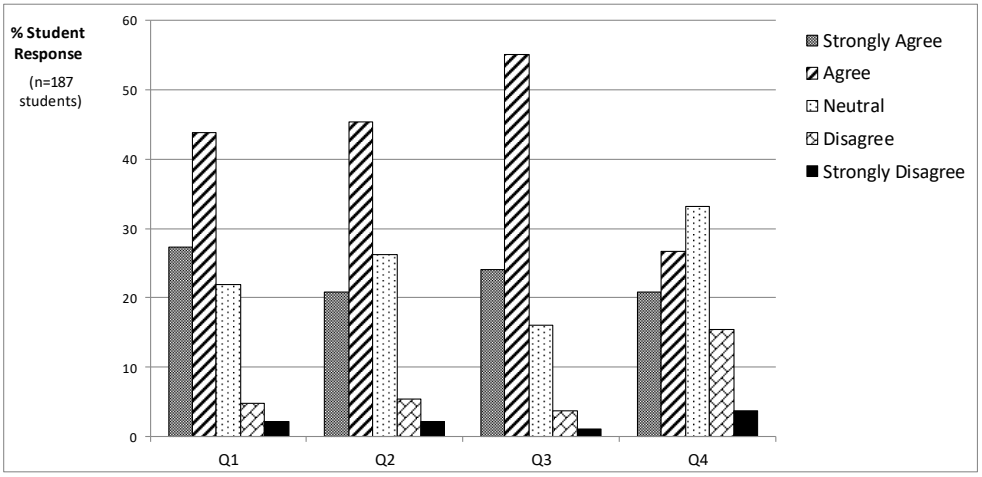


Figure 10. Student Responses to Survey2:Q1 to Q4 on LogicBlocks and Logisim

## 5. CONCLUSIONS

We have carried out several digital logic experiments using physical logic gates (LogicBlocks) in an introductory Computer Architecture course. The aim of these experiments is to gain an understanding of the impact of using a physical computing environment on student engagement with digital logic. Student feedback indicates that using the physical logic blocks was helpful in gaining a better understanding of digital logic and digital circuits and was helpful in transitioning to a more abstract digital logic drawing environment (Logisim simulator). Scaffolding student learning of digital logic is important for developing student understanding of how a computer works.

For future work, we plan to expand the size of the LogicBlocks kits available to each student and develop more complex activities and experiments using a larger number of logic blocks to address student feedback regarding the lack of complexity available to them with the current LogicBlocks kit.

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# CHARACTERIZING THE DYNAMICS AND TENSIONS IN THE SOCIAL PRACTICES OF LOW-ACHIEVING STUDENTS IN A KNOWLEDGE-BUILDING ENVIRONMENT

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**ABSTRACT**

The study used activity systems analysis to characterize the processes, dynamics, and tensions in the social practices developed by a class of academic low-achievers in a knowledge-building environment augmented by analytics-supported reflective assessment. A class of 37 Grade 9 low-achievers and an experienced teacher participated this study. Classroom data sources including classroom videos and observations, student artifacts, student interviews, and videos of reflective-assessment sessions were collected and analyzed. The findings indicated that staging tasks, frequent and opportunistic knowledge-building talks, the framing of discourse improvement as collective responsibility, and the acquisition of new skills and interests served as new tools mediating the students' activities. Our findings have important implications for the design of technology-rich environments as metacognitive tools to support low achievers.

**KEYWORDS**

Knowledge Building, Academic Low-Achieving Students, Activity System Analysis

## 1. INTRODUCTION

Understanding how low-achievers develop social practices by which they gradually generate creative ideas is critical for low-achievers' continuous development. This study used activity systems analysis (ASA), developed by (Yamagata-Lynch, 2010), to map the development of, and the dynamics and tensions in, the social practices in which a class of low-achievers collectively advance their ideas in a community context. This study was part of a program that examined the design, process, and effects of knowledge building environments augmented by analytics-supported reflective assessment on low-achievers. The study addressed the following research questions:

1) What is the nature of social practices from a cultural historical activity theory (CHAT) perspective?
2) What characterizes the dynamics of the social practices from a CHAT perspective, and how do the dynamics drive the development of the social practices?

## 2. REFLECTIVE ASSESSMENT AND LOW-ACHIEVING STUDENTS

In reflective assessment, students use their agency to reflect on a set of criteria/principles or learning goals. They produce their own feedback based on continuous assessment of the inquiry process and product, and improve their ongoing learning by attacking broader problems and continuously creating knowledge (Scardmalia, 2002; White & Frederiksen, 1998). Reflective assessment is collaborative: not everyone in the community needs to be highly metacognitive for the process to be effective, and students can scaffold others' metacognitive development through modeling.

Research in the learning sciences suggests that students of various achievement levels can participate in and benefit from reflective assessment. For example, White and Frederiksen (1998) found that reflective assessments carried out by middle-school students positively affected their performance in a scientific-inquiry test and a physics test, and that the process was particularly beneficial for low-achieving students. Toth et al. (2002) reported a similar intervention in which students were guided by a reflective assessment rubric during the inquiry, and found that reflective assessment typically had a positive effect on learning. Herrenkohl et al. (2011) found that the use of self- and peer-assessment tasks in an interactive online environment, accompanied by assessment criteria and useful tools such as software advisors, can scaffold students' conceptual understanding in science. However, there has been relatively little research into how we might assist low-achieving students to carry out this assessment as active agents to improve their collaborative inquiry.

This study characterized and mapped the developmental process of social practices created by low-achieving students in a knowledge-building environment augmented by reflective assessment. In this study, we provided students an assessment tool, the Knowledge Connections Analyzer (KCA) (Yang et al., 2016) to support reflective assessment. The KCA is a Web-based analytics tool designed to be used by secondary-school students to reflect on their online work in a Knowledge Forum. It queries the Knowledge Forum database to collect information on four intuitive questions related to knowledge building. For a full description, see Yang et al. (2016).

# 3. METHODS

## 3.1 Research Context and Participants

The study was conducted at a Band-3 school in Hong Kong, which is at the 10th percentile. Students at such schools tend to be weaker in Chinese and English, communication, and critical thinking than their counterparts in Band-1 and Band-2 schools, and have poorer motivation, self-identity, self-image, and metacognitive skills. The participants were 37 9$^{th}$ graders from a class taking a visual-arts course. They studied the topic of "Art appreciation" over five months in weekly one-hour lessons. Their teacher had previously found the students to be more motivated by knowledge building, a promising student-centered approach, than by other teaching methods. The teacher had considerable experience of teaching the visual arts, had taken a postgraduate course on knowledge building, and had used knowledge building for approximately eight years.

## 3.2 Pedagogical Design

The teacher used a three-phase pedagogical process to familiarize the students with knowledge building, as described in detail by Yang et al. (2016): (1) Creating a collaborative culture and helping students to build skills in inquiry, collaboration, and metacognition, (2) Deepening problem-centered inquiry in the Knowledge Forum, an online learning environment that supported students' online discourse, and (3) Using analytics-supported reflective assessment to foster deep domain understanding and metacognitive skills.

## 3.3 Data Sources and Analysis

### 3.3.1 Data Sources

In this study, we collected the following interrelated sets of qualitative data:

*Classroom observations.* We conducted the observations while the participants were engaged in activities related to knowledge building. The data comprised photographs and field notes related to some of the lessons, and video recordings of 17 one-hour lessons.

*Video recordings of reflective-assessment sessions.* We video recorded the students' reflective-assessment activities while on KF, in class, and during after-class group sessions, including their interpretations of and reflections on the data and plans for their KF discourse.

*Interviews.* We conducted semi-structured interviews to obtain information about the students' experiences of KCA. Some of the interviews were conducted individually, and others in groups of 2-3 students. Most of the interviews were conducted informally in the computer laboratory in which the students used the KCA during class, and each interview lasted for 20-30 minutes. The interview questions corresponded to the four questions in the KCA to obtain information about students' use of the KCA to support reflective assessment. The interviews were audio recorded.

### 3.3.2 Data Analysis

We used ASA to characterize the social practices that arose from the KCA-aided reflective assessment during knowledge building. ASA has been used in several studies to identify the systemic contradictions and tensions that shape developments in educational settings (Barab et al., 2002; Kim, 2011). The ASA was conducted in two main stages: identifying codes and analyzing activity systems.

*Code identification.* We began data analysis using the constant comparative method (Strauss & Corbin, 1998). Analyses were conducted to explore the potential determinants of students' productive and unproductive use of the KCA to conduct reflective assessment, and to identify the elements and ongoing activities that supported the transformation of newly introduced artifacts into cultural tools. The multifaceted analysis results of students' online discourse (Yang et al., 2016) provided the basis for the qualitative ASA. The study began by examining video-recordings of reflective assessment sessions to identify productive and unproductive uses of the KCA. Next, the study analyzed the potential of reflective assessment to increase students' focus on the key learning goals of knowledge building. The study further systematically analyzed the remaining sources of data to cast light on the students' perceptions of the effectiveness of the KCA in supporting reflective assessment, their experiences of using the KCA to conduct reflective assessment, and the activities and other elements that assisted or hindered the students' productive use of the KCA. The goal of this analysis was to report on thematic findings on the participants' engagement in KCA-afforded reflective assessment and various activities and other factors that made their use of the KCA productive or unproductive.

*Identifying activity systems.* This task involved three main steps: (a) developing thick descriptions of the participants' experiences in narrative format, (b) conducting ASA of the narratives, and (c) identifying substantiated findings (Yamagata-Lynch, 2010). Before drafting narratives of the students' experiences of self-directed reflective assessment, we identified substantiated stories from the data. "Work done by the class" was viewed as an activity system subject to ASA, and Engeström's (1987) triangle was used to describe the component structure of each instance of this activity. Identifying activity systems was an iterative process that involved multiple stages of revision, during which the drafted narratives were also modified. After finalizing the narratives and the ASA, we began identifying substantiated findings.

*Validity of ASA.* Trustworthiness was enhanced through consistent observation, methodological triangulation, and a rigorous coding process. We observed the participants consistently for approximately five months. At the same time, we obtained necessary information about the students, the teacher, methods of instruction, and curriculum by observing the teacher's work in other classes, and drawing on our six-year research relationship with the teacher. We conducted methodological triangulation using multiple sources of data: observation, students' artifacts, interviews, and questionnaires.

# 4. RESULTS

## 4.1 Results of ASA

We constructed three activity systems to describe and explain the development of the reflective-assessment activities and the interaction of these activities (a) before the KCA student activity, (b) during the KCA student activity, and (c) immediately after the KCA student activity. The activity systems are shown in Figures 1-3.

Activity system A (Figure 1) comprised the students' knowledge-building activities before using the KCA to carry out reflective assessment. In this activity system, a variety of meditational tools enabled the students to advance their knowledge, develop skills in summarization, collaboration, and metacognitive reflection, and develop a collaborative knowledge building culture. For example, the construction of a

knowledge-building wall helped low-achievers to make their ideas visible and public and created a collaborative culture conductive to subsequent productive knowledge building.

These tools motivated the students to invest much more effort in developing both face-to-face and online knowledge-building discourse, and to some extent improved their understanding of knowledge building as a collective enterprise focusing on idea improvement. However, the students still lacked motivation and showed weak inquiry, collaborative, and metacognitive skills, which led to tension (a): the need to attain an object despite lacking motivation and skills. In addition, the resource limitation that directed students' attention from individual note-writing to collective knowledge advancement, and urged students to continuously review, reflect on, and further synthesize/rise above community ideas, brought about tension (b): attaining the object with limited resources. Moreover, the traditional teacher-centered school culture and the associated norms for participation undermined the teacher's efforts to foster knowledge building and the students' efforts to carry out knowledge building, which brought about tension (c): the need to attain an object within a traditional teacher-centered school culture and the norms for participation in that culture. These tensions placed the student participants involved in activity system A in contradictory knowledge-building situations, and provided minimal support for their attempts to collaboratively advance their discourse. The forces created by these conditions militated against the subjects' efforts to attain the object.

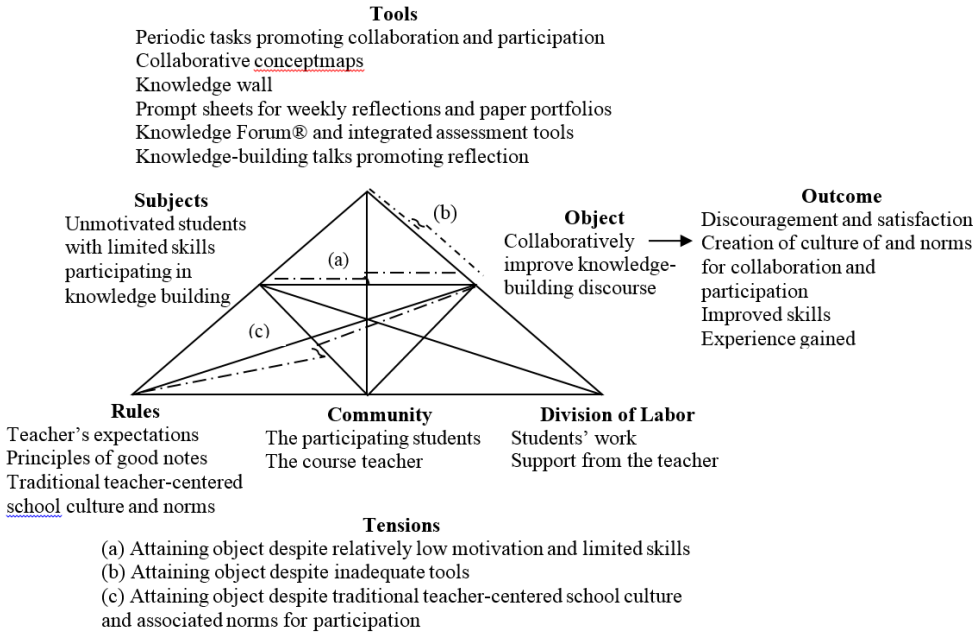


Figure 1. Activity System A: Before the KCA Student Activity

After the students engaged in reflective assessment using the KCA, the dynamics of the student activity systems changed: the students subsequently attempted to advance their knowledge-building discourse by carrying out KCA-based reflective assessment. Figure 2 shows the activity system at this stage (activity system B), a nested system incorporating the outcome of the earlier activity system (activity system A) (Yamagata-Lynch, 2010). In activity system B, the KCA was introduced to help the students engage in reflective assessment. They reflected on the KCA data and further synthesized and rose above the community's ideas. Initially, however, the students were unable to interpret the KCA data productively, leading to tension between the students' efforts to use the KCA data to improve their discourse and their ability to interpret the data. However, this tension lessened as the students gradually acquired the skills needed to interpret and use the KCA data and synthesize their ideas. Their skills development benefited from frequent and opportunistic knowledge-building talks promoting reflection on and thoughtful use of the KCA data, with an overarching emphasis on discourse improvement as a collective responsibility. For example, the following excerpt from the KCA reflection sheet demonstrates how the student was able to generate synthesis and rise above ideas collectively through reflective assessment with the KCA data, from the question "Are we putting our knowledge together?":

> We are wondering whether we have really put our knowledge together by referring to each other' notes, improved our understanding, and drawn conclusions…Look at the chart (pointing to the pie chart generated by the KCA), only 3% of our notes contain references... kind of very low…only 6% of our notes were used as references... You see, many of the summary notes are not quite good. Actually, we can further improve them (reading the pooled summary and rise-above note in the KCA)…we need to comment the notes referred to, for example why we choose them, why they are good or not…we need to refer more notes, summarize what they have talked about and identify further inquiry areas (from collective reflection in small groups)

In this excerpt, the students carried out KCA-supported reflective assessment with the purpose of inquiring ("whether we have really put our knowledge together by referring to each other' notes, improved our understanding, and drawn conclusions"), and analyze the possible issues ("only 3% of our notes contain references;" "kind of very low;" "only 6% of our notes were used as references;" "see, many of the summary notes are not quite good"). Based on their analysis, the group of students appeared to reflect on the quality of reference notes, made a plan ("further improve them") and took actions to address the issues ("we need to comment the notes referred to, for example why we choose them, why they are good or not…we need to refer more notes, summarize what they have talked about and identify further inquiry areas"). This example suggests that KCA-enhanced reflective assessment helped this student to connect their learning orientation to the knowledge-building goal of idea improvement as collective responsibility.

During this process, the students also became more motivated. As a result, tensions (a) and (b) in activity system A (the need to attain an object with limited skills and motivation, and the need to attain an object in the absence of a community-oriented framework for data-driven idea improvement) were substantially alleviated. In addition, during the KCA-driven reflective assessment, a range of tools (e.g., knowledge-building talks, a community-oriented framework for data-driven idea formation, collaborative concept maps, and strategies for developing collaboration skills and increasing motivation) helped the students to develop a knowledge-building culture. As a result, tension (c) in activity system A (the need to attain an object in the absence of a knowledge-building culture and associated norms for participation) was also substantially alleviated.

In activity system B, however, the teacher's expectations clashed with the students' limited attention, energy, and time. In addition, the expectations of the teacher and the research team clashed with students' attention, energy, and time. Tension (a) arose from the students' competing obligation to actualize the expectations of the teacher and research team and to complete their SBA projects. This tension is represented in a circular fashion because elements of the rule component created further tension in the system. Nevertheless, the overall outcome of activity system B was positive: the whole class collaboratively advanced their understanding by engaging in reflective assessment using KCA. Many of the students produced high-quality synthesis/rise-above notes, although others did not. The students continued to advance their collective understanding by gaining the skills, interests, and motivation necessary to pursue knowledge building.

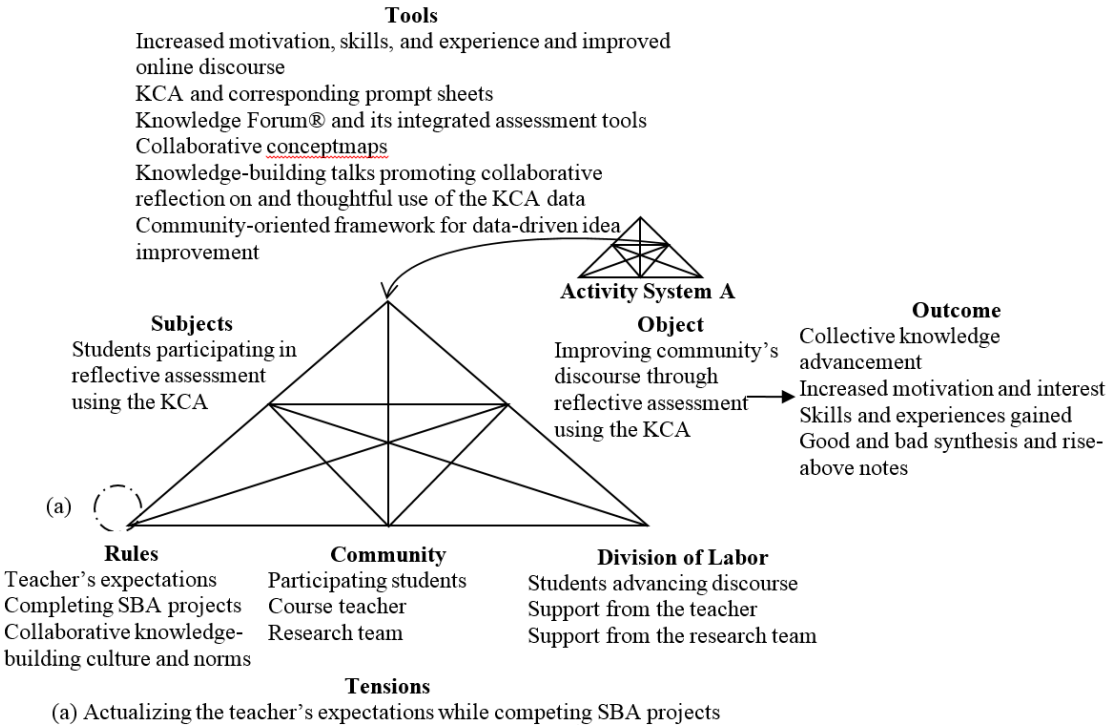


Figure 2. Activity System B: After the KCA student activity

Figure 3 shows Activity System C in which the knowledge-building participants are represented as subjects, and the intended collaborative improvement to the students' knowledge-building discourse is represented as the object. Capitalizing on the outcomes of activity system B, the students were able to collaboratively improve their knowledge-building discourse and develop skills in areas such as summarization, inquiry, collaboration, and metacognition. Many of the students also became interested in knowledge building, synthesizing notes, and analyzing their conceptual progress.

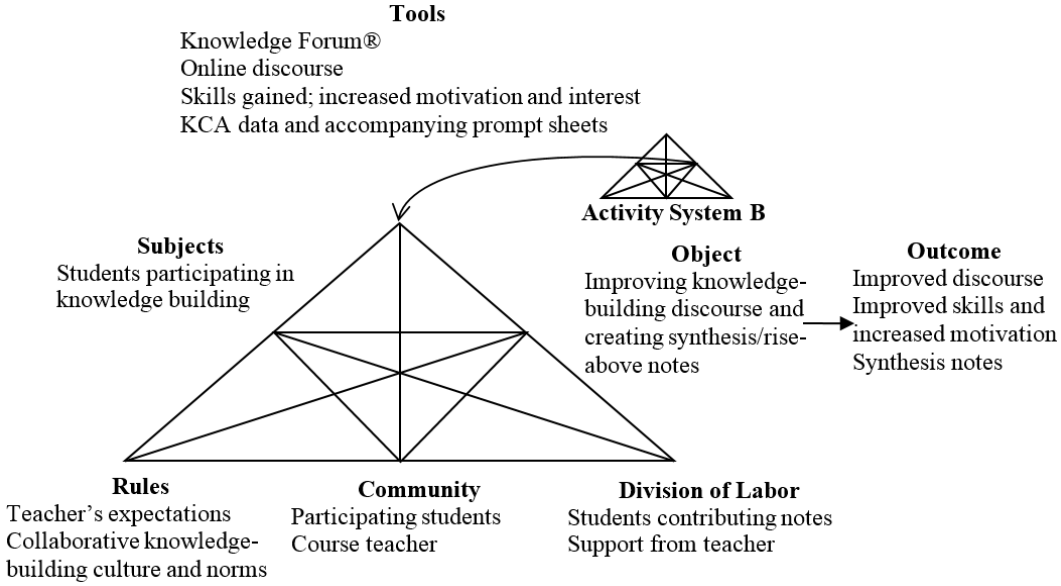


Figure 3. Activity System C: Immediately after the KCA Student Activity

## 4.2 Findings of the ASA

The ASA yielded three main findings that explain the nature, dynamics and tensions of the social practices that arose from the students' KCA-afforded self-directed reflective assessment. These findings offer insights into the elements that became influential cultural tools, and the ongoing activities that supported the transformation of these newly introduced artifacts into cultural tools.

*Regular tasks promoting inquiry, collaboration, and reflection introduced new tools that mediated student activities.* Regular tasks were designed to help the students to develop skills in inquiry, collaboration, and reflection, and to create a collaborative culture and norms. Comparison of activity system A with activity system B revealed that these tasks constituted valuable tools mediating the students' activities. For example, the students exhibited limited cognitive skills (inquiry and summarization) and metacognitive skills (reflection) in activity system A, and seldom reflected on their existing (lack of) knowledge (based on informal individual student interviews at the beginning of the course). Therefore, the teacher encouraged the students to write weekly reflections and create individual paper portfolios with the help of a task sheet. These regular tasks enabled the students to gradually develop cognitive and metacognitive skills that mediated their subsequent activities. Writing paper portfolios cultivated the ability to summarize information, which in turn mediated the students' engagement in activity system B: some wrote synthesis notes in the style used to prepare the paper portfolios, i.e., identifying a string of good notes and explaining why these notes were good.

*Framing discourse improvement as a collective responsibility acted as new tools that mediated new activities.* As indicated in activity system A and activity system B, framing discourse improvement as a collective responsibility helped the students to understand over time that knowledge building requires a collective effort to improve ideas. A knowledge wall was used to frame discourse improvement as a collective responsibility before the students began working in the Knowledge Forum (see activity system A). After they were introduced to the KCA, the students were guided to reflect on the assessment data with an emphasis on data-driven discourse improvement as a collective responsibility. The students were encouraged to help each other to make sense of the data, engage in joint action planning, and discuss and share strategies for improving the community's discourse. The benefits of these activities became evident in activity systems B and C, as the students collectively advanced the community's discourse by capitalizing on their collective reflections of the assessment data. Framing data-driven discourse improvement as a collective responsibility facilitated the creation of norms and fostered a sharing culture underpinned by a shared understanding of the processes and purposes of data use purposes and processes, and also stimulated student conversations about the data that improved the accuracy of their interpretations. Fostering norms and a culture that promotes critical inquiry, reflection, and the examination of underlying beliefs enables discourse to be improved through data use (Schunk & Zimmerman, 1997).

*New skills and increased interest were transformed into new tools that mediated the students' new activities.* As indicated in activity system B and activity system C, the students used their newly gained skills and interests to engage in new activities that allowed them to progressively advance ideas in the communal space. For instance, in activity system B, the students used the collaboration skills learned in activity system A (through collaborative concept-mapping and collaborative knowledge-wall building) to engage in note writing in the Knowledge Forum and reflective assessment. The knowledge-building process required the students to collectively advance ideas and help each other to improve their notes. Combined with the skills gained in activity system A such as summarization, inquiry, collaboration, and metacognition, the students gradually exhibited increasing engagement in reflective assessment through the KCA and the production of knowledge-building discourse.

# 5. CONCLUSION

In this study, we found that various components of the activity systems shaped the students' knowledge-building behavior and reflective assessment in the KCA. These components were the skills required for data use, the establishment of a collaborative culture and norms for participation, the opportunities available for collaborative reflection about data, and the framing of data-driven discourse improvement in terms of collective responsibility. Our findings on the interactions between the conditions of

and tensions within an activity system, and the processes by which such factors become either affordances or constraints to students' collaborative use of data, suggest ways of structuring change in classrooms and even schools, particularly to meet the needs of educationally disadvantaged students. Our findings also lay the groundwork for future research on students' collaborative work and metacognitive activities in relation to data use.

Our findings indicate that the KCA and its accompanying prompt sheets can help students to engage in productive reflective assessment and focus on the key learning goals of knowledge building, thereby collectively improving the discourse created by a community. Also, the findings suggest a design with three important components that are accessible and feasible for low-achievers: (a) establishing a collaborative culture and norms for participation, practicing cognitive skills such as summarization and concept mapping, (b) periodic tasks that promote collaborative reflection and thoughtful use of the KCA, and (c) framing the data-driven improvement of discourse as a collective responsibility (Scardmalia, 2002).

Within knowledge-building research, studies have mainly relied on online discourses and quantitative server-log data in the Knowledge Forum database. Very few studies have made use of qualitative data such as interview transcripts, student artifacts, and face-to-face teacher-student and student-student discourse to characterize the social practices that arise from knowledge building. However, to gain a fuller understanding of knowledge building, it is necessary to understand the relationship between online discourse and the nature and dynamics of the social practices that develop during knowledge building (Zhang et al., 2007). This study has addressed this gap in the literature.

## ACKNOWLEDGEMENT

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# AN EXPERIMENTAL STUDY OF AN EDUCATIONAL INTERVENTION TO CHANGE GOAL ORIENTATION

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**ABSTRACT**

This study examined the effects of intervention with a 2 × 2 factor manipulation, identifying the effects of evaluation indicators (presentation/construction) and evaluator (self/peer) on students' goal orientation. Specifically, we created five groups (one control group and four experimental groups) and conducted experimental lessons. The learning topic was debate training. The participants were 67 first-year students. Analyses focusing on the cross-lagged relationships of goal orientation before and after the intervention were performed. The effects of the intervention on goal orientation may depend on the individual student's initial goal orientation. By increasing the level of the intervention, students' initial goal orientation might have a greater effect on the goal orientation that the student exhibited after the intervention. The results of this study give guidelines on the learning intervention according to student's initial goal orientation.

**KEYWORDS**

Goal orientation, Intervention, Cross-Lagged Relationships

## 1. INTRODUCTION

## 1.1 Goal Orientation

Goal-achievement theory (Dweck 1986), which accounts for differences in learning behavior in terms of what each student's goals are as they execute tasks, classifies such goals into two categories: learning and performance goals. The purpose of the former is to acquire new knowledge and skills through challenging activities while that of the latter is to seek positive and avoid negative evaluations. Students with learning goals tend to select challenging tasks and persevere even when they encounter failure, regardless of whether they are confident in their abilities. Performance-oriented appear similar to students with the learning orientation, provided they are confident in their abilities; however, if they lack confidence, they are less likely to persevere until they have completed the given tasks. Elliot and Dweck's (1988) findings support the latter statement. Ames and Archer (1987, 1988) note that learning goals have a positive effect on both academic achievement and endogenous motivation; learning goals are generally considered superior for attaining learning achievement.

Elliot and Harackiewicz (1996) divided performance goals into a performance-approach goals, in which a student tries to outperform others, and performance-avoidance goals, or attempting to avoid performing worse than others. Elliot and Church (1997) and Rawsthorne and Elliot (1999), among others, have found that performance-approach goals lead to positive effects on endogenous motivation and academic performance, but performance-avoidance goals have negative effects, thus demonstrating the importance of distinguishing between the approach and avoidance utilities.

## 1.2 Stability and Change in Goal Orientation

These perspectives treat goal orientation either as a personality characteristic— goal orientation is considered to be consistent and not to depend on the learning context—or a controllable characteristic—goal orientation is induced by the learning environment (DeShon & Gillespie 2005). We take the latter position here and

create an intervention intended to change the student's goal orientation. Fryer and Elliot (2007) and Muis and Edwards (2009) examined stability and change in students' goal orientations. These studies indicate that goal orientation is relatively stable, but there is the possibility that it may change in response to certain situations. It is important to account for both stability and change in goal orientation (Fryer & Elliot 2007). Changes in goal orientation in response to interventions may be affected by the initial goal orientation of the student.

## 1.3 Feedback as Change Agent for Goal Orientation

Winne et al. (2003) intervened in students' goal orientation using feedback and examined the resulting changes in goal orientation. They found that positive feedback resulted in decreases in the performance-avoidance goal orientation, and negative feedback resulted in decreases in the performance-approach goal orientation. However, no increase in the learning-goal orientation was found. Geitz et al. (2015) intervened in students' goal orientation with feedback, using the method indicated by Boud and Molloy (2013), and they examined the effects on goal orientation and learning behavior. The intervention did not influence goal orientation directly, but it helped goal-oriented students maintain deep learning.

The findings of Winne et al. (2003) made it clear that feedback could play a role in changing goal orientation, and Geitz et al. (2015) suggested that the effectiveness of feedback intervention depends on the initial goal orientation of the student. We assumed that the effects of changing goal orientation through feedback intervention depends on the initial goal orientation of the student.

## 1.4 Self-Evaluation / Peer-Evaluation

In this study, we manipulated two factors. The first was the evaluator. It is important who provides feedback. According to Boud and Molly (2013), to create effective feedback, it is necessary for students to be actively involved in their own learning and to be agents of their own change. In this study, to increase the involvement of students in their learning, we adopted a self-evaluation, in which students provide themselves with feedback, and a peer-evaluation, in which students give feedback to each other, in the place of any evaluation from teachers.

Peer-evaluation has been found to improve student motivation (Asghar 2010), and it encourages students to draw each other's attention to what they know and do not know (Topping 2005; Ladyshewsky & Ryan 2006). Thus, peer-evaluation was expected to be more effective in enhancing student involvement in their learning process than self-evaluation was. Peer-evaluation was considered to be the higher level of intervention.

## 1.5 Presentation / Construction of Evaluation Indicators

The second factor concerned evaluation indicators. We examined the effects of presenting evaluation indicators to students in advance using rubrics, in one manipulation, while in another, we let students make rubrics themselves, meaning that they were responsible for identifying indicators. Rubrics are assessment tools that articulate specific expectations for assignments by listing the criteria for higher marks, identifying what is particularly important in students' work, and describing levels of quality on a scale from excellent to poor (Panadero & Romero 2014). The standard usage is to present students with rubrics constructed by teachers, but Anderson (1998) recommends that students be involved in constructing them. In this way, students can gain awareness of their own involvement in their learning and can be expected to take tasks seriously (Steaven & Levi 2013). The intervention of having students construct evaluation indicators themselves was expected to be more effective for enhancing involvement in learning than the intervention in which evaluation indicators were presented in advance and represented a higher level of intervention.

## 1.6 Purpose

This study examined the effects of intervention with a 2 × 2 factor manipulation, identifying the effects of evaluation indicators (presentation/construction) and evaluator (self/peer) on students' goal orientation.

Specifically, we created five groups: one control group (Control Group) and four experimental groups (Presentation-Self Group, Construction-Self Group, Presentation-Peer Group, Construction-Peer Group) and conducted experimental lessons. Because the level of intervention for Construction was higher than for Presentation, and the level of intervention for Peer was higher than for Self, the relationships of expected effects were as follows.

Control Group < Presentation-Self Group < Construction-Self Group, Presentation-Peer Group < Construction-Peer Group

Two analyses focusing on the cross-lagged relationships of goal orientation before and after the intervention were performed, as described below. Analysis 1 revealed the cross-lagged relationships of each group regarding goal orientation using multi-group structural equation modeling (SEM) analysis. Analysis 2 identified the path-coefficient differences between the control group and each of the four experimental groups and clarifies the characteristics of each group by comparison with the control group, which is taken to be the baseline.

## 2. METHOD

We intervened in classes held in a public university in 2018. The learning topic was debate training, as the student-centered learning was more likely to increase the involvement of students in learning and to change their goal orientation. Classes were held five times every other week. The participants were 67 first-year students (Control Group: N = 14; Presentation-Self Group: N = 14; Construction-Self Group: N = 13; Presentation-Peer Group: N = 13; Construction-Peer Group: N = 13). Each group was subsequently divided into three smaller groups (three to five students per group). Table 1 shows the class procedure.

Table 1. Class Procedure

| | |
|---|---|
| Week 1 | ・Pre-test (10 min) ・Watching an introduction video of debate discussion (60 min)<br>・**Evaluation indicators (presentation/construction)** (20 min) |
| Week 2 | ・Practice for debate (90 min) |
| Week 3 | ・Preparing for match up debate (90 min) |
| Week 4 | ・Preparing for match up debate (45 min)・Evaluating performance: **evaluator (self/peer)** (45 min) |
| Week 5 | ・Match up debate (80 min) ・Post-test (10 min) |

**Pre-test and post-test**

The questionnaire comprised 18 items, which was modified from Mitsunami (2010) translated in Japanese from the Achievement Goal Scale developed by Elliot and Church (1997).

**Evaluation indicators (presentation/construction)**

We explained to the students in the four experimental groups that a rubric is a tool for indicating a desired goal and its evaluation indicators. Teacher-constructed rubrics were distributed to students of the two Presentation Groups. Empty sheets were provided for students of the two Construction Groups. These students were asked to carefully consider the goals that they wished to achieve through studying their lessons and to fill in the evaluation items and their level. Each group constructed one rubric.

**Evaluator (self/peer)**

We explained to the students in the four experimental groups that the purpose of evaluation is to improve learning behaviors to achieve a goal. The students in the two Self Groups conducted self-evaluation, and students in the two Peer Groups conducted peer-evaluations, adapting the evaluation indicators of the rubric, which was presented or constructed during the first week.

## 3. RESULTS

The responses of 63 subjects who attended lessons during weeks 1, 2, and 5 and responded to all questions in the questionnaire were analyzed. The model fit was using by the comparative fit index (CFI) and the root

mean square error of approximation (RMSEA). Values above .95 for CFI and below .07 for RMSEA were regarded as indicating sufficient fit (Hooper et al. 2008).

## 3.1 Confirmatory Factor Analysis

A confirmatory factor analysis was performed to test the three-factor structure, composed of the learning goal (LG), performance-approach goal (PAPG), and performance-avoidance goal (PAVG). We excluded three items that had a factor loading of .40 or less; as a result, the above criterion was satisfied: CFI-pre = .963, RMSEA-pre = .047, CFI-post = .955, RMSEA-post = .061. Table 2 shows the Cronbach's α coefficient and the items for each factor. The average value for the items was regarded as the respective value for each factor.

Table 2. Items and α Coefficient

| Factors and items |
|---|
| **Learning goal (pre:α = .71, post:α = .77)** |
| I want to learn as much as possible from classes. |
| I hope to have gained a broader and deeper knowledge when I am done with classes. |
| I prefer course material that really challenges me so I can learn new things. |
| I prefer course material that arouses my curiosity, even if it is difficult to learn. |
| **Performance-approach goal (pre:α = .85, post:α = .86)** |
| It is important to me to do better than the other students. |
| My goal is to get better grades than most of the students. |
| I am striving to demonstrate my ability in relation to others. |
| I am motivated by the thought of outperforming my peers. |
| It is important to me to do well as compared to others. |
| I want to do well to show my ability to my instructors, friends, and family. |
| **Performance-avoidance goal(pre:α = .73, post:α = .78)** |
| I worry about the possibility of getting a bad grade. |
| I often think to myself, "What if I do badly?". |
| I just want to avoid doing poorly. |
| My fear of performing poorly is often what motivates me. |
| I'm afraid that if I ask my instructor a "dumb" question, they might not think I'm very smart. |

## 3.2 Mixed-design Analysis of Variance

A mixed-design analysis of variance (mixed-design ANOVA) of group (five groups) × time (pre, post) was performed. Table 3 shows the results of this ANOVA. A marginally significant main effect of time was found for LG, but no other significant effect was found. The results of the mixed-design ANOVA show no effect of intervention on goal orientation.

Table 3. Results for Mixed-Design ANOVA

| | Control | | Presentation -Self | | Construction -Self | | Presentation -Peer | | Construction -Peer | | Group (df) | Time (df) | Interaction (df) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | mean | SD | mean | SD | mean | SD | mean | SD | mean | SD | | | |
| LG-pre | 3.82 | 0.71 | 3.83 | 0.67 | 3.85 | 0.55 | 3.90 | 0.43 | 4.25 | 0.37 | 1.24 | 3.26 + | 0.68 |
| LG-post | 3.91 | 0.77 | 4.08 | 0.70 | 3.83 | 0.40 | 4.04 | 0.41 | 4.29 | 0.52 | (4) | (1) | (4) |
| PAPG-pre | 3.30 | 0.76 | 3.15 | 0.84 | 3.44 | 0.59 | 3.32 | 0.60 | 3.56 | 0.77 | 0.65 | 2.66 | 0.12 |
| PAPG-post | 3.14 | 0.79 | 3.09 | 0.80 | 3.40 | 0.66 | 3.18 | 0.53 | 3.44 | 0.77 | (4) | (1) | (4) |
| PAVG-pre | 3.90 | 0.64 | 3.55 | 0.84 | 3.83 | 0.44 | 3.83 | 0.52 | 3.93 | 0.64 | 0.80 | 2.02 | 1.03 |
| PAVG-post | 3.54 | 0.84 | 3.51 | 1.03 | 3.87 | 0.45 | 3.67 | 0.41 | 3.95 | 0.55 | (4) | (1) | (4) |

+<.10.

## 3.3 Cross-Lagged Model

To examine the cross-lagged relationships among LG, PAPG, and PAVG between pre- and post-intervention, we hypothesized a cross-lagged model. SEM served as the basis for exploring the relationships among variables in the cross-lagged model. The results of an SEM analysis to determine whether the cross-lagged model fit was acceptable, the criterion was satisfied: CFI = 1.00, RMSEA = .00.

**Analysis 1: Multi-group structural equation modeling analysis**

We conducted a multi-group SEM analysis to determine whether the cross-lagged model fit was acceptable among the groups. We excluded the path from PAVG-pre to PAPG-post, which was not significant at the 10% level for any group; as a result, the criterion was satisfied: CFI = .995, RMSEA = .034.

Figure 1 shows the cross-lagged model for each group. Determination coefficients, error variables, correlation paths and their path coefficients, and autoregressive paths (e.g., LG-pre → LG-post) and their path coefficients are omitted from Fig. 1 for clarity. The autoregressive path coefficients account for the stability of each answer between pre- and post-intervention. Most autoregressive path coefficients in all groups were significant at 5% level. The exceptions were the effects of PAVG-pre on PAVG-post (significant at the 10% level) in Control Group and the effect of PAVG-pre on PAVG-post in the Construction-Self Group (n. s.).

The results of the cross-lagged effects are described below. In the Control Group and Presentation-Self Group, no significant cross-lagged effects were found. In the Construction-Self Group, PAPG-pre had a positive effect (β = .65) on LG-post. In the Presentation-Peer Group, LG-pre had a positive effect (β = .30) on PAPG-post; PAPG-pre had a positive effect (β = .52) on LG-post; and PAVG-pre had a negative effect (β = -.46) on LG-post. In the Construction-Peer Group, LG-pre had a negative effect (β = -.45) on PAVG-post; PAPG-pre had positive effects on LG-post (β = .75) and PAVG-post (β = .35); PAVG-pre had a negative effect (β = -.94) on LG-post.

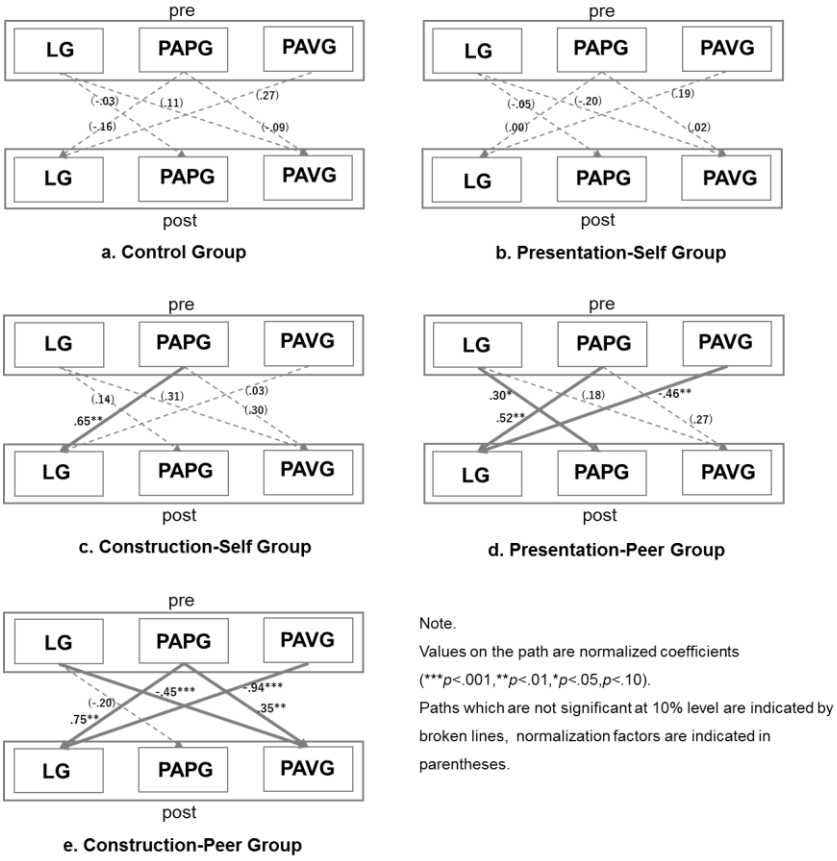
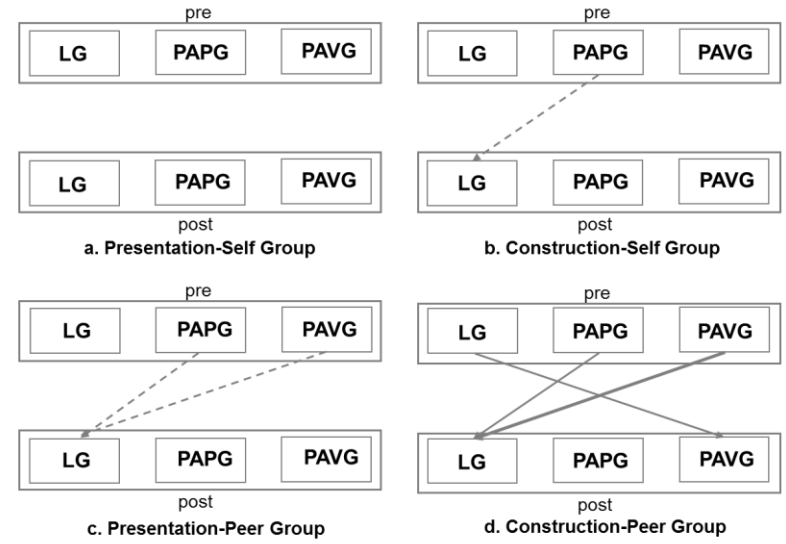



Figure 1. Cross-lagged Model for Each Group

**Analysis 2: Test for path–coefficient differences**

We tested for measurement invariance to determine whether path coefficients differed significantly between the control group and the four experimental groups. Figure 2 indicates whether the path coefficients in the four experiment groups differ significantly at the 10% level compared to the Control Group.

No path coefficient exhibiting a significant difference between the Control Group and the Presentation-Self Group. The path coefficient from PAPG-pre to LG-post differed significantly between the Control Group and the Construction-Self Group ($z = 1.82$, $p < .10$). Two path coefficients from PAPG-pre to LG-post ($z = 1.71$, $p < .10$) and from the PAVG-pre to LG-post ($z = 1.72$, $p < .10$) differed significantly between the Control Group and the Presentation-Peer Group. Three paths from LG-pre to PAVG-post ($z = 2.17$, $p < .05$), from PAPG-pre to LG-post ($z = 2.08$, $p < .05$), and from PAVG-pre to LG-post ($z = 2.62$, $p < .01$) differed significantly between the Control Group and the Construction-Peer Group.




Note. Dashed line shows significant at 10% level, solid line shows significant at 5% level, thick solid line shows significant at 1% level.

Figure 2. Paths Exhibiting Significant Difference

# 4. DISCUSSION

## 4.1 Effects of the Intervention

This was a 2 × 2 factor study, measuring evaluation indicators (presentation/construction) and evaluator (self/peer) on goal orientation were manipulated. The results, assessed using mixed-design ANOVA, showed no salient features. The results of analysis 1 and 2, nevertheless, indicated that there were differences in the effects of intervention among the groups, and these effects were shown. These results showed that the effects of the intervention on goal orientation may depend on the individual student's initial goal orientation. In other words, simple analyses of changes in goal-orientation scores before and after the intervention (Winne et al. 2003; Geitz et al. 2015) are insufficient for finding the effects of an intervention. Instead, it should be concluded that the effects of the intervention were affected by the individual student's initial goal orientation. This study provides a new perspective for intervention studies that change goal orientation.

In analysis 1, cross-lagged relationships for goal orientation were examined for each group. No significant cross-lagged effect was found in the Control Group or the Presentation-Self Group, while there was a significant cross-lagged effect for the Construction-Self Group, three significant cross-lagged effects in the Presentation-Peer Group, and four significant effects in the Construction-Peer Group. In analysis 2, we tested for measurement invariance to examine whether path coefficients significantly differed between the control group and each of the four experiment groups. There was no path coefficient found that exhibited a significant difference between the Control Group and the Presentation-Self Group, while there were path

coefficients that exhibited a significant difference between the Control Group and each of the other experimental groups (Construction-Self Group: one path coefficient; Presentation-Peer Group: two path coefficients; and Construction-Peer Group: three path coefficients). The results of analysis 1 and 2 suggest that by increasing the level of the intervention, students' initial goal orientation might have a greater effect on the goal orientation that the student exhibited after the intervention. Because there was no difference between the Presentation-Self Group and the Control Group, self-evaluation using given evaluation indicators may not be sufficient for obtaining the effects of the intervention.

## 4.2 The Cross-Lagged Relationships

The results of this study give guidelines on the intervention according to student's initial goal orientation. We discuss this below in three ways.

**Performance-approach goal-pre → learning goal-post**

In the Construction-Self, Presentation-Peer, and Construction-Peer Groups, PAPG-pre had a greater positive effect on LG-post than the Control Group. Increasing levels of intervention for students who wanted to be evaluated positively (PAPG-pre) may promote their interest in understanding the contents and/or improving their skills (LG-post). It was suggested that it would be effective for students with a high performance-approach goal orientation to construct evaluation indicators or conduct peer-evaluations.

**Performance-avoidance goal-pre → learning goal-post**

In the Presentation-Peer Group and the Construction-Peer Group, PAVG-pre had a greater negative effect on LG-post than the Control Group. Because this effect was seen in the two Peer groups but not in the two Self groups, peer-evaluation may be the decisive factor here. Students who wanted to avoid being evaluated negatively (PAVG-pre) may have suppressed their interest in understanding content and/or improving their skills (LG-post) due to being evaluated by others. This result indicates that designing situations to receive evaluation from others may not be effective for students with a high performance-avoidance goal orientation.

**Learning Goal-pre → performance-avoidance goal-post**

Third, in the Construction-Peer Group, LG-pre had a greater negative effect on PAVG-post than in the Control Group. Students who were trying to understand the contents and improve their abilities (LG-pre) and were evaluated by their peers according to their own evaluation indicators were able to increase their understanding of the significance of evaluation and reduce their fear of being evaluated (PAVG-post). This suggests that for students with a high learning goal orientation, combining their own construction of evaluation indicators and peer-evaluations may be effective.

# 5. FUTURE WORK

This study investigated students' goal orientation by manipulating evaluation indicators (presentation/construction) and evaluator (self/peer). The overall results indicated that the intervention had positive effects for students with a high learning goal orientation or a performance-approach goal orientation, but it had negative effects for students with a high performance-avoidance goal orientation. In the future, effective methods for students with a high performance-avoidance goal orientation should be carefully considered.

The multiple goal perspective (Elliot 1999; Harackiewicz et al. 2002; Pintrich 2000) indicates that students could endorse different levels for multiple goals. For example, they could endorse high levels of both the performance-approach goal and the performance-avoidance goal at the same time. This then indicated another future task, namely, to explore the effects of intervention on students with multiple goals.

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# POWER AND CONTROL AS MEANS TO EXPLORE TEACHERS' PRACTICE IN THE ONE-TO-ONE COMPUTING CLASSROOM: IS THERE A SHIFT FROM TEACHER-CENTERED PRACTICE TO STUDENT-CENTERED PRACTICE?

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**ABSTRACT**

This paper reports on a study about teachers' practice in one-to-one computing classrooms in Social Studies in upper secondary school. In the study, two teachers were followed in their daily practice with students where the observer collected empirical material through classroom observations, informal discussions and interviews. The teachers taught both academic and vocational programs in Social Studies and all students were equipped with a personal laptop. The aim and research questions demonstrate an attempt to both explore and explain how different power and control relations contribute to describe these teachers' practice as either teacher-centered or student-centered. The theoretical framework was based on Bernsteins' theory regarding symbolic power and control. Both teachers used one-to-one computing to extend the students learning outside the school building but they demonstrated two different theoretically informed practices. These teachers' practice involved the students to different extent in the decisions about, for example, content, sequence and how the classes should be organized individually or in groups. The different teaching approaches reflects how the teachers either kept or distributed power and control to the students. The findings contribute to understand the differences between teacher-centered and student-centered practice.

**KEYWORDS**

One-to-one Computing, Power and Control, Teachers' Practice, Teacher, Student

## 1. INTRODUCTION

This study is part of a larger Nordic research project, including a series of substudies with a common research objective of examining teachers' practice in one-to-one computing classrooms in Denmark, Sweden and Finland (Jahnke, Bergström, Mårell-Olsson, Häll & Kumar, 2017, Bergström, Mårell-Olsson & Jahnke, 2017; Bergström & Mårell-Olsson, 2018). One-to-one computing includes one personal laptop or tablet for each student, wireless internet (WiFi) in school buildings, and a setup of appropriate software for school use (Penuel, 2006). An extensive amount of research have reported on teachers' use of one-to-one computing in practice (Bergland Holen, Hung, & Gourneau, 2017; Dunleavy, Dextert, & Heinecket, 2007; Håkansson Lindqvist, 2015; Lei & Zhao, 2008; Pegrum, Oakley, & Faulkner, 2013; Tay, 2016), while only a limited amount of studies have considered teachers' practices in depth. Barr & Tagg (1995) identified teachers' practice as either teacher-centred or student-centered. In two narrow studies from compulsory school, Bergström et al (2017) and Bergström & Mårell-Olsson (2018) used the combination of power and control to analyse the continum from teacher-centred practice to student-centred practice. Briefly, the concept of power highlights, for example, to which extent teachers allow students to be part in the design process of a lesson (Klein & Kleinman, 2002), whereas the concept of control concern teachers' decisions about content, squence, pace, assessment and speech space in a lesson. The rich combinations of power and control relations that can appear in a lesson makes teachers' practice to an intricate process, especially in the one-to-one computing classroom since new resources possibly affect the practice in different directions. This addresses a gap in the litterature, since few studies have considered the power and control relations in upper secondary

schools with one-to-one computing. The aim is to explore and explain what kind of power and control relations two teachers' practice in upper secondary school constructs. The following research questions were asked:

- What kind of power and control relations can be found in the teachers' practice?
- How are teacher-centered teaching and student-centered teaching constrained or encouraged in the teachers' practice?

## 2. TEACHERS' PRACTICE AND CONTROL

Teaching in one-to-one computing classrooms have been reported to increase the complexity of teachers' work, a matter traced to issues of power and control (Laurillard and Derntl, 2014, Bergström et al, 2017; Bergström & Mårell-Olsson, 2018). In a study of 64 one-to-one computing classrooms, Jahnke et al (2017) identified both teacher-centered practices and student-centered practices. The characteristic of the teacher-centered practices were described as surface learning and memorizing, while the student-centered practices supported deep and meaningful learning. In the literature, control is described as an aspect of students influence over educational organization regarding decisions about for example methods and content (Player-Koro and Tallvid, 2015). Studies (Fleischer, 2012; Hatakka et al, 2013; Floridi, 2014) have shown that one-to-one computing affect teachers' control with regard to who selects the content. The question of who select content got attention based on the increased choice due to the large amount of content available on the internet. Research shows that one-to-one computing can change the teacher-role and student-role when teachers' practice shifts from teacher-centered practice to student-centered practice (Bergland-Holen, 2017). The shift towards student-centered practices point on increased student influence in what sequence something should be learned as well as how fast they shall acquire content, and that teacher-student interaction differs significantly, for example by adjusting the instruction in response to the students' learning (Rosen and Beck-Hill, 2012). In a longitudinal study, Tay (2016) found that during the third year of study, students started to talk more while teachers talked less. Thus, when considering teachers' practice in the one-to-one computing classroom through the lens of control about content, sequence, pace, evaluation and speech-space one-to-one computing can be considered as a small-step school development project over time (Weston & Bain, 2010; Bebell & Kay, 2010; Håkansson Lindqvist, 2015). Further, social media are reported to provide both possibilities and challenges in teachers' practice in the one-to-one computing classroom (Andersson et al., 2014; Blikstad-Balas, 2012). For example, Hatakka et al (2014) found that 73% of the teachers in their study reported a negative influence on teaching and learning caused by students' use of social media. Such use can be explained as gaps between the multimodality (Kress & Selander, 2012) of the one-to-one computing classroom in contrast to teachers' practice based on a dominant textbook discourse (Blikstad-Balas, 2012).

## 3. RESEARCH METHOD, MATERIAL AND THEORY

The present study took place at an upper secondary school in the northern part of Sweden in a municipality with an established one-to-one computing initiative. From day one at the school, each student was equipped with a laptop computer. Based on a personal ownership model, the students were responsible for the laptop but were also allowed to take it home after school and during the holidays. Additionally, the classrooms were equipped with digital projectors, an interactive board (Smartboard), and a whiteboard. The whole school had wireless internet access, and access to a learning management system (LMS). The teachers used the LMS for sharing files, links, and syllabuses. At the front of the classroom, the interactive board was most often placed at the center and the whiteboard beside it. The classroom layout had desks in rows, with the teachers' desk at the front.

Table 1. Profile of the Social Study Classes

| | Class A | Class B | Class C |
|---|---|---|---|
| Total number of students | **20** | **25** | **27** |
| Program | **Technology** | **Construction** | **Social studies** |
| Grade | **Third year** | **Second year** | **First year** |
| Level | **Social Studies C** | **Social Studies B** | **Social Studies A** |
| Topic | **Mass Media** | **Swedish constitution and the European Union** | **Socio-economics and personal finance** |
| Assessment | **Final exam or extensive group work assignment with oral presentation** | **Final exam** | **Oral presentation and final exam** |

As shown in Table 1, the two teachers in this study taught three classes in different programs, both academic and vocational. At the time for the study, the Technology Program and the Social Studies Program were academic while the Construction Program was vocational. Social Studies is divided into three levels A, B and C. One teacher taught third year technology program students in Social Studies C. The other teacher taught second year construction program students in Social Studies B, and first year social science students in Social Studies A.

In total, 16 classroom observations were conducted during three weeks of study. The observer documented classroom activities, and noted time indications when things happened. The observations were combined with informal conversations with the teachers. The field notes were developed, as closely as possible to the observation, into "thick descriptions" (Kullberg, 2004, p. 153). Thick descriptions are characterized as narrative, describing, analyzing, and interpreted. The two teachers became what Miller and Crabtree (1999) call "key informants". As a complement to the observations the teachers were interviewed. The interviews followed a semi-structured interview guide covering two themes that aimed to probe the teachers' decisions and motives when teaching with technology. The second theme focused on the use of one-to-one computing with questions about why the teachers chose to use one-to-one computing. The interviews were recorded and transcribed; each one lasted approximately 30 minutes.

The analysis in this paper draws upon Bernstein's (2000) theory concerning the realization of power and control in teachers' practice. Cause (2010) highlight both critique and possibilities of using Bernstein's theory. The critique has especially pointed on the complexity and for being unreadable. Despite these challenges, Bernstein's theory is widely used especially as a theory for understanding teaching through concepts for power and control that can be applied from micro to macro levels. Key concepts for power and control are: classification and framing. The concept power is operationalized in the concept of classification that addresses the relationships between categories e.g. teacher-student. According to Bernstein (2000), categories hold relative power positions, either strong or weak, and any attempt to change the degree of separation in the relationship will reveal the power relationship on which the classification is established. Framing indicates the locus of control in practice, that is, who controls what in pedagogical communication and interaction. Like classification, framing is a relative concept, either strong or weak. A more detailed account of the concept of framing is provided in the following section.

## 3.1 Analysis

Both classification and framing are relative concepts, either strong or weak. These can generate rich variations of power and control in and between teachers' practice. A theory-driven coding scheme (Stebbins, 2001) was developed based on Bernstein's (2000) concept of framing. Framing was used and applied to analyze what Bernstein describes as control through six framing categories: selection, sequence, pace, evaluation, and regarding speech space categories of the teacher-student and the student-student relationships. Bernstein's theory was developed in a time without one-to-one computing. When processing the data, the use of technology played a role in teachers' practice. Therefore, another two categories were developed in the coding scheme: teachers' use of ICT, and students' use of ICT. The extract shows in Table 2 regarding the category selection to describe the teaching approach to content.

Table 2. Example of Extract

| Category | Indicator | F++ | F+ | F- | F-- |
|---|---|---|---|---|---|
| Selection | Teacher-student communication in practice | **The teacher provides a teaching approach regarding the content to acquire** | **The teacher provides a teaching approach regarding the content for the students, accepting students' suggestions** | **The teacher provides different teaching and learning activities to choose from without referring to priorities and asks students to make a selection** | **The teacher asks students to suggest teaching approaches for the course/lesson/content** |

Example of transcripts
F++ "I hear and see that the teacher starts to talk in detail about what they have worked on, and she emphasizes that the students need to take notes since there is a lot of information to acquire (Maria, Observation 3)
F+ "Towards the end of the teacher's introduction, the teacher decides that in forthcoming lessons, the students will have the possibility to select either a teacher-centred assignment or a student-centred inquiry-based assignment." (Christine, Observation 2)
F- "The teacher tells me she used to have a final exam, but it might not be the best approach since the students just had a final exam. The teacher asks the students to choose. Some of the students suggest receiving assignments, others protest. The teacher suggests the possibility of conducting a not-too-comprehensive group project where they [the students] conduct interviews." (Christine, Observation 2)
F-- "The teacher then walks to Johnny and June's group. The teacher stands next to Johnny and asks what the group have in mind. The group have decided to study Twitter and the Arab Spring. The teacher gives feedback on the topic and comments on the students' choice. The teacher says, 'Shouldn't you study what's going on in Syria instead? It is more current.' The students' body language conveys that they are quite uninterested in the teacher's idea." (Christine, observation 14)

Table 2 shows the principle of how the teachers' communication in practice was coded on a relative scale. The coding scheme affords theoretical discrimination of who controls what. Furthermore, the extract includes transcripts documented in the classroom observations illustrating framing that span from very strong to very weak. The material was coded using the software NVIVO based on the eight framing categories above. In addition, the material from the interviews illuminated the teachers' understanding of decisions of designing the observed lessons, in a way their teaching beliefs regarding control, as well as motives to use one-to-one computing.

## 4. FINDINGS

This section presents the results of the study. The two teachers' names have been replaced with pseudonyms: Christine and Maria. Christine taught the technology class (academic) and Maria taught the construction (vocational) and the Social Studies (academic) classes. This section starts with a presentation of how the teachers compared Social Studies with and without one-to-one computing. Fundamentally, Social Studies is a subject based on a context of weak classifications, or blurred boarders between categories (Bernstein, 2000). Such symbolic borders were highlighted in two contextual categories. First, the subject of Social Studies has a strong relationship to one-to-one computing; as Christine said, "*Social Studies and the internet go hand in hand."* Secondly, and because of the first, neither of the teachers used a textbook in any of the observed lessons. In the interviews, the teachers argued that one-to-one computing has changed the practice of Social Studies. They compared the nature of Social Studies with and without one-to-one computing, highlighting that one-to-one computing simplifies the process of designing inquiry-based teaching and learning compared to methods that involve leaving the classroom. For example, in Sweden, several agencies, like the Swedish Social Insurance Agency, have become e-agencies. Even though study visits and interviews are still used, one-to-one computing reduces the need for such methods in favor of inquiry-based teaching and learning with students' laptops. However, the empirical material indicates two distinct teaching practices based on how the control either was kept by the teacher or dislocated to the students. Not all of the eight categories were found in the 16 observations.

## 4.1 Christine's Teaching Practice

The below findings are based on 6 classroom observations in the technology program.

### 4.1.1 The Teacher-Student Relationship

In 5 of 6 Social Study lessons in the technology program, Christine's teacher-student communication demonstrates a speech-space based on weak framing, which indicates distribution of control from the teacher to the students. Christine's pedagogical communication was framed by three key features: problematization of content, students' critical capacity, and students' acquisition of certain perspectives. However, when considering control through the category selection of content, Christine's classes indicates an array of both teachers' and students' control when content was selected. An example of distribution of control was when Christine invited the students into the process of decision-making when planning for the semester; in the interview, she said, "*They [the students] were given suggestions, like a smorgasbord, which they could choose between at the start of the semester. We then visualized what we needed to do; some reserve topics were also provided.*"

In Christine's practice, the selection of content is strongly influenced by what happens in the world around, such as the Palestine-Israel conflict, indicating a distribution of teachers' control. However, the control in which sequence content should be acquired demonstrates strong teacher regulation. It was Christine who directed the students' process so they would acquire content in a certain order. The qualitative nature of the material indicates that Christine's design influenced the students because it involved them personally, as students in their final year at upper secondary school. The observations serve to distinguish this nature in relation to the characteristics of one-to-one computing in Social Studies. For example, in one observed lesson, the students were to explore what they could earn in future employment and then study the relationship between taxes and salary. The students were first instructed to search for information and organize it using three different kinds of websites: 1) a freely chosen union site, 2) a tax check site, and 3) a municipality's website containing maintenance support information. Secondly, in the category selection of content, the teacher guided students in a direction based on the assignment structure, indicating strong power and teacher control. The selection of content also involved the students when they could individually choose their dream job and check salaries and how much they would pay in tax, indicating weak framing and student control. The sequence was strongly monitored by the teacher since students needed to do the operation in the suggested order. Christine argued that she wanted the students to problematize the content by asking questions: "*What is the money used for? Don't you think it is strange that so much money is allocated for schools? People used to say that the social services receive most of the money. What are your impressions?*" (Field note, T1).

Furthermore, in the teacher-student relationship, the problematizing nature of Christine's teaching privileges teacher-student interaction when she asks for students' impressions and challenges them, indicating weak framing and students' control. Christine's questions engaged the students to take a stance and to become critical of what they find in relation to what taxes are allocated for. The above task and field note demonstrate how the teacher strongly guided the students' use of ICT, indicating teachers' control. The students' use of laptops was well integrated, and students were active and conducted the work they were asked to do. In the category students' use of ICT also indicate that social media applications (e.g. Facebook, YouTube) were only minor distractions

### 4.1.2 The Student-Student Relationship

The student-student relationship was observed in all Social Study lessons in the technology program. The empirical material indicates that the student-student relationship has a preponderance towards groups with an open dialogue among the group members, indicating weak classification and framing between students. When organizing such a teaching practice Christine talked explicitly about being critical: "*Christine starts to read the schedule in relation to her planning for the next lessons. She says that they [the students] should do things together to become critical and get a variety of perspectives. There will also be a possibility to choose between project work and a final exam.*" (Field note, T10)

The above field note highlights the students' possibility to select, which indicates distribution of symbolic power from the teacher to the students. Then, in the next lessons, students could choose to study in groups or individually. Regarding the group work, students selected a topic according to criteria specified by the

teacher. In contrast, for students who selected individual studies, the teacher monitored their work to ensure they acquired the specific predetermined content, which indicates teachers' strong power and control. In the group work, the students selected, for example the Arab Spring. Students were required to choose different tweets on Twitter and other information on social media. They needed to support each other in the group in deciding what would and would not be a useful learning resource, which indicates weak framing and students' control.

## 4.2 Marias' Teaching Practice

Maria taught the social science program students in 3 Social Study lessons, and the construction programme students in 7 Social Study lessons.

### 4.2.1 The Teacher-Student Relationship

In general, for both the construction program and the Social Studies program, Maria's teaching practice indicates strong framing, making the teacher in control of speech-space and content decisions. Independent of program, in almost all observations the modality in the teacher-student relationship demonstrated strong or very strong framing, indicating strong teacher control. In a majority (N=6) of the observed classes, such designs were based on lectures, for example "*the teacher starts to talk in detail what she has presented and sends a hint to the students that in today's lesson they will also [compared to yesterday's lesson] take notes because it is a great amount of content to go through*" (Field note C5). Thus, it was Maria who held the control over the speech-space, and it was Maria who decided on the selection of content, the order (sequence) of students' acquisition of content, and what students were expected to acquire in relation to time and preconditions. Such a speech-space is based on communication that mostly goes from teacher to student with limited discussion and explanation. Even though variation exists in the teacher-student communication, the students asked detailed questions with a lack of possibilities for dialogue, for example when students in Social Studies were working in groups of four: "*After a couple of minutes, when the teacher stops at one group, Aron asks a question about the number of votes and parliament members, and asks for some advice about expressions. Maria gives the group some advice about expressions and says that they should include the picture Michael found because it is simple and easy to understand.*" (Field note, SS12)

The above field note indicates strong teacher control based on explicit guidance what content to select and what content to exclude, for example when pointing to Michael's picture. Considering the above field note from another perspective, it illustrates characteristics of the teacher-student communication. Such a speech-space indicates less discussion and more emphasis on strong control towards clarifying what the students should write or say. Even if some variation exists, or evaluation categories were not found, the nature of the communication indicates features of an approach that emphasis looking for the right answer.

Independent of program, the strong control in Maria's classes was also based on her use of one-to-one computing for teaching. She prioritized the use of one-to-one computing that centralizes teaching to the teacher, for example, by using presentations on the Smartboard or showing films. As consequence, the students' use of one-to-one computing becomes regulated towards note-taking activities. In contrast, the one-to-one computing classroom involves a choice for students to use technology either by following the teachers' intention or as a means of distraction (e.g. social media). In the students' use of ICT, independent of program, indicated weak framing and that students excluded themselves from Maria's teaching. Maria sometimes used strong regulation when asking students to pay attention and she instructed students to close their laptop screens, sometimes even physically closing the screens herself. Students responded by picking up and using their smartphones to do other things, indicating symbolic actions of excluding themselves from the teaching.

### 4.2.2 The Student-Student Relationship

Student-student interaction was found in 4 of 10 observations, with a majority (N=3) in the construction program. The observed group-work activities followed a similar pattern where the activity started in one lesson and stopped in the next lesson. In the interview, Maria reflected on her design when student-student interaction takes place: "*Social Studies A is a content-rich module and sometimes rather difficult for the students. I have noticed that, for example, in the construction program from short group-work activities lasting 40-50 minutes they can possibly perform a 2-minute record.*" Such designs echoed strong framing in

the categories selection of content, sequence, and pacing for example when Maria for the construction students posed questions like "*What kinds of decisions are conducted at the institution?"* (Field note C16) Maria asked the students to present their answers to questions that had been assigned to the whole class. Maria reflected on the lesson and expressed disappointment at the students' performance. She had not expected the groups of students to read the answers one by one, which gave the impression that they were not very engaged. When the observer accompanied her on the way back to the staff room, Maria considered the students' performance in relation to the nature of her expectations: "*Before I planned this topic, I wondered if they should really do a different assignment, but I thought what the heck, we'll carry on. I can always lecture, but that becomes boring. However, the students' performance was not good, so I need to repeat it [the lesson] again. Hmmm, they learn best from lectures when I talk slowly and they take notes. But we can't do that every lesson.*" (Field note, C16)

The above field note confirms what Maria said in the interview, "*I think they [the students] learn best through lectures.*" Thus, the solution is to strengthen framing in the teacher-student relationship. Maria also wished to provide some variety to her lessons. The design of the observed lessons required students to do what they were asked to do: deliver answers to the teacher's question. However, Maria expected something else, which was not apparent in her design and guidance.

# 5. DISCUSSION

This study has revealed how two distinct teaching practices in Social Studies in upper secondary school were constructed based on how control either was kept by the teacher or distributed to the students. Previous studies have indicated that the concepts of power and control are important for understanding students' possibilities to exert influence in teachers' practice (Laurillard and Derntl, 2014, Player-Koro and Tallvid, 2015; Bergström et al, 2017; Bergström & Mårell-Olsson, 2018). When considering the first research question regarding power and control relations in the teachers practice, the results provide theoretical discrimination and variation within each teacher's practice, as well as, between the two teachers' practices. That leads us to the second research questions how teacher-centered teaching and student-centered teaching are constrained or encouraged in the teachers' practice. Bergland Holen et al (2017) found a shift from teacher-centered teaching to student-centered teaching in the one-to-one computing classroom. When comparing the two teachers' practice and how they keep or distribute power and control, similar results was found in this study. Christine who taught the older students in an academic program and Maria who taught the younger students in both academic and vocational programs, Christine's practices distributed more power and control to the students. In contrast, Maria's practice demonstrated strong teacher control in both the speech space and in the decisions. Especially, Christine's practice reflects characteristic to Social Studies as blurred boarders between categories, for example, in situations where students use content that is not predetermined such as tweets on Twitter. The distribution of power and control enabled the student-centered practice in Christine's classes, while Maria who kept power and control is understood as a teacher-centered practice.

Further, when comparing the both teachers' use of ICT, Maria frequently used ICT for teacher-centered teaching but also that the students used their laptops or other devices to take control when they virtually left the lesson and the teachers' teaching. Whether it is academic or vocational program, students do not seem concerned. That can be understood as a sign of strong student power, since they break the rule of listening to the teachers' lecture. Blikstad-Balas (2012) found similar results which was explained as two different discourses competing. A previous textbook dominated discourse, in contrast to a new discourse of internet-based content. Floridi (2014) pointed on the fact that the great impact of the internet means that information is not something on behalf of the teachers. Thus, the learning resources constrain the shift from teacher-centered teaching to student-centered teaching especially in Maria's practice. One-to-one computing possibilities has been identified as giving students a growing number of choices, due to the increase in resources (Fleischer, 2012; Hatakka et al., 2012).

Even though Christine does not distribute all control to the students in the eight framing categories (selection, sequences, pacing, evaluation, teacher-student relationship, student-student relationship, teachers' use of ICT, and students' use of ICT) and that they are in the final year in an academic program, the control she does distribute to the students seems to be a meaningful learning experience (Jahnke, et al, 2017) about

issues that affect students in their life and beyond. Therefore, introducing one-to-one computing into daily teaching and learning is an intricate process for teachers as well as for the school organization (Weston & Bain, 2010). When reflecting upon the two distinct practices, especially from the teacher Maria's perspective, the results highlight the intricate process, and challenge, of how to design teaching and learning with one-to-one computing that support students' meaningful learning. One approach could be to use real world problems (Jahnke et al, 2017) that possibly affect students in their life and near future.

## 5.1 Limitations

This study contains some methodological limitations. One limitation concerns the unequal amount of observations between the two teachers and between the programs. This was unavoidable due to overlaps in the schedules and consequently, we may have also lost important information about teachers' teaching. A second limitation concerns how the data were collected during the classroom observations. With field notes, the observer selects the situations to document; video or audio recordings provided other opportunities to select and assess critical situations afterwards. In order to strengthen the classroom observations, teacher interviews complemented and confirmed some of the observed episodes. Nevertheless, the results of the study still contribute to the research field.

# 6. CONCLUSION

This study aimed to explore and explain what kind of power and control relations two teachers' practice in one-to-one computing classroom in upper secondary school constructs. The teachers' practices showed two distinctive patterns here addressed as teacher-centered practices and student-centered practices. The teacher-centered practice was based upon strong power and control relations. Such an approach demonstrated the teacher as a lecturer, short paced actives, increased use of social media for virtually leaving the classroom and thereby challenging the teachers' power. The second pattern of student-centered teaching was based on real world problems that affected the students in their life which can be considered as meaningful tasks. This practice was based on distribution of power and control to the students. Further, Bernstein's concept of power and control both discriminate and problematize the possibilities and challenges in teachers' teaching with one-to-one computing in Social Studies. An implication is that the control concept through the eight categories are general; that they should be applicable in other school subjects. This study confirms what other studies (cf. Weston & Bain, 2010) have shown: that one-to-one computing is a school development project.

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# DIVERSITY IMPLICATIONS OF ONLINE LEARNING OF CODING

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**ABSTRACT**

This article is an exploratory analysis and comparison of the demographic distributions of data collected from the 2016 New Coder Survey, with that obtained from the Integrated Postsecondary Education Data System (IPEDS). In comparing the data sets, the findings suggest that overall females were more likely to engage in online self-paced coding education, particularly when they had no background or previous study in an IT discipline. This contrasted strongly with females having an existing IT qualification. When looking at ethnicity, the research identified that those students who identify as an ethnic minority were more likely to undertake formal tertiary education in IT, rather than engage in online coding study. The research also confirmed that the average age was higher, and diversity of age groups was larger for those undertaking online study, when compared with those undertaking formal tertiary study. The practical implications of this analysis to diversity in Information Technology disciplines such as computer science, and more broadly with STEM-related disciplines are discussed.

**KEYWORDS**

STEM, Education, Ethnic Minority, Diversity, Coding, Information Technology, Gender Bias, Ageism

## 1. INTRODUCTION

If effectively managed in the workplace, diversity can help encourage creativity and innovation (Østergaard et al 2011), improve team performance (McLeod et al 1996), and identify new product and market opportunities (Robbins 2004, Bourgeois 2018). Therefore, it is important that the education sector embraces diversity to produce talents who are committed to diversity (Bial 2016, Bourgeois 2008). Aside from economic benefits, diversity in the workplace and education is also considered a key aspect of social justice (Sue 2008, Ayers et al. 2008).

However, despite continued efforts in equal opportunity, we continue to witness underrepresentation of minority groups in various subject areas and, in particular, computer science. For example, in the US, the percentage of females awarded with a bachelor's degree in computer science increased from 13.6% in 1970-1971 to 37% in 1983-1984 but gradually declined to 18% in 2010-2011 (Kendall 2017). Both enrolment and completion rates in computer science are lower for females than males (Miliszewska et al 2006). In terms of ethnicity, Taylor and Ladner (2012) show that there is little improvement between 2000 and 2009 in the problem of underrepresentation of some ethnic groups (African Americans, Hispanics, and American Indian or Alaska Natives) in the field of computing. A more recent study shows that ethnicity and gender gaps continue to persist in computer science education (Google Inc. and Gallup Inc. 2016). Similar problems are observed in other parts of the world including the UK, New Zealand, Australia and South Korea (Glick 2017, UNESCO 2017).

Ageism is another major diversity concern in the IT sector. Castillo (2017) reports that many over 40 find it hard to find a job in the industry. More than 40% of IT workers worry about losing their jobs because of age (Sumagaysay 2017). Several real examples of ageism in recruitment in video game development are outlined in Serrels (2018). In fact, many tech giants such as IBM, Amazon, Facebook and Intel are now facing charges or being investigated for ageism (Mcintyre 2018, Claburn 2018, Wells 2018).

The purpose of this study is to investigate whether the use of online learning can reduce some of the diversity gaps compared to formal undergraduate education with a focus on gender, ethnicity and age. In the

following sections, we shall (1) review the relevant literature to discuss how online learning can potentially address diverse student needs, (2) describe our research design and methodology, (3) analyze our data, (4) discuss the practical implications of our data analysis and (5) summarize our findings and identify future research directions.

# 2. LITERATURE REVIEW

## 2.1 Addressing Diversity Gaps in STEM

Industry reports and the academic literature have offered a number of explanations for the persistence in diversity gaps observed in computing, including insufficient recruitment and retention efforts targeting minority groups (Whittaker and Montgomery 2013); insufficient diversity in faculty members (Towns 2010); subtle discrimination in the workplace and in education (Marder 2012, Moss-Racusin et al 2012); and insufficient incentive for diversity commitment among faculty members (Whittaker and Montgomery 2013).

To address the persistent diversity gaps, organizations have dedicated resources to develop interest among underrepresented minorities at the high school level (Bystydzienski et al 2015, Cheryan et al 2015). E-mentoring has been used to provide underrepresented groups electronic access to mentors who have similar backgrounds in other institutions (Wadia-Fascetto and Leventman 2000, Blake-Beard et al 2011). It is also recommended that tertiary institutions cultivate commitment to diversity by formalization of policies, engagement and accountability (Whittaker and Montgomery 2013). Implicit bias training has also been shown to improve attitudes toward women in STEM (Jackson et al 2014). Various learning methods and interventions have also been found to improve performance disparities among students of different backgrounds including pair programming (McDowell et al. 2006), value affirmation (Miyake et al 2010), structured course design and active learning (Haak et al 2011).

## 2.2 Online Learning and Diversity

Baker et al (2018) conducted a field experiment on an online learning platform where each comment was assigned a student name connoting a specific race and gender and found that instructors were 94% more likely to respond to White male students. This result suggests that hidden biases exist in even in the online learning environment. On the other hand, Grella and Meinel (2016) found that although only 16% of those who take part in learning STEM in MOOCs are female, success completion rates are about the same for female (25%) and male (26%) learners. Furthermore, discussion forum participation, which increases the likelihood of successful completion, is greater among female than male learners. A high level of involvement among female students is also reported in online learning of non-STEM subjects (Cuadrado-Garcia, et al 2010). Drew et al (2015) show that a hybrid online 2+2 STEM program increases participation of underrepresented minority students as compared to a similar traditional face-to-face 2+2 program. Together, these findings suggest that online learning can potentially be used to resolve some issues that lead to diversity gaps in STEM education.

Wladis et al (2015) show that, compared to face-to-face STEM courses, Black and Hispanic students are significantly underrepresented in online STEM courses. However, females and students with non-traditional student risk factors (such as delayed enrollment, no high school diploma, part-time enrolment, financially independent, have dependents, single-parent status, and working full-time) are significantly overrepresented in online STEM courses. This suggests that the diversity implications of online learning are actually quite complex and require further research attention.

## 2.3 Research Question

The purpose of this study is to analyze the demographic distribution of students who learn to code on an online platform compared to that of formal undergraduate education. Specifically, our research question is: *Are there differences in the demographics of students learning to code online and students acquiring a formal IT-related degree in terms of gender, ethnic minority status and age?* The answer to this question will

allow us to evaluate the diversity implications of online learning of coding, and shed some light on why online learning affects different diversity gaps differently.

# 3. RESEARCH METHODOLOGY

To compare the demographic distributions of online learning and formal undergraduate education, we make use of two publicly available data sources: (1) the 2016 New Coder Survey and (2) the Integrated Postsecondary Education Data System (IPEDS).

The 2016 New Coder Survey was predominantly completed by online self-paced students of Free Code Camp (FCC) and CodeNewbie (CN). FCC is a self-education portal for people who are interested in software development and in learning to code, particularly in web-development languages such as HTML, CSS, JavaScript and JQuery among others. CN is an online community focussed on the support and education of users who are interested in coding. The survey asked up to 43 questions (depending on respondents' answers) covering respondents' learning approach as well as demographic and socio-economic data. 15,620 respondents completed the survey; of these respondents, 6,265 were from the U.S. The survey was completely anonymous, and all questions were non-compulsory. The data can be downloaded from: https://github.com/freeCodeCamp/2016-new-coder-survey.

IPEDS is a system that contains survey data conducted annually by the U.S. Department of Education's National Center for Education Statistics. The surveys collect data such as enrolments, program completions, graduation rates, faculty and staff, finances, institutional prices and student financial data from institutions that participate in federal student aid programs. The data can be downloaded from https://nces.ed.gov/ipeds/use-the-data. To ensure comparability, non-U.S. data from the New Coder Survey are excluded when comparing the demographic distributions between online learning and formal undergraduate education. Since the IPEDS data set does not provide data on computer science enrolment broken down by age and ethnicity, we will compare our New Coder Survey data with the completions data from the IPEDS data set, specifically, degrees awarded under CIP Code 11: Computer and Information Sciences and Support Services in 2016.[1]

The 2016 New Coder Survey was analysed and compared with general findings from related research focussed on formal education, as a part of the lead author's master's dissertation (Lane, 2017). This paper endeavours to refocus the survey analysis, by contrasting with comparable survey data from the formal education domain.

# 4. DATA ANALYSIS

## 4.1 Educational Background of Respondents from the New Coder Survey

Before comparing online learning and formal education, we provide some descriptive statistics on the education background of the respondents of the New Coder Survey (online learning) in Table 1.

Table 1. Highest Education Attained by Respondents from the New Coder Survey

| Highest Education | Count (n) | Percentage (%) |
|---|---|---|
| No high school (secondary school) | 65 | 1.0375% |
| Some high school | 194 | 3.0966% |
| High school diploma or equivalent (GED) | 325 | 5.1875% |
| Some college credit, no degree | 1304 | 20.8140% |
| Trade, technical or vocational training | 134 | 2.1389% |
| Associate's degree | 444 | 7.0870% |
| Bachelor's degree | 2782 | 44.4054% |

[1] We use the latest available data set at the time of writing, i.e., the provisional release data for collected in the academic year 2016-2017.

| | | |
|---|---|---|
| Master's degree (non-professional) | 633 | 10.1038% |
| Professional degree (MBA, MD, JD, etc.) | 279 | 4.4533% |
| Ph.D. | 79 | 1.2610% |
| Missing value | 25 | 0.3990% |
| **Total** | **6265** | **100%** |

As shown, more than half of the respondents from the New Coder Survey actually own a higher degree. This is consistent with Ho et al (2015) and Schmid et al (2015) who found that the majority of massive open online course (MOOC) students are college graduates.

## 4.2 Online Learning vs. Formal Education: Gender

The gender distributions from the New Coder Survey (online learning) and IPEDS (formal education) are shown in Table 2A.

Table 2A. Gender Distributions

| **Gender** | **Online Learning** | | **Formal Education (Computer Science Only)** | |
|---|---|---|---|---|
| | **n** | **%** | **n** | **%** |
| Male | 4,369 | 69.737% | 410,508 | 76.272% |
| Female | 1,781 | 28.428% | 127,707 | 23.728% |
| Other | 94 | 1.500% | 0 | 0% |
| Missing value | 21 | 0.335% | 0 | 0% |
| **Total** | **6,265** | **100%** | **538,215** | **100%** |

If we focus only on the two major groups (i.e., male and female) and perform a z-test to compare the two population proportion, we find that the proportion of females in online learning is significantly different from the proportion of females in formal education ($z = 9.2609$, $p < 0.001$).

We noted in Section 4.1 that the majority of our subjects are degree holders. To assess the democratizing effect of online learning, we distinguish between those who majored in an IT-related subject and those who majored in a non-IT related subject. The New Coder Survey asked respondents to specify their major. Of the U.S. sample, a total of 4,158 answered the questions, giving a total of 426 distinct majors specified (e.g., Accounting, Public Health, Women's Studies, etc.). Two of the authors independently classified each of the unique majors into "IT-Related" and "non-IT related" based on the name of the major. Out of the 426 majors, there were 22 discrepancies. Overall, the level of agreement is 94.84%. The Cohen's kappa coefficient is 94.81%, suggested a high inter-rater reliability. For the 22 discrepancies, a third author was asked to make the final decision.

Table 2B. Online Learning Gender Distributions (with and without IT Background)

| **Gender** | **Online Learning (With IT Background)** | | **Online Learning (With no IT Background)** | |
|---|---|---|---|---|
| | **n** | **%** | **n** | **%** |
| Male | 891 | 78.989% | 1859 | 61.353% |
| Female | 225 | 19.947% | 1119 | 36.931% |
| Other | 8 | 0.709% | 45 | 1.485% |
| Missing value | 4 | 0.355% | 7 | 0.231% |
| **Total** | **1128** | **100%** | **3030** | **100%** |

Focusing only on males and females, z-tests show that the percentage of females among those with an IT background is significantly lower than the overall average of online learning (1781/(1781+4369) = 28.96%) ($z = -6.6735$, $p < 0.001$) and the percentage of females among those without an IT background is significantly higher than the overall average of online learning ($z = 9.6740$, $p < 0.001$). It seems that the democratizing effect of online learning is stronger among those who do not have an IT background. It is also interesting to note that females who already have an IT background are less likely to participate in online learning of coding than non-IT counterparts. In fact, participation rate of females with an IT background in online learning is even lower than the participation rate of females in formation computer science education ($z = -2.9851$, $p = 0.003$).

## 4.3 Online Learning vs. Formal Education: Ethnic Minority

The New Coder Survey directly asked whether the respondent is an ethnic minority. The IPEDS divided students into specific ethnic groups (white, American Indian or Alaska native, black or African American, Hispanic or Latino, native Hawaiian or other Pacific islander, nonresident alien, race/ethnic unknown, two or more races). Here, we group all groups other than white as minority.

Table 3A. Distributions of Ethnic Minority Status

| Is Ethnic Minority? | | Online Learning | | Formal Education (Computer Science Only) | |
|---|---|---|---|---|---|
| | | n | % | n | % |
| No | | 4284 | 68.380% | 245,463 | 45.607% |
| Yes | American Indian or Alaska Native | 1936 | 30.902% | 2,736 | 0.508% |
| | Asian | | | 45,366 | 8.429% |
| | Black or African American | | | 51,612 | 9.589% |
| | Hispanic or Latino | | | 52,848 | 9.819% |
| | Native Hawaiian or Other Pacific Islander | | | 1,338 | 0.249% |
| | Nonresident Alien | | | 98,667 | 18.332% |
| | Race/Ethnic Unknown | | | 26,700 | 4.961% |
| | Two or More Races | | | 13,485 | 2.506% |
| Missing value | | 45 | 0.718% | 0 | 0% |
| **Total** | | **6265** | **100%** | **538,215** | **100%** |

If we exclude the missing values from analysis, take the ethnic minority status as a binary variable and perform a z-test to compare the proportions of ethnic minorities, we find that the proportion of ethnic minorities in online learning is significantly different from the proportion of ethnic minorities in formal education ($z = 36.8794$, $p < 0.001$).

Table 3B. Online Learning Ethnic Minority Distributions (with and without IT Background)

| Is Ethnic Minority? | Online Learning (With IT Background) | | Online Learning (With no IT Background) | |
|---|---|---|---|---|
| | n | % | n | % |
| No | 796 | 70.657% | 2114 | 69.769% |
| Yes | 325 | 28.812% | 898 | 29.637% |
| Missing value | 7 | 0.621% | 18 | 0.594% |
| **Total** | **1228** | **100%** | **3030** | **100%** |

From Table 3B, we can see that an IT background does not seem to have a significant effect on ethnic diversity in online learning ($z = 0.4988$, $p = 0.6179$). Even when we include only those who do not have an IT background in our analysis, online learning still seems to discourage ethnic minorities compared to formal education of computer science ($z = 26.7654$, $p < 0.001$).

## 4.4 Online Learning vs. Formal Education: Age

The age distribution for students majoring in computer science is not available in the IPEDS data set. However, we have the age distribution for all students enrolled in U.S. tertiary institutions as shown in Table 4A. Comparing the age distributions of online learning and formal education, we find that the largest age group is 25-34 for online learning and 18-21 for formal education, which is not surprising since we have earlier noted that the majority of the learners from online learning are degree holders. Excluding the missing values and the unknown age category, a $\chi^2$ test on the percentage distributions in Table 4A shows that the distributions are significantly different ($\chi^2_9 = 5{,}783$, $p < 0.001$).

Figure 1A graphically compares the two distributions. As shown, starting from the 25-29 age group, the bars for online learning are consistently taller than those for formal education. This observation seems to suggest that online learning can help encourage age diversity in computing.

Table 4A. Age Distributions

| Age | Online Learning | | Formal Education | |
|---|---|---|---|---|
| | n | % | n | % |
| Age under 18 | 243 | 3.879% | 1,880,218 | 5.848% |
| Age 18-19 | 174 | 2.777% | 7,311,886 | 22.742% |
| Age 20-21 | 225 | 3.591% | 6,795,868 | 21.137% |
| Age 22-24 | 788 | 12.578% | 5,373,464 | 16.713% |
| Age 25-29 | 1702 | 27.167% | 4,354,772 | 13.545% |
| Age 30-34 | 1258 | 20.080% | 2,269,636 | 7.059% |
| Age 35-39 | 681 | 10.870% | 1,452,208 | 4.517% |
| Age 40-49 | 734 | 11.716% | 1,701,600 | 5.292% |
| Age 50-64 | 347 | 5.539% | 875,362 | 2.723% |
| Age 65 and over | 25 | 0.399% | 101,020 | 0.314% |
| Age unknown | 0 | 0% | 35,526 | 0.110% |
| Missing value | 88 | 1.405% | 0 | 0% |
| **Total** | **6265** | **100.000%** | **32,151,560** | **100.000%** |

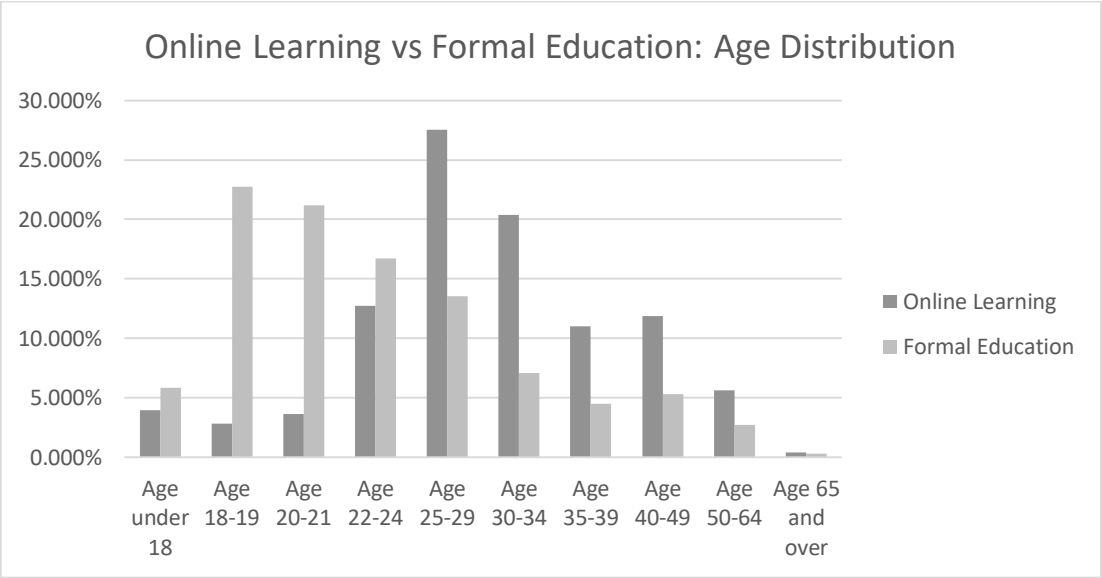


Figure 1A. Age Distributions of Online Learning and Formal Education

To evaluate the effect of an IT background on age diversity in online learning, we produce Table 4B and Figure 1B. Referring to the dark and light bars in Figure 1B, the difference between the age distributions seems to be smaller than those between online learning and formal education. However, it is still statistically significant ($\chi^2_9 = 38.78$, $p < 0.001$). Among those with no IT background we observe a larger proportion of learners between 25 and 34 but a smaller proportion of learners between 35 and 49. Overall, an independent sample *t*-test reveals that the mean age between those with and without an IT background is not statistically significant ($t = 1.1773$, $p = 0.2392$). Therefore, it is hard to say whether online learning has a greater age diversity implication among people with or without an IT background.

In Figure 1B, we can see that both online learning groups have an age distribution that is significantly different from that of formal education (online learning with IT background: $\chi^2_9 = 1318$, $p < 0.001$; online learning without IT background: $\chi^2_9 = 4274$, $p < 0.001$). In other words, a greater age diversity is observed in online learning regardless of IT background.

Table 4B. Online Learning Age Distributions (with and without IT Background)

| Age | Online Learning (With IT Background) | | Online Learning (With no IT Background) | |
|---|---|---|---|---|
| | **n** | **%** | **n** | **%** |
| Age under 18 | 1 | 0.0887% | 1 | 0.0330% |
| Age 18-19 | 6 | 0.5319% | 2 | 0.0660% |
| Age 20-21 | 25 | 2.2163% | 25 | 0.8251% |
| Age 22-24 | 164 | 14.5390% | 361 | 11.9142% |
| Age 25-29 | 327 | 28.9894% | 941 | 31.0561% |
| Age 30-34 | 221 | 19.5922% | 738 | 24.3564% |
| Age 35-39 | 143 | 12.6773% | 367 | 12.1122% |
| Age 40-49 | 149 | 13.2092% | 363 | 11.9802% |
| Age 50-64 | 67 | 5.9397% | 183 | 6.0396% |
| Age 65 and over | 4 | 0.3546% | 17 | 0.5611% |
| Missing value | **21** | 1.8617% | **32** | 1.0561% |
| **Total** | **1128** | **100%** | **2998** | **100%** |

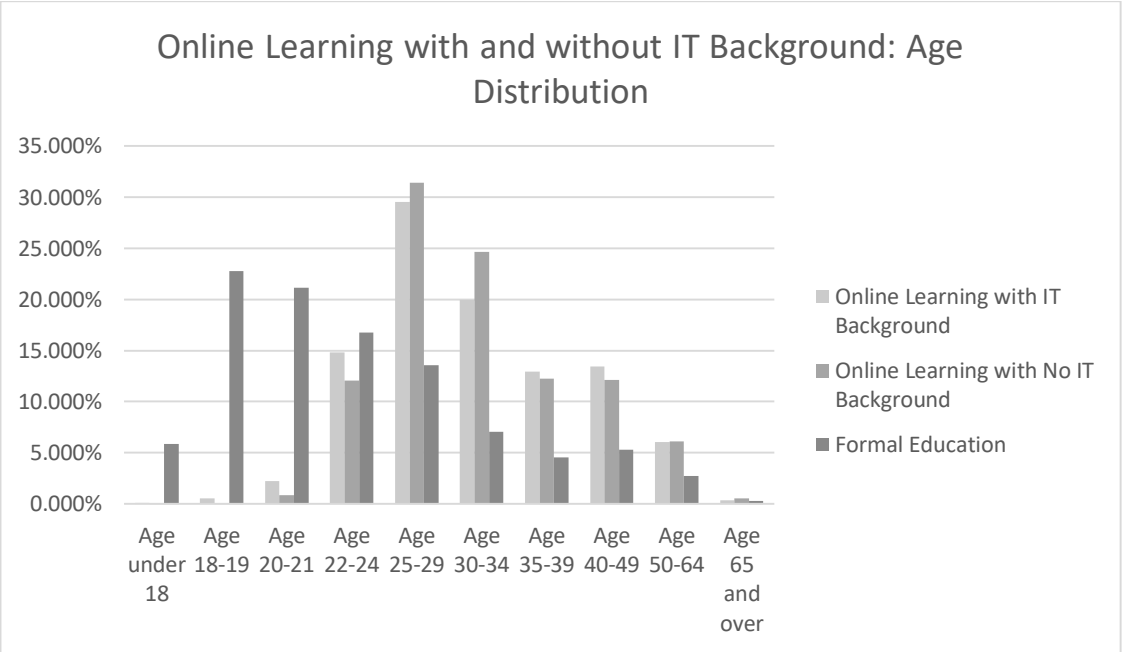


Figure 1B. Age Distributions of Online Learning Respondents with and without IT Background

## 5. PRACTICAL IMPLICATIONS

Our analysis has shown that online learning can potentially be used to promote a greater diversity in computing. Females without an IT background and people over 25 may find online learning of coding more accessible than formal education, which is consistent with Wladis et al (2015) and Johnson et al (2015).

However, online learning seems to have a negative impact on diversity in terms of ethnicity, again consistent with Wladis et al (2015).

One explanation for the negative impact on ethnic diversity is that the possible language barrier that some learners of ethnic minority may face in a predominantly English-speaking learning platform where social cues that assist interpretation are generally lacking. Johnson et al (2015) reported a significant lower proportion of speakers of English as a foreign language in online learning compared to on-campus university students, and argue that students who are in the process of enculturation may prefer to acquire language proficiency and cultural familiarity through on-campus education. Google Inc. and Gallup Inc. (2016) suggest ethnic minorities face both social and structural barriers in access and exposure to computer science. It is important for us to understand the drivers behind the observed differences between online learning and traditional face-to-face learning, and design online learning platforms that promote diversity.

It is also important to be aware that the drivers that affect diversity may also change over time. For example, earlier studies have suggested online learning may put female students in a disadvantaged position because they tend to have lower computer self-efficacy (Shashaani 1997, Thompson and Lynch 2003) and prefer face-to-face communication (Anderson 1997). However, the gender difference in computer self-efficacy among digital natives these days has mostly disappeared (Price 2006) and hence computer self-efficacy as a barrier for female students to adopt online learning is no longer a valid argument. In fact, more recent studies have shown that female students tend to benefit more than their male counterparts from social interaction within the learning platform (Johnson 2011). Our findings also show that female participation in online learning of coding is higher than that of formal computer science education. However, our data sets are not capable of validating the hypothesis that opportunity to socially interact on an online platform increases the female participation rate.

We found that the female participation rate in online learning of coding among those with an IT background is significantly lower than that in formal education of computer science, suggesting that female computer science graduates are less likely to upgrade their coding skills online. This finding is in line with the industry report that female graduates of STEM are less likely to persist in STEM jobs due to various reasons such as family constraints (Glass et al 2013) and dissatisfaction with pay and promotion (Hunt 2016). Further investigation into ways to improve retention of females in computer science in the job market is recommended.

# 6. CONCLUSION

Lack of diversity in Information Technology disciplines such as computer science, and more broadly with STEM-related disciplines is a common problem in many societies. This study compares of the demographic distributions of data collected from the 2016 New Coder Survey with that obtained from the Integrated Postsecondary Education Data System (IPEDS). The findings suggest that female and mature learners were more likely to engage in online self-paced coding education, whereas those who identify as an ethnic minority were less likely to undertake online coding study. The practical implications of this analysis are reflected in the opportunities that it suggests.

Female participation in Information Technology-related disciplines such as computer science falls well behind male participation. Those institutions looking to increase female participation would be encouraged to provide a more supportive environment to cultivate female interest. The research points to a greater percentage of females seeking the comfort of self-paced online learning when looking to engage in computer science as a novice.

A similar observation can be made regarding mature aged students. If tertiary institutions are looking to expand their offering, rather than looking to markets further afield, they need only consider marketing to, and providing a supportive environment for older students looking to return to tertiary study, or to attempt it for the first time, as a means to upskill.

To encourage participation in online study by those who identify as an ethnic minority, more may need to be done to provide lessons or other external support in languages other than English. Where formal tertiary study has the benefit of fostering communication within student groups, online learning can possibly be more difficult for a non-native speaker of the majority language.

Study into online learners in this new education paradigm of Massive Open Online Courses is in its infancy and this research seeks to highlight some similarities and differences within the demographics of online and traditional tertiary courses.

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# AN INVESTIGATION INTO THE EFFECTS OF PROGRAMMING WORKSHOP EXPERIENCES ON PARENTS' CONCERNS ABOUT PROGRAMMING EDUCATION IN ELEMENTARY SCHOOL

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**ABSTRACT**

To investigate the effects that experiences in programming have on parents' concerns about programming education in elementary schools, a survey was carried out before and after parent-children workshops. Participation in the programming workshops seemed to promote parents' understanding of programming, boost their expectations, and decrease their anxieties about introducing programming education to primary schools. Moreover, attitudes and confidence in supporting children at home were improved through participation in the workshop. Since the number of participants in this study was limited, it is necessary to carry out the survey with more participants in the future, followed by detailed analysis.

**KEYWORDS**

Programming Education, Elementary School, Parents' Concerns, Computational Thinking, Programming Workshop

## 1. INTRODUCTION

There have been widespread attempts to introduce computational thinking to elementary/secondary or K-12 education (Barr and Stephenson 2011, Grover and Pea 2013). The term "computational thinking" was first used by Papert (1993), and was popularized by Wing (2006). According to Wing, "'Computational thinking' involves solving problems, designing systems, and understanding human behavior, by drawing on concepts that are fundamental to computer science." (p. 33). Additionally, she stated that computational thinking is a fundamental skill for everyone and that it should be added to every child's analytical ability. The article caught the attention of many education researchers and educators, and many research studies related to computational thinking in K-12 have since been carried out. In the United Kingdom, a new subject, "computing," was introduced to primary and secondary schools. In the primary teachers' guide for this subject, the importance of computational thinking is repeatedly stated.

As computational thinking increasingly draws attention, programming education is also receiving attention as one of the ways of teaching computational thinking. Lye and Koh (2014) state that "[p]rogramming is more than just coding; for, it exposes students to computational thinking which involves problem-solving using computer science concepts, and is useful in their daily lives" (p. 51). In Japan, the central council for education in the Ministry of Education, Culture, Sports, Science, and Technology submitted a report that mentioned the introduction of programming education to elementary schools. Another council report said that programming education in elementary schools should not aim to teach students how to code, but rather to foster students' programming thinking (translated by author). Programming thinking is considered to be a concept similar to computational thinking, and is also considered to be a part of computational thinking. However, the aim of programming education has not infiltrated the public adequately. Misconceptions and anxieties concerning programming education seem to have begun spreading among parents. Parents play a very important role in elementary education, and their attitudes toward education have considerable influence on children's attitudes. Indeed, some researchers have investigated parent-child collaboration in robotics education (Cuellar et al. 2013, Roque et al. 2016) and in learning programming (Lin and Liu 2012, Hart 2010). Parents' misconceptions and anxieties related to programming

education could become obstacles to their involvement in children's learning. It is therefore important to know parents' concerns about programming education. Moreover, it is necessary to encourage parents' involvement in their children's programming education. This study aims to suggest a support system for parents to get them involved in programming education in elementary schools. This paper provides the results of a preliminary investigation into the influence of participation in a programming workshop for children and parents on changes in parents' concerns about programming education in elementary schools.

## 2. RESEARCH STUDIES ON PARENTS' ROLE IN EDUCATION INVOLVING NEW TECHNOLOGY

As mentioned above, parents' attitudes toward education have considerable influence on children's attitudes.

Hart (2010) carried out a computer science based workshop that targeted fourth through sixth graders, mainly female students, and their parents. Participants took part in an attitudinal survey during the first and last session of the workshop. The results of this survey show their perceptions of general computer use, the potential for a career as a computer scientist, and that perceived differences in ability based on gender became positive during the last session. Moreover, much of the feedback from parents was positive.

Lin and Liu (2012) observed three parent-child pairs in a computer camp used MSWLogo. They found that parent-child collaboration during programming naturally fell into a special form of "pair programming" and that children wrote programs in a more systematic and disciplined manner. Moreover, they reported that the programs produced by these participants were relatively more compact, well-structured, and error-free.

Cuellar et al. (2013) conducted a robotics education workshop in which parents and children interacted by experimenting with concepts of robotics and developing problem solving skills. They expected students to become more interested in technology and their parents to encourage them toward engineering and science majors. As a result, they observed enhanced teamwork and interaction as well as a positive attitude towards the initiative over the course of the workshop.

Thus, parents' involvement in education significantly impacts children's attitudes and outcomes. However, it seems that some parents have low confidence in their involvement in education, especially regarding new technology.

Feng et al. (2011) regard parents as important influencers in children's decision to attend a robotics course and the use of educational robots among children. Therefore, they investigated parents' perception of edutainment products including programmable bricks. They sent questionnaires to 55 parents and received 26 valid questionnaires. Questionnaires included questions about the usefulness of programmable bricks, and the respondent's confidence in teaching programmable bricks. The results showed that parents thought that programmable bricks were useful for their children, but they were not confident in using them to teach their children. Taking this into account, Feng et al. alluded to customized courses for both parents and children; and means of improving parents' confidence in teaching children for future research.

Lin et al. (2012) investigated parents' perceptions regarding educational robots. Results of responses to the self-report questionnaires from 29 parents indicated that parents had a positive attitude toward educational robots and considered learning about educational robots to be beneficial for children. Additionally, they found that parents have little confidence in using educational robots to teach or to play with their children. Therefore, they suggested that it was crucial to train or teach parents about educational robots.

As mentioned in these two research studies, participation in educational workshops could be one of the promising ways of improving parents' attitudes and confidence.

Roque et al. (2016) state that social support from parents could be essential to engage children in creative opportunities regarding computing; however, parents whose background in computing is limited are often unsure of the roles they can play. To develop such parents' support they suggest offering them a chance to gain first-hand experience in creative computing. Therefore, they examined the experiences of parents' participation in a community-based program where families design and invent together using creative technologies. Through case analyses of three parent-children groups, they illustrated how parents' participation in design-based activities with their children enabled and supported the roles that they played in the program.

There are some research studies on the impact that parents' participation in parent-child workshops have on their attitudes, but they are not sufficient. In these studies, the numbers of participants were small. And there are very few studies focused on changes in parents' concerns. This paper provides the results of a preliminary investigation into the influence of participation in a programming workshop for children and parents on changes in parents' concerns about programming education in elementary schools.

# 3. METHOD

The survey for this study was carried out in programming workshops for children and their parents, organized by the author.

## 3.1 Programming Workshops

Three types of programming workshops took place in August, 2018. Participants were recruited via brochures distributed through seven local elementary schools in Kanagawa, which is near Tokyo. Participants required to attend the workshops were a group of children with their parents or guardians. Workshops were held 13 times in nine days. Participants took part in one of them. Each workshop took two hours.

In each workshop, there was one instructor (author) and one assistant (university student). At the beginning of each workshop, a short lecture about computer programming was given, and then participants carried out workshop activities. A total of 83 groups took part in the workshop. Of these groups, five included two children, and one group included both parents.

### 3.1.1 Programing Workshop 1

Cubetto (Primo Toys https://www.primotoys.com/) was used in workshop 1. Cubetto is an educational and screenless coding toy for children aged three to six years. Users can make a program that controls cubetto's movements using coding blocks by placing them in a control board. The workshop targeted first and second grade students. A total of 16 groups took part in the workshop in four days. In the workshop, each group used one set of cubetto.

### 3.1.2 Programing Workshop 2

A toy robot BB-8™ App-Enabled Droid™ (Sphero https://www.sphero.com/) and visual programming language SpheroEdu (https://edu.sphero.com/) were used in workshop 2. The workshop targeted third to sixth grade students. A total of 37 groups took part in the workshop in four days. In the workshop, each group used one BB-8.

### 3.1.3 Programing Workshop 3

Visual programming language Scratch (The Lifelong Kindergarten Group at the MIT Media Labhttps://scratch.mit.edu/)was used in workshop 3. The workshop targeted first to sixth grade students. A total of 30 groups took part in the workshop in five days. In the workshop, parents and children used a computer by themselves.

## 3.2 Investigation

### 3.2.1 Questionnaires

The investigation was carried out using questionnaires that had the following sections: 1) demographics of participants and their children (only in the questionnaire administered before the workshop), 2) participants' interests in programming education, 3) attitudes toward programming education in elementary schools, 4) expectations of introducing programming education to elementary schools, 5) anxieties regarding the introduction of programming education, 6) attitudes toward and confidence in supporting children's programming education at home, and 7) participants' experiences in computer usage (only in the

questionnaire administered before the workshop). There were other questions that sought responses from children, but the results of responses to these questions have not been included in this paper.

**Expectations of Introducing Programming Education to Elementary Schools**

Parents who are not familiar with computer programming think that outcomes of programming education are merely related to computers. So, they expect children to get familiar with computers or acquire skills or knowledge related to computers.

On the other hand, Resnick (2011), who is known as the central researcher in a research group developing the Scratch, mentioned that as member of the Scratch community become more fluent with digital media, they develop an important array of "fluency skills" in particular thinking creatively, reasoning systematically and working collaboratively. He also stated, "These skills are essential for full participation and success in today's workplace, not only for computer programmers but for marketing managers, journalists, graphics designers, and most other occupations." Moreover, Yamamoto et al. (2016) examined the educational significance of programming education in elementary secondary education by reviewing previous research studies. As a result, they suggested that the educational significance and learning effect of programming education are to obtain skills such as inquiring skills, algorithmic and logical thinking skills, comprehension skills, communication skills, collaborative skills, and informational perspectives and ways of thinking. Considering the above, twenty-three items were created (table 8). These items are categorized into five categories including P: related programming (item 17), C: related computer and knowledge of computer and ICT (item 1, 2, 5, 6, 13, 14, 15, 16 and 18), J: related future job (item 4 and 7), S: related other subjects (item 19 and 21), and G: general skills (item 3, 8, 9, 10, 11, 12, 20 and 22).

**Anxieties Regarding the Introduction of Programming Education**

With regard to anxieties, two research studies related to English education in elementary school (Morita 2011, Makino 2008) were referenced while creating the items (table 8). The reasons for this reference are as follows. 1) There are only a few research studies related to programming education in elementary schools focusing on parents' concerns. 2) English education will be introduced into Japanese elementary schools as a subject from 2020. Compared to programming education, English education in elementary school appears to receive more attention from researchers; therefore, there are several insightful studies on this matter. It is apparent that useful suggestions for research on programming education can be gained from these studies.

The aim of the study by Morita (2011) was to establish a learning environment for English education at home. They stated that it was necessary to know parents' concerns regarding English education in order to establish the appropriate environment. Therefore, they studiously considered items to incorporate in a questionnaire to investigate parents' concerns, and chose items regarding parents' anxieties about English education.

Makino (2008) carried out a survey on parents' concerns about English education in elementary school. The results of the survey showed that parents were anxious about the contents and policies of education, and about teachers.

### 3.2.2 Respondents

Participants in workshops were handed two questionnaires at the reception and were asked to fill them before and after the workshops respectively; this was voluntary. Sixty-six valid responses were obtained. Of the 66 respondents in the survey, 51 were mothers and 15 were fathers of elementary school children. The average age of respondents was 41.9. The ages of respondents and the school years of their children are shown in tables 1 and 2, respectively.

Table 1. Ages of Participants

| Age | Freq. |
|---|---|
| -39 | 17 |
| 40-44 | 34 |
| 45-49 | 11 |
| 50- | 4 |

Table 2. School Years of Participants' Children

| School year | Freq. |
|---|---|
| 1 | 7 |
| 2 | 9 |
| 3 | 11 |
| 4 | 17 |
| 5 | 12 |
| 6 | 11 |

# 4. RESULTS AND DISCUSSION

## 4.1 Experiences of Computer Usage and Interests in and Attitudes toward Computer Education

As shown in table 3 and 4, more than two thirds of respondents use computers in work or daily life. Table 5 shows respondents' self-evaluations of their computer skills. About one third of them answered "capable," but about 60% of them answered "not very skilled" or "not skilled at all." It seems that respondents in this study were relatively familiar with computers but not very skilled.

Table 3. Experience of using computers at work

| Responses | Freq. (%) |
|---|---|
| I have a computer-related job | 5(7.6) |
| I had a computer-related job | 1(1.5) |
| I use a computer for work | 30(45.5) |
| I used a computer for work | 9(13.6) |
| I seldom use a computer for work | 14(21.2) |
| I never use a computer for work | 7(10.6) |

Table 4. Experience of using Computers in Daily Life

| Responses | Freq. (%) |
|---|---|
| I use one often | 21(31.8) |
| I use one sometimes | 26(39.4) |
| I seldom use one | 14(21.2) |
| I never use one | 5(7.6) |

Table 5. Self-evaluation of using Computers

| Responses | Freq. (%) |
|---|---|
| Quite skilled | 5(7.6) |
| Capable | 21(31.8) |
| Not very skilled | 30(45.5) |
| Not skilled at all | 10(15.2) |

Figure 1 shows results regarding interest in programming education. As the graphs for item 1 and 3 show, majority of the respondents are interested in programming education and welcome the introduction of programming education in elementary school. However, as the graphs for item 2 and 4 show, they are not familiar with the contents of education, meaning that they do not have enough information about programming education.

Figure 2 and 3 show responses to questions concerning attitudes toward programming education (Table 7) before and after workshops. Respondents were asked to choose a response from a five-point Likert scale ranging from 1 - I fully think so, to 5 - I do not think so at all. As concerns teaching programming education in elementary school (item 2 and 3), about 75% of respondents responded with 1 or 2. They support teaching programming in elementary school. However, in response to "Everyone needs to know how to program" and "Programming should be part of the elementary school curriculum," more than half of the respondents chose "neutral," "I do not think so" or "I do not think so at all" before the workshops, but after the workshops, the number of respondents who gave these responses decreased. It seems that lack of enough information perhaps affected their attitudes, and that participation in the workshops promoted their understanding of programming.

Table 6. Questions Concerning Parents' Interests in Programming Education

| |
|---|
| (1) Are you interested in programming education in elementary school? |
| (2) Do you know what the new Course of Study (teaching guidelines issued by the Ministry of Education, Culture, Sports, Science and Technology) for elementary schools stipulates regarding programming education? |
| (3) Are you in favor of or opposed to programming education in elementary school? |
| (4) Do you know what children currently learn concerning computers in elementary school? |

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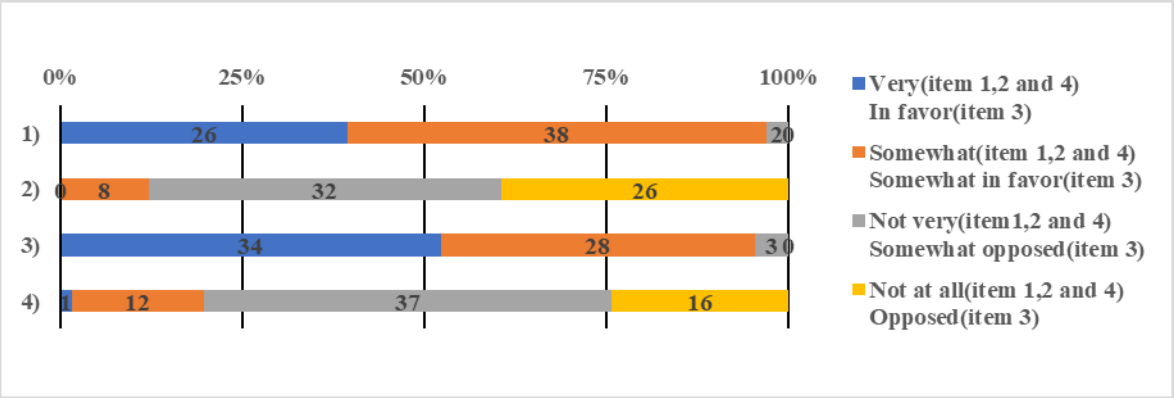


Figure 1. Responses to Questions Concerning Interests

Table 7. Questions Concerning Parents' Attitudes toward Programming Education

| **Attitudes (How do you feel about programming being taught in school?)** |
|---|
| (1) Everyone needs to know how to program. |
| (2) Programming should be taught in elementary school. |
| (3) Programming will be required in future societies, so it should be taught in elementary school. |
| (4) Elementary school is too early to learn programming. |
| (5) Programming should be part of the elementary school curriculum. |
| (6) Programming will affect students' other studies, so it should not be taught in elementary school. |

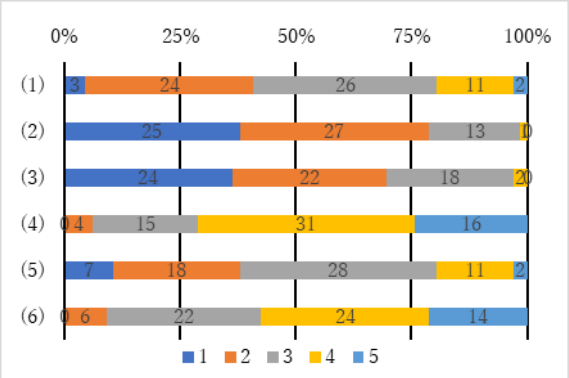


Figure 2. Responses to Questions Concerning Anxieties before Workshops

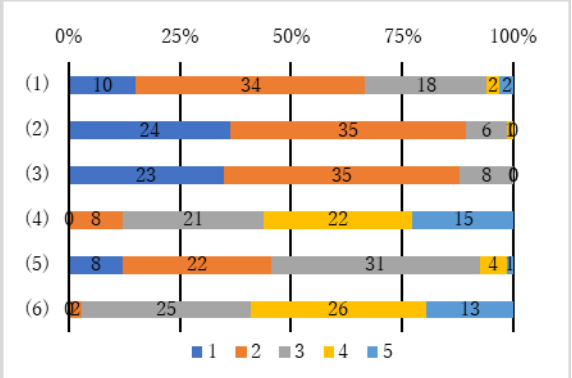


Figure 3. Responses to Questions Concerning Anxieties after Workshops

## 4.2 Expectations and Anxieties about Programming Education

Figure 4 shows results concerning expectations before workshops. Respondents were asked to choose a response from a five-point Likert scale ranging from 1 - I fully expect it, to 5 - I do not expect it at all. The graphs are in descending order of rate of respondents who chose response 1 or 2; that is, in order of expectation. Each alphabet located in the labels on the horizontal axis stands for categories mentioned in section 3.2.1. It suggests that respondents had high expectations of outcomes related to computers as well as knowledge of computers and ICT. On the other hand, concerning general skill, they expected that "Children will learn to think logically," but did not have much expectations for outcomes related to communication (item 12 and 22) and to collaboration (item 23). It seems to be easy for parents to associate programming with logical thinking skills. However, parents considered not to have much experience in programming cannot visualize the process of programming, so they do not expect communication and collaboration skills as outcomes.

To explore differences in expectations before and after the workshop, a Wilcoxon signed-rank test was conducted. The results are shown in table 9. The results indicate statistically significant differences for item 1, 7, 8, 9, 10, 12, 19, 21, 22, and 23. Expectations for general skills increased. This was probably because experiences in workshops promoted understanding of programming and programming education.

Table 8. Questions Concerning Parents' Expectations and Anxieties

| |
|---|
| **Expectations (Do you expect the following outcomes as a result of introducing programming education?)** |
| (1) Children will become skilled at using computers |
| (2) Children will like using computers |
| (3) Children will learn to think logically |
| (4) It will help with work in the future |
| (5) Children will learn how to use information and communications technology (ICT) |
| (6) Children will learn ICT skills |
| (7) It will foster personnel with advanced ICT skills |
| (8) Children will learn problem-solving skills |
| (9) Children will learn to be creative |
| (10) Children will learn how to express themselves |
| (11) Children will acquire problem-identification skills |
| (12) Children will be better able to communicate |
| (13) Children will be inclined to use computers |
| (14) Children will be able to use a computer to write compositions |
| (15) Children will be able to use a computer to draw pictures |
| (16) Children will understand how a computer works. |
| (17) Children will be able to write computer programs. |
| (18) Children will learn how to use the internet. |
| (19) Children will understand arithmetic and science. |
| (20) Children will think about the steps one must follow when performing a task. |
| (21) Children will be better able to study other subjects. |
| (22) Children will be better able to communicate their thoughts. |
| (23) Children will be better able to work with others. |
| **Anxieties (Are you anxious about the following items concerning programming education in elementary schools?)** |
| (1) There are not enough teachers to provide instruction |
| (2) The aim of programming education is not clear |
| (3) Perhaps programming will adversely affect the study of other subjects |
| (4) The content taught differs depending on the school and teacher |
| (5) Children's workload will increase |
| (6) I wonder whether my child can keep up |
| (7) I wonder whether I can provide guidance at home |
| (8) Perhaps there are inequalities in the degrees of comprehension |
| (9) Contents of programming education are not clear |
| (10) I wonder whether the teacher can take care of the whole class. |

This tendency is shown in results concerning anxieties. Figure 5 and 6 show responses to questions concerning anxieties before and after workshops respectively. Respondents were asked to choose a response from a five-point Likert scale ranging from 1- I am very anxious, to 5 - I am not anxious at all. For item 9 which reads, "Contents of programming education are not clear," the number of respondents that chose response 1 or 2 decreased after the workshops. Statistically significant differences for item 9 were confirmed by the Wilcoxon signed-rank test ($p = 0.00 < 0.01$). It is likely that their experiences in the workshops promoted their understanding of programming so that they were able to visualize the contents of programming education.

Results of the Wilcoxon signed-rank test indicate statistically significant differences for item 7 and 10 ($p = 0.001 < 0.01$ and $p = 0.025 < 0.05$). The study suggests that participation in the workshop has an effect on decreasing parents' anxieties.

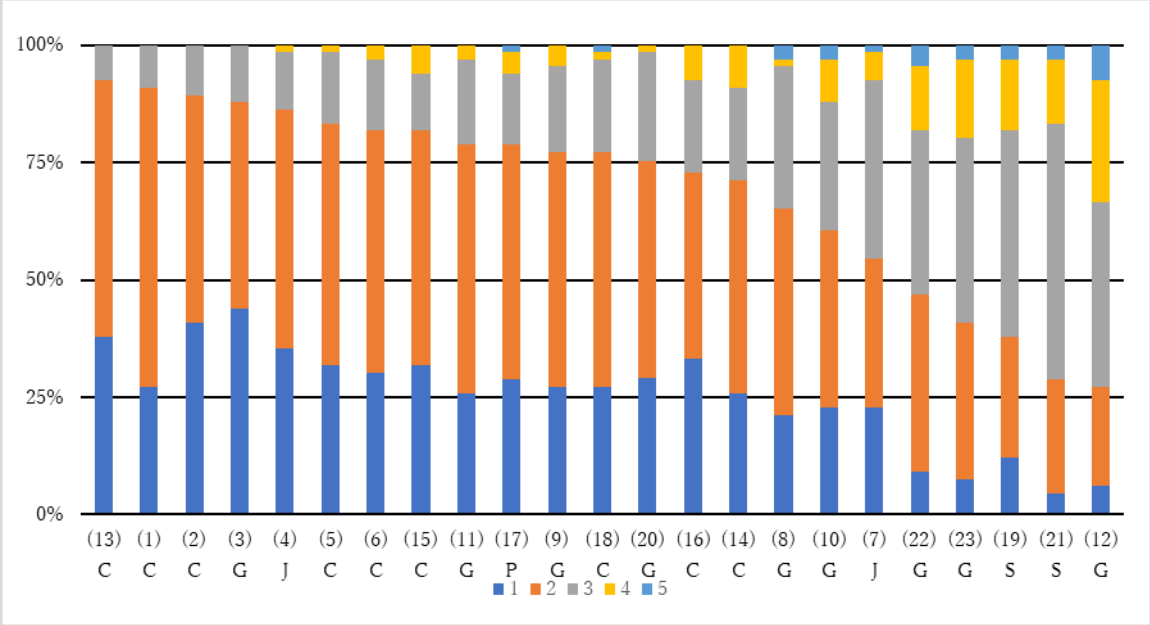


Figure 4. Responses to Questions Concerning Attitudes before Workshops

Table 9. Responses to Questions Concerning Attitudes before and after Workshops

| | Before | | | | | After | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | *p* |
| (1) | 18 | 42 | 6 | 0 | 0 | 30 | 32 | 2 | 2 | 0 | 0.033* |
| (2) | 27 | 32 | 7 | 0 | 0 | 29 | 31 | 6 | 0 | 0 | 0.532 |
| (3) | 29 | 29 | 8 | 0 | 0 | 29 | 28 | 7 | 2 | 0 | 0.738 |
| (4) | 23 | 33 | 8 | 1 | 0 | 28 | 25 | 12 | 1 | 0 | 1.000 |
| (5) | 21 | 34 | 10 | 1 | 0 | 28 | 27 | 8 | 3 | 0 | 0.29 |
| (6) | 20 | 34 | 10 | 2 | 0 | 28 | 28 | 7 | 3 | 0 | 0.079 |
| (7) | 15 | 21 | 25 | 4 | 1 | 22 | 23 | 17 | 4 | 0 | 0.016* |
| (8) | 14 | 29 | 20 | 1 | 2 | 23 | 25 | 15 | 2 | 1 | 0.013* |
| (9) | 18 | 33 | 12 | 3 | 0 | 28 | 26 | 9 | 3 | 0 | 0.034* |
| (10) | 15 | 25 | 18 | 6 | 2 | 22 | 26 | 16 | 1 | 1 | 0.002** |
| (11) | 17 | 35 | 12 | 2 | 0 | 25 | 26 | 14 | 1 | 0 | 0.163 |
| (12) | 4 | 14 | 26 | 17 | 5 | 10 | 18 | 26 | 7 | 5 | 0.000** |
| (13) | 25 | 36 | 5 | 0 | 0 | 33 | 29 | 4 | 0 | 0 | 0.072 |
| (14) | 17 | 30 | 13 | 6 | 0 | 15 | 27 | 19 | 5 | 0 | 0.402 |
| (15) | 21 | 33 | 8 | 4 | 0 | 21 | 31 | 11 | 3 | 0 | 0.99 |
| (16) | 22 | 26 | 13 | 5 | 0 | 25 | 26 | 12 | 3 | 0 | 0.163 |
| (17) | 19 | 33 | 10 | 3 | 1 | 20 | 31 | 12 | 3 | 0 | 0.724 |
| (18) | 18 | 33 | 13 | 1 | 1 | 21 | 30 | 11 | 3 | 0 | 0.519 |
| (19) | 8 | 17 | 29 | 10 | 2 | 12 | 19 | 28 | 5 | 2 | 0.014* |
| (20) | 19 | 30 | 15 | 1 | 0 | 26 | 25 | 12 | 3 | 0 | 0.353 |
| (21) | 3 | 16 | 36 | 9 | 2 | 15 | 13 | 28 | 6 | 4 | 0.023 |
| (22) | 6 | 25 | 23 | 9 | 3 | 13 | 24 | 21 | 5 | 3 | 0.009** |
| (23) | 5 | 22 | 26 | 11 | 2 | 10 | 24 | 21 | 8 | 3 | 0.028* |

*p<0.05, **p<0.01

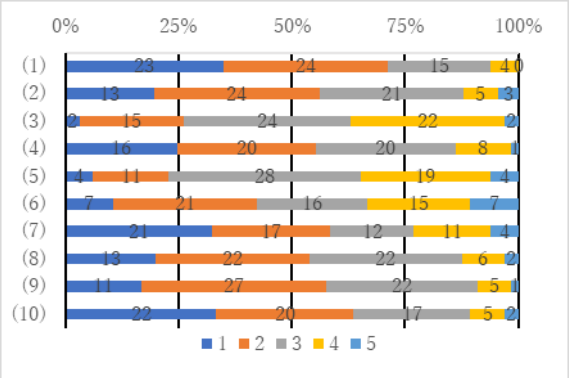


Figure 5. Responses to Questions Concerning Anxieties before Workshops

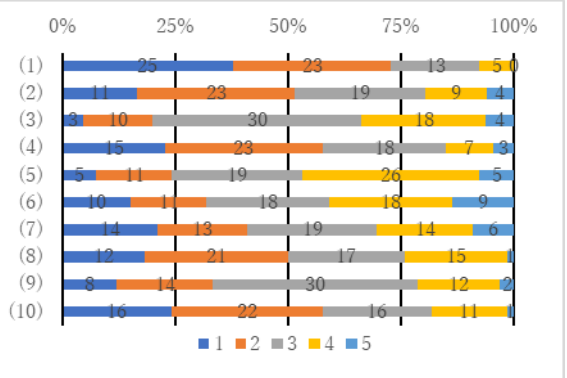


Figure 6. Responses to Questions Concerning Anxieties after Workshops

## 4.3 Attitudes toward and Confidence in Supporting Children at Home

The effects of participation in the workshop can be observed in changes in attitudes toward and confidence in supporting children's programming education at home. Figure 7, 8, and 9 show responses to three questions concerning supporting children at home (table 10). Concerning necessity of supplementary instruction, parents who answered "fully think so," or "somewhat think so" increased. Concerning involvement, parents who answered "will be actively involved" or "will be actively involved to a certain extent" increased. Concerning confidence in supporting children at home, parents who answered "I'm not confident at all" decreased. On the contrary, those who answered "I'm somewhat confident" increased. The results of the Wilcoxon signed-rank test indicated statistically significant differences among all of them ($p = 0.003 < 0.01$, $p = 0.000 < 0.001$ and $p = 0.000 < 0.01$). Attitudes toward and confidence in supporting children at home improved as a result of participating in the workshop.

Table 10. Questions Concerning Support at Home

| |
|---|
| (1) Do you think supplementary instruction outside of school will be necessary for programming education? |
| (2) Do you think you will be involved in supplementary instruction for programming education at home? |
| (3) If you will be involved in supplementary instruction at home, how much confidence do you have in your involvement? |

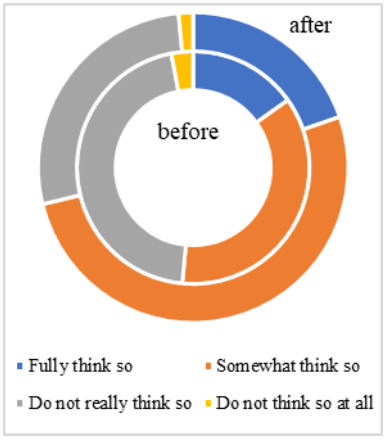


Figure 7. Views on the Necessity of Supplementary Instruction

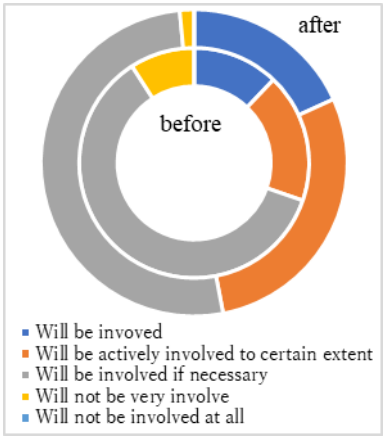


Figure 8. Involvement in Supplementary Instruction

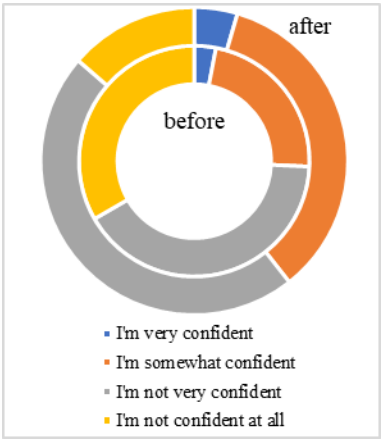


Figure 9. Confidence in Involvement in Supplementary Instruction

## 5. CONCLUSION

This paper provides research findings from the results of a preliminary investigation into the influence of participation in a parent-children programming workshop on parents' concerns about programming education in elementary schools.

It is likely that experiences in workshops promote parents' understanding of programming so that they are able to visualize the contents of programming education. Moreover, attitudes toward and confidence in supporting children at home improved as a result of participation in the workshop.

However, the number of participants in this study was limited. It is necessary to carry out this survey with more participants and a detailed analysis.

## ACKNOWLEDGEMENT

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# COLLECTIVE WISDOM OF FLIPPED CLASSROOMS IN HONG KONG HIGHER EDUCATION: PREPARING FOR POTENTIAL CHALLENGES

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**ABSTRACT**

The flipped classroom approach is widely regarded to be able to enhance teaching and learning. Despite its many advantages, it is still in the early stage of implementing in Hong Kong. This may be due to the potential challenges such as learners' limited participation and adaptation problems. The purpose of this article is to discuss the challenges based on Brame's (2013) four key elements of the flipped classroom – Exposure, Incentive, Assess and Activities. Particularly, we put emphasis on how teachers from Hong Kong higher education address the four aspects of challenges in their flipped classroom planning and design. Twenty-six teachers from five universities in Hong Kong were invited to complete a teaching profile for their coming flipped courses which they were asked to elaborate their teaching goals and how they would execute the course. The teaching profiles revealed that the teachers devised a wealth of different strategies in implementing flipped classroom. We generalized their careful planning into eleven tips that can be seen as the collective wisdom of the teachers, as well as potential solutions to the flipped classroom challenges. This article summarizes the first phase of our study that eventually will examine the success factors of the flipped classroom approach in Hong Kong higher education.

**KEYWORDS**

Flipped Classrooms, Challenges, Tips

## 1. INTRODUCTION

The flipped classroom is an idea to reverse the traditional learning environment by moving lectures out of the classroom and bringing activities such as projects, discussions, and presentations into the classroom, hence it is called "flipped" or "inverted" classroom. Unilateral information presenting activities such as traditional lectures are removed from the classroom, so that classroom time is freed for activities that focus on assimilating or applying knowledge. The content and form of delivery of both in-class and out-of-class activities can be varied, hence there is no single model of flipping the classroom (Sams, 2011). For example, lectures can be delivered through distance learning technologies such as multimedia or online delivery, and activities of different teaching styles or the use of active learning strategies that focus more on application of knowledge can be applied in classroom time according to teaching needs (Baker, 2000; Lage et al., 2000). This approach has two major advantages: it promotes active learning in a constructive learning environment and increases interaction.

A constructive learning environment is a learning environment that allows students to construct their knowledge through active discovery. The flipped classroom approach creates such a learning environment by combining video lectures and hands-on classroom experience from different in-class activities. Students can construct their knowledge by actively exploring different learning materials and participating in different activities (Gannod et al., 2008). The lecture materials in a flipped classroom are delivered asynchronously out of class, so students can access the material whenever they need, meaning that they can control their own learning progress (Gannod et al., 2008). This provides a higher degree of flexibility and a greater sense of responsibility for their learning (Baker, 2000; Lage et al., 2000). Different kinds of learning activities are introduced into the classroom to engage students' involvement. This also agrees with the principle of active learning (Gannod et al., 2008).

Interaction is also increased in the flipped classroom. Teachers have a greater chance to engage their students, which is more rewarding than repeating lectures. On the other side of the coin, students receive immediate feedback from teachers. Particularly, weaker students receive more attention, since their teacher works with them directly (Gannod et al., 2008). Moreover, interaction among students also increases because discussions are encouraged. Through explaining concepts to each other, their understanding is reinforced, knowledge is consolidated, and they can learn from their peers (Baker, 2000; Gannod et al., 2008).

According to Gökçe Akçayır and Murat Akçayır (2018), the number of research articles on the flipped classroom steadily increased after 2012, with 79% of those studies conducted between 2015 and 2016. With growing research interest and efforts in the pedagogy, various challenges on its implementation were discovered. One of the most frequent challenges discovered was limited student preparation before class. Other challenges included students' adaptation problems caused by their anxiousness and resistance, teachers' unwillingness to participate and a lack of school support or technological support (Akçayır and Akçayır, 2018).

This article examines and categorizes the abovementioned challenges according to a framework based on four key elements suggested by Brame (2013). In addition, we explore how university teachers in Hong Kong designed their flipped classrooms in response to the four areas of challenges through a cross-university study conducted in 2018. Twenty-six teachers from five universities in Hong Kong were invited to complete a teaching profile on how they would design their flipped courses. By analyzing these teaching profiles, we discovered eleven tips on the level of course design which might be able to meet the challenges.

## 2. CHALLENGES

In her guide to flipping the classroom, Brame identifies four key elements in the flipped classroom, namely "exposure", "incentive", "assess" and "activities". These key elements should be well thought out before course delivery to guarantee its success. In a successful flipped classroom, "incentive" motivates students to gain knowledge through accessing "exposure" material before class while teachers evaluate students' understanding of the material through "assess", and tailor in-class "activities" according to students' need to foster their assimilation of the knowledge. However, different challenges may occur in these four key elements and hamper the success of a flipped classroom.

### 2.1 Exposure

"Exposure" implies the opportunity for students to gain first exposure prior to class. In a flipped classroom, learning materials are provided for students to study before class so that they obtain basic knowledge and skills to participate in high cognitive activities during class. (Brame, 2013).

Although Brame suggests that pre-class exposure does not need to be high-tech, most teachers still choose to deliver learning materials in the form of videos (Akçayır and Akçayır, 2018). But producing a video poses a frequent challenge – how to ensure its quality? Teachers are reported to be hesitant to use videos provided by others and do not have the skills or resources to produce good quality videos. As a result, students' understanding of the contents is undermined by tedious and dry videos or videos with poor audio quality. On the other hand, the length of a video also affects students' view counts. The longer the video, the fewer the view counts (Akçayır and Akçayır, 2018). The form and medium of delivering pre-class exposure play an important role in students' perception of the teaching approach.

Besides the form and medium, additional assistance is needed for pre-class exposure. Some students report that they are unable to get help, for they cannot ask questions immediately when they are viewing pre-class materials (Fautch, 2015; Chen et al., 2015). It is also suggested that clear guidelines or instruction are crucial for pre-class learning (Wanner and Palmer, 2015).

### 2.2 Incentive

"Incentive" is a "pull" factor that motivates students to participate in the flipped classroom learning processes. Comparing to the traditional classroom, the workload of students in a flipped classroom increased because flipped classroom requires students to prepare for the class and participate in class actively (Khanova et al.,

2015). Therefore, some additional incentives would be crucial for motivating students to participate in the flipped classroom learning process.

There are two types of incentive for learning. Extrinsic incentive refers to individuals engaging in learning because it leads to separable outcomes, in which a score is an example. Intrinsic incentive refers to individuals engaging in learning because it is inherently interesting and enjoyable (Abeysekera and Dawson, 2014). Brame suggests that tasks should be set to indicate that students have finished their preparation before they attend class, and extrinsic incentive can be provided by assigning scores to motivate students to finish these tasks (Brame, 2013). Apart from the extrinsic incentive of giving scores, intrinsic incentive such as promoting students' acceptance of the flipped classroom approach is also an important part in the "incentive" element. Previous studies show that some students do not participate in the flipped classroom because they are anxious about the flipped classroom approach, they are uncertain about what the flipped classroom may entail. Some students do not view it as useful comparing to traditional lectures (Akçayır and Akçayır, 2018). Moreover, the flipped classroom approach may disfavor students who are less active (Strayer, 2007). They may find themselves in an unsafe situation where they need to participate actively in class instead of passively listening to lectures as in the traditional lecturing approach (Chen et al., 2014). Worse still, they may even think that the flipped learning environment is unfair or unbearable. All of these factors contribute to students' resistance to the flipped classroom approach (Akçayır and Akçayır, 2018).

## 2.3 Assess

"Assess" is a mechanism to assess students' understanding. The assessment on pre-class exposure aims mainly at assessing students' understanding. Teachers can identify areas that students are struggling with so that teachers can tailor in-class activities according to students' needs. These assessments should be graded for completion rather than effort so that they can also serve as evidence of students' preparation. (Brame, 2013).

Challenges usually occur in using the assessment to check students' preparation. Although some teachers assign quizzes at the beginning of a class, it is still difficult to ensure that students study the pre-class materials thoroughly. It is reported that formative assessment that graded upon completion is difficult to hold students accountable for their preparation (Fautch, 2015), both because the questions are not hard enough and because the grade is insignificant. In addition, online quizzes are vulnerable to students' inappropriate behaviors. Students might guess all the choices of a multiple-choice question until getting the right answer or search through the material to find correct answers just to complete the assessments (Koh et al., 2018). Students might exploit the advantage to finish the assessments without learning from the materials.

## 2.4 Activities

The "Activities" component means in-class activities. Students learn basic knowledge outside the classroom, therefore different activities can be introduced into class time to promote deeper learning and improve their skills. Brame provides a board range of activities and advises teachers to make their choice according to the learning objective of their class and the culture of their discipline (Brame, 2013).

Planning activities can be challenging for teachers. If teachers fail to plan an appropriate number of types of activities and guide students through these activities, students may withdraw from the class. Strayer (2007) provides an example for this. In Strayer's class, too many types of activities with different goals were given to his students. They felt that it was difficult for them to meet the expectations of each activity and to navigate the expectation for the whole class, and therefore they "were 'lost' by the end" (Strayer, 2007, p. 160).

Another challenge for teachers is the need to make more effort in catching students' attention to in-class activities. The class would be disrupted if students work on tasks unrelated to the class instead of participating in in-class activities (Strayer, 2007). This challenge is not only on teacher's ability to control the classroom but also on designing engaging in-class activities.

To conclude, various challenges may arise in these key elements, including the need of good quality videos and additional assistance for students' exposure; the need of incentive, both extrinsic and intrinsic, to motivate students; the need for assessment as a means to ensure students' preparation; and the adequate numbers of types of activities and their ability to engage students. These challenges can hamper the

successful implementation of a flipped classroom. However, these challenges can be met by careful planning of the course. By examining the course design of teachers from Hong Kong higher education institutions, this article tries to extract some tips that may be able to meet these potential challenges.

# 3. METHOD

## 3.1 Participants

Five universities (the Chinese University of Hong Kong, City University of Hong Kong, the Education University of Hong Kong, Hong Kong Baptist University, and the Hong Kong Polytechnic University) are engaged in a collaborative project (https://www.flippedclasshk.net/) to support teachers to use the innovative pedagogy. The project invited teachers who intended to implement the flipped classroom approach in their courses to participate in the first phase of the project. Twenty-six teachers from various fields of study were recruited. The courses that they intended to flip were also offered to students of different levels. Demographics of the courses can be seen in the table below:

Table 1. Demography of the Courses Participated

| Level | No. | Field of Study | No. |
|---|---|---|---|
| Courses for undergraduates | 23 | Arts | 1 |
| Courses for graduates | 3 | Business and Administration | 5 |
| | | Education | 2 |
| | | Engineering | 2 |
| | | Textile | 1 |
| | | Law | 1 |
| | | Nursing | 2 |
| | | Science | 8 |
| | | Social Science | 4 |
| Total No. of Courses | 26 | | 26 |

## 3.2 Procedures

The teachers were asked to complete a teaching profile before the semester began. The teaching profile was divided into two parts, the first on basic information of the course, and the second on course design. A sample of the teaching profile is attached in the appendix.

Basic information of the course included course name and code, its date, time, venue and estimated number of students. This information helped us identify the size of each class, the level of targeted students and the field of study of each course.

Questions on the course design are closely related to Brame's framework. Teachers were asked why they chose to implement the flipped classroom approach in their course and what goals they aimed to achieve. There were also questions about activities before class (exposure), ways to encourage students to complete the activities (incentive), activities during class and activities after class (activities), and assessment design (assess). Some teachers also wrote down their concerns regarding related issues in their teaching profile. The course design ideas collected in this part provided the data which is the collective wisdom of our teachers in implementing the innovative pedagogy.

# 4. RESULTS

From the teaching profiles, we can see that the teachers devised different measures to avoid the failure of their flipped classes. Through examining these measures, we extracted and generalized eleven tips that may

be useful in meeting the challenges stated above. These tips are organized according to the four key elements and presented as follows.

## 4.1 Exposure

### 4.1.1 Ensuring Video Quality and Using a Variety of Media

Videos were still the most common type of medium in delivering pre-class exposure as seen from the teaching profiles. For some teachers, however, making good quality videos remained a challenge. Two teachers explicitly stated that they would incorporate existing videos provided by others into their courses. Existing video lectures, such as Khan Academy or TED talks, are proven to be useful in minimizing boredom and distraction (Gilboy et al., 2015). Many publishers have also developed nice recorded videos (McGivney-Burelle and Xue, 2013). The quality of the video can be ensured by using these videos. Besides, teacher's burden on producing material might also be reduced.

We found that the teachers also employed a variety of media to deliver pre-class exposure in order to enrich students' learning environment. Pre-class readings and documents were assigned to students not only in text form but also as digital documents or websites. Some courses required students to search for texts they needed in the web by themselves. One course stressed the use of various formats in delivering pre-class exposure, including text, video, audio, and multimedia. Other types of pre-class exposure included animation, VR trip to a specific site, or visits to the showroom of famous brands. As stated, the combination of different learning materials and learning activities can provide a constructive learning environment for students (Gannod et al., 2008). In addition, the wide array of media and forms would also be able to stimulate students' interest.

### 4.1.2 Offering Additional Assistance to Students

A persistent problem in the flipped classroom approach is that students cannot receive immediate responses when they have questions on the pre-class exposure materials (Fautch, 2015; Chen et al., 2015). Previous flipped classes encourage students to write down their questions and save them for lectures (Fautch, 2015). With the help of online discussion forums, students can raise questions whenever they needed help, and teachers can offer instant feedback and immediate assistance to students by text message (Fautch, 2015). Most of the teachers in our project utilized the online discussion forum in the learning management software provided by their own universities, such as FutureLearn, Moodle and Canvas. One course even provided a discussion forum that allowed students to discuss with previous students of the course. These discussion forums enabled students to raise questions or discuss with each other even when they were out of class.

Besides, guiding questions would be useful to enhance students' understanding of the materials. Guiding question, if well-designed, can help students review learning contents, stimulate critical thinking, thus having a positive effect on learning performance (Thai et al., 2017). Well-designed guiding questions can guide students to understand the pre-class exposure materials, thus reducing students' questions. Two courses provided guiding questions with some text-based materials to students as pre-class exposure, and both courses had discussions on pre-class exposure material as their in-class activities.

## 4.2 Incentive

### 4.2.1 Giving Score as an Incentive

Incentives are necessary to motivate students to participate in a flipped classroom. A score is a strong extrinsic incentive for students (Brame, 2013). Most teachers chose to score the tasks relating to pre-class exposure for the final grade of their course. In fourteen courses that provided a detailed assessment scheme, eleven indicated that some score between 5% and 20% of final grade were assigned to tasks related to pre-class exposure. The other three courses listed the tasks relating to pre-class exposure as parts of "continuous assessment" that occupied between 30% and 50% of the final grade. In addition to directly assigning grades to tasks, teachers also incorporated the content of pre-class exposure material into mid-term and final examination. One teacher decided to give bonus scores as an incentive, but no details on the arrangement of bonus marks were provided. Teachers believed that score is a common incentive for students to participate in any learning activities.

### 4.2.2 Increasing Students' Acceptance of the Flipped Classroom

Students' resistance to the flipped classroom approach posed a great challenge to their incentive, therefore, it is crucial to reduce their resistance. The teachers in our project try to increase students' acceptance by explaining the advantages of the flipped classroom approach. Three teachers stimulated students' incentive by explaining the advantages of the flipped classroom and the usefulness of pre-class preparation to students. They explained to students that students can learn at their own pace, thus enhancing their autonomy. In a biology course, the teacher explained to his students that both understandings of the concepts and adequate training on the laboratory skills were important for experiment results, so students must acquire knowledge by watching pre-class exposure before class and do experiments in class time. For courses that had discussion activities, teachers explained to students that it would be easier for them to engage in in-class discussions with preparation before class. It is believed that if students realize that the flipped classroom can satisfy their needs for autonomy, their intrinsic incentive in learning can be facilitated (Abeysekera and Dawson, 2014).

## 4.3 Assess

Assessment in the flipped classroom should aim at assessing students' understanding. The assessment result can demonstrate students' weakness, and teachers can tailor their in-class activities to focus on the students' need. This can further improve students' understanding. However, the teachers in our project seldom explored this aim of assessment. Instead, they emphasized the use of different assessment tasks to check students' preparation. This might be because they regard the need to ensure students' preparation as one of the most serious challenges.

### 4.3.1 Assigning Pre-class Tasks

Regarding the difficulty of ensuring students preparation, most courses required students to finish a variety of tasks before class. While those tasks mainly included multiple choice questions and online quizzes, they were designed to ensure that students had studied the material thoroughly. For example, questions on pre-class exposure were made to cover more contents of the materials. In addition, some courses required students to finish worksheets, write summaries, submit comments, or raise discussion questions as pre-class tasks. These tasks reduce the possibility that students exploit the advantage to finish the task without studying the pre-class exposure materials.

### 4.3.2 Assessing Students through In-Class Activities

Different kinds of in-class activities can also help check students' preparation before class. Four teachers stated that they would ask questions in class occasionally to check if students had prepared for class. Besides, students were required to finish tests or online quizzes in class. Six courses set quizzes in their classes by using different kinds of student response systems. These assessments were designed to be based on pre-class exposure. In-class discussions were also arranged on the basis of pre-class exposure. Students' preparation could be checked by observing students' participation in discussions.

### 4.3.3 Designing Assessment that Connects to Pre-class and In-class Activities

Teachers can also check students' preparation before class by building a strong connection between pre-class exposure, in-class activities, and assessments. Two courses connected students' preparation for class to students' performance in in-class activities, which was part of the assessment. In the first course, students were required to watch a 10-15 minutes video clip on teaching and write a lesson plan on the clip with possible ways of improvement as pre-class exposure. In the class, students discussed each other's plan, presented their findings, modified their plan based on their findings, and performed trial teaching. They were required to design a worksheet after the class. All tasks above would contribute to their final grade. In another course, students were required to read assigned text, search additional sources from the web, and have a showroom visit as pre-class exposure. In the class, students worked in groups to brainstorm and present a tactical marketing plan on improving the showroom they had visited. This presentation was worth 20% of the final grade. These two assessment designs allowed the teachers to observe students' preparation through their performance in the in-class activities, which is weighted in their final grade. In addition, it is believed that students can achieve learning goal easier if pre-class exposure, in-class activities, and assessment are strongly connected (Ginns and Ellis, 2007).

## 4.4 Activities

### 4.4.1 Reducing the Types of In-class Activities

As stated above, assigning too many types of in-class activity poses a challenge to the flipped classroom. Reducing the types of in-class activities can "allow students to become familiar with the active learning strategy and avoid the risk of students focusing on the process of the strategy rather than the learning related to content" (Gilboy et al., 2015, p. 112). Most of our teachers chose to reduce the types of in-class activities by implementing flipped classroom partially. Among twenty-six courses, sixteen decided to have only 1 to 2 flipped classes, and eight planned for 3 to 6 flipped classes. The three courses that decided to flip all teaching classes (12 to 13) limited their types of in-class activities to group work, discussion and presentation. The limited types of in-class activities can help students focus on the content of learning.

### 4.4.2 Designing Activities to Focus on Application and Practice

In some courses, experiment or application of knowledge to cases formed the core of in-class activities. A marketing course had students' presentation of marketing strategies as its in-class activity. A course on science centered its in-class activity on conducting experiments. A course on nursing adopted simulation of a real-life situation in class. A course on electronic design required students to design electronic gadgets in class. Students were well aware of what they were expected to do in class. They were also well aware of the relevancy between the activity and the course, for they knew that in-class activity was an application of the theoretical knowledge taught in the course. Therefore, it was easier for them to navigate through the course. In addition, students can consolidate their knowledge and integrate what they learned into real life through these activities.

### 4.4.3 Planning Interactive and Engaging Activities

As stated, increasing interaction is an important advantage of the flipped classroom approach. Interaction with students is also a way to catch students' attention to in-class activities. Most courses in the project adopted activities that encourage interaction between teacher and student and among students into their classroom. Group discussion, presentation and group project were three common examples. Various software requiring individual responses from students such as uReply and clickers were introduced as additional measures.

One course encouraged interaction by introducing team competition into class. It employed different gaming software including Bingo, Kahoot!, Badaboom, and constructed a real-time board game with iPad for its in-class activity. The teacher of this course stated explicitly in the teaching profile that his class objective was to get students active in class and the characteristic of his flipped class was an engaging and fun classroom.

### 4.4.4 Arranging After-class Activities

In addition, some teachers planned after-class activities to further consolidate their students' knowledge. In one course on science, planting on a rooftop was employed as an after-class activity. Some courses required their students to write a short summary for in-class discussions or do calculation exercises after class. Other after-class activities included movie-watching, further discussions, post-class quiz, or teachers providing feedback to students.

# 5. CONCLUSION

This article examines the challenges of flipped classroom as demonstrated in previous literature through a framework according to the four key elements suggested by Brame. The four key elements are exposure, incentive, assess, and activities. Exposure is the materials provided for students to study before class. The quality of videos as exposure and students' need for assistance outside classroom pose a challenge to it. Incentives are provided for students to prepare for class. A score is a strong extrinsic incentive. The intrinsic incentive is on students' acceptance of the flipped classroom pedagogy. Challenges occur when students do not accept the pedagogy. Mechanism to assess students' understanding should be able to ensure students'

preparation, but teachers find it difficult to do so. Activities in class should be designed to deepen students' understanding, enhance their skill, and promote interaction. However, the number of types of activities and the ability to engage students into activities pose challenges to the flipped classroom implementation.

Observing from the teaching profiles of the twenty-six teachers, this article suggests eleven tips on flipped classroom design that would be able to meet these challenges. Regarding exposure, (1) the quality of videos can be ensured by adopting existing videos, especially those with proven quality, and a variety of media can also be used as pre-class exposure. Besides, (2) additional assistance such as guiding questions and online discussion support can help students' preparation. For incentive, (3) scoring pre-class tasks is a strong extrinsic incentive for students, and (4) teachers can facilitate students' intrinsic incentive by addressing the advantages and benefits of the flipped classroom pedagogy. In assessing students' preparation, three kinds of assessment can help teachers ensure that students are well prepared: (5) assign pre-class tasks that cover pre-class exposure, (6) check students' preparation by in-class activities, and (7) design assignments that connect with pre-class and in-class activities. Regarding activity planning, (8) teachers should reduce the types of activities by sticking to a few types or implementing flipped classroom partially. (9) In-class activities can be designed to focus on experiments or application of knowledge. (10) Interaction and student's engagement can be increased by different kinds of activities, and finally, (11) some extra activities can be arranged after class to further consolidate students' knowledge.

The preliminary research has obvious limitations. Firstly, the tips provided were concluded from an observation of course design only. Their usefulness must be examined through observing the execution of those courses, which is also the focus in the next phase of our project. Future research assessing the effectiveness of the tips shall collect and examine two sets of data, including teachers' reflection on implementing their courses and students' opinion towards the flipped class they attended. Second, as mentioned in the introduction, teachers' willingness to participate, school support and technological support are also vital in the implementation of the flipped classroom. Due to the scope of this article, the challenges in these aspects were not assessed thoroughly. Further investigation in this research project would shed light on these aspects.

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# APPENDIX: SAMPLE OF TEACHING PROFILE

Flipped Classroom in Higher Education Project
Teaching Trials (1st round; 1st semester, 2018/19)

**Profile**

## 1. Course Information

| | |
|---|---|
| Course name | |
| Course code | |
| Instructor name | |
| Classroom | |
| Lecture/ Tutorial (Time/Day) | |
| Class size | |

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## 2. Course Design

Briefly illustrate how the flipped classroom approach is incorporated into the course design

| | |
|---|---|
| Objectives of using the flipped classroom approach in this course | |
| Number of classes that use the flipped mode | |
| Activities before class | |
| Ways to encourage students to complete the above activities | |
| Activities during class | |
| Activities after class | |
| Assessment design | |
| Others | |

# ONTOLOGY OF UBIQUITOUS LEARNING: WHATSAPP MESSENGER COMPETES SUCCESSFULLY WITH LEARNING MANAGEMENT SYSTEMS (LMS) IN GHANA

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**ABSTRACT**

The purpose for this study was to add to the body of research and to further examine how mobile learning can help remedy the limitations e-learning poses for students who live in Ghana with lack of access to electrical power and internet connectivity issues. Qualitative approach was employed with a total sample size of 807 students, composed of 58 percent male and 42 percent female. When the question was asked about students' willingness to purchase a new mobile device if they thought it would improve their performance at school; 87 percent indicated "yes." About 95 percent of the students indicated that having course materials such as lecture notes, practice quizzes, videos, and PowerPoints available on their mobile devices would be beneficial for their study process. The participants stated that they would be comfortable to allow their lecturers to contact them through their mobile devices. They also indicated that, apart from using their mobile phones to make and receive calls, texting using WhatsApp Messenger was the activity they often engaged in with their mobile phones. In this study, I made several assertions that, for WhatsApp Messenger to work properly in any classroom in Ghana, there must be intentional designs and step-by-step approach to teach both the faculty and the students how to use the application to achieve the utmost outcomes. I, therefore, concluded that using WhatsApp Messenger in a blended mobile learning context may help resolve many of the contextual difficulties that plague students in a e-learning situation in Ghana.

**KEYWORDS**

Ubiquitous Learning, Blended e-Learning, Connectivity, Mobile-Learning

## 1. INTRODUCTION

The evolution of the Third Generation Web and smartphone applications which have been created to run on mobile devices of the 21st Century have transformed the entire universe in all areas, including the way we communicate, function, in our daily living, and even the way we study. Almost every corner of the universe, including developing countries such as, sub-Saharan Africa, South Asia, and South America, use these technologies for transactional purposes. Farmers use these applications (apps) to transact farm businesses; communities use them to preserve family traditions and memories; and business executives are able to bridge transactional gaps. Meanwhile, researchers acquire access to research artifacts through apps, and teachers engage their students in the classrooms using these innovative technologies.

Mobile technologies with cellular connectivity continue to dominate the information communication technology market in sub-Saharan Africa. Prior to the advent of mobile phones, many sub-Saharan African countries whose citizens lived in the most remote parts of the country were cut-off regarding the use of telephones, powered by landlines to connect to the global world. However, the abundance of the mobile network systems has changed the face of telecommunication and has transformed the way business is transacted in sub-Saharan Africa and the rest of the developing world. Citizens are able to skip the landline developmental stage of telecommunication to digitalization.

According to the Pew Research Center (2015), cell phone usage in Africa pales in comparison to that of developed countries like the United States of America. However, there has been a dramatic surge in the growth of smartphone usage in sub-Saharan Africa. As of 2014, the following countries recorded high percentages of cell phone usage; Uganda 65%, Tanzania 73%, Kenya 82%, Ghana 83%, and South Africa, 89%. In the same year, the United States' cell phone usage was 89%, the same as in South Africa and only in

single-digits, higher than Ghana and Kenya. Among the many uses of cell phones in Africa for a twelve-month period, texting was the most (Pew Research Center, 2015).

Joy Online (2013) reported that Ghana was ranked by the International Telecoms Union Report as number one in Africa with more people using or connected to mobile broadband. Laary (2016) stated that for the period ending December 2015, Ghana's mobile phone voice penetration rate surged to 128%, far above earlier projections by telecommunication experts. The adoption of mobile technology with its diverse apps can serve as a conduit for mobile learning.

## 2. RELATED WORK

The objective of this paper was to create an ontology to demonstrate new approaches to study and understand mobile learning through the use of WhatsApp Messenger as a learning tool in a distance learning program. The goal was to add to the body of research and further study how mobile learning can help to remedy the limitations online learning poses for students who live in sub-Saharan Africa with lack of access to electrical power and internet connectivity issues. Motlik (2008) suggested that, mobile learning will pave the way for online learning as the internet is not stable and is unavailable in many parts of rural areas in developing nations. Also mobile learning is more affordable to less developed nations and financially constrained groups (Gronlund & Islam, 2010).

Notwithstanding these positive developments, some, including academics in higher education in sub-Saharan Africa, refuse to accept the fact that online learning can be done through mobile devices. They still believe that because of the unstableness of Internet connectivity, few institutions of formal learning can successfully go online in sub-Saharan Africa, including Ghana (Yeboah & Ewur, 2014). However, with mobile learning technologies like "WhatsApp Messenger," developing countries have no excuses as to why they are not able to adopt online learning in the remotest parts of the country where connectivity is a major setback. Everywhere a mobile phone is used, whether for WhatsApp, Email, SMS, video or photo sharing, online learning is possible. In the academic environments, just as in the community, households and business places, WhatsApp Messenger has been used to create group chats for work teams, social networking, and learning.

In Ghana, the most common format adopted in Distance Learning is the tutorial format, where very few online interactions occur; in most instances, there are no online interactions. The universities that enroll their students through the distance learning mode, rely heavily on print materials in the form of course modules and students meet regularly during weekends in tutorial centers throughout the nation where they receive face-to-face instructions. Very few programs include videos and voice presentations in their distance learning pedagogy (Larkai, Ankomah-Asare, & Nsowah-Nuamah, 2016; Yeboah & Ewur, 2014).

### 2.1 Mobile Learning

UNESCO (2013) defines mobile learning (m-Learning) as involving; "the use of mobile technology, either alone or in combination with other information and communication technology (ICT), to enable learning anytime and anywhere. Learning can unfold in a variety of ways: people can use mobile devices to access educational resources, connect with others, or create content, both inside and outside classrooms (p. 6). Quin (2001) also defines m-Learning as learning that is done through mobile computational devices, such as "Palms, Windows CE machines, even your digital cell phone."

UNESCO has compiled many unique benefits of mobile learning. Among the list are; 1). Reach and equity of education – making learning accessible to people in the world who would otherwise be cut out from receiving education via online learning; 2). Personalized learning – learners can carry their mobile devices to and from places of employment, schools, bedrooms, boardrooms, and to recreational venues; 3). Provides immediate feedback and assessment – allowing learners to quickly pinpoint problems of understanding and review explanations of key concepts; 4). Productive use of time spent in classrooms – students can learn anywhere anytime; 5). Build new communities of learners. 6). Support situated learning; 7). Enhance seamless learning – students can access learning materials from wide varieties of devices; 8). Bridge formal and informal learning; 9). Minimize educational disruption in conflict and disaster areas; 10). Assist learners with disabilities; 11). Improve communication and administration; and 12). Maximize cost-efficiency by leveraging technology students already own, rather than providing new devices that are not tested (UNESCO, 2013, p. 10-26).

## 2.2 WhatsApp Messenger for m-Learning

Research on the application of WhatsApp Messenger in the classroom is new and developing, however, its usage as a social media tool on smartphones is widespread (Cetinkaya, 2017; Bouhnik & Deshen, 2014; Yeboah
& Ewur, 2014; Church & de-Oliviera, 2013). WhatsApp is the most popular mobile messaging application widely used worldwide and is ranked as the number one in terms of monthly active users, based on a study of over 22,500 sources worldwide (Statista, 2018).

WhatsApp features include;

- Text – simple and reliable;
- Group Chat – keeping in touch with love ones, people in your network, business partners, and parishioners;
- On the Web and Desktop – keeping the conversation going anytime, anyplace, anywhere;
- Voice and Video Calls – free face-to-face conversation, when voice and text are not enough;
- End-to-End Encryption – provides security by default;
- Photos and Videos – opportunity to share moments that matter;
- Voice Messaging – using the voice messaging system to convey emotional moments; and
- Documents – attaching and sharing documents including PDFs, spreadsheets, slideshows, photos, and Word documents (http://www.whatsapp.com/features/).

WhatsApp Messenger features make it easy for teaching and learning. The app uses phone internet connections (4G/3G/2G/EDGE of Wi-Fi) of users to send and receive messages. That is, as long as there is data on users' phones, sending and receiving messages are free. (https://faq. whatsapp.com/en/android/20965922/). WhatsApp announced in May 2018 at its F8 developer conference in San Jose, California, that over 65 billion messages have been sent by users with more than 2 billion minutes of voice and video calls made everyday on the app platform, and about 1 billion people uses this messaging app each day (Al-Heeti, 2018).

Though few studies have researched into the educational benefits of the WhatsApp Messenger platform; students at the university level have used the texting feature to send and receive short messages through mobile devices; institutions of higher learning are gradually adopting WhatsApp for educational purposes; and discussion forums that are prominent in Learning Management Systems (LMS) are also available on some mobile learning platforms such as WhatsApp Messenger (Chan, 2005; Johnson, 2007, Smith, Salaway, & Caruso, 2009).

## 2.3 Key Players of the Ontology

Effective distance learning program requires inter-relationships among key players. This section identifies four important key players, which include: students, faculty, support staff, and administrators (Barry, 1992). Brian Kathman (2017) posited that, higher education institutions are engaging students more and more through text messaging and fostering of one-to-one relationships. In the past, distance learning students were not as able to freely interact with each other to share their backgrounds and interests. However, new technologies are bringing students together and helping to build communities of learners through distance education (Barry, 1992, pp. 30-32). According to Bernard Bull (2013), faculty acts as tour guides by directing and redirecting the attention of learners toward key concepts and ideas in teaching and learning. Barry Willis (1992) described the support staff as "silent heroes of a successful distance education program" (p. 37).

The support staff assist in promoting persistence and participation to avoid students' dropout. Their services include academic, administrative, and technological support. In most institutions, the support staffs' services are offered through extended hours (Moisey & Hughes, 2008). Regarding administrators, Barry Willis (1992), indicated that their duties include, planning for technological resources, deploying manpower resources, financial and the necessary capital expenditures to enhance the institution's online learning mission. They also "lead and inspire faculty and staff in overcoming obstacles that arise. Most importantly, they maintain an academic focus, realizing that meeting the instructional needs of distant students is their ultimate responsibility" (Barry, 1992, p. 38).

Factors that plague online learners in Ghana are many, including; computer illiteracy, access, long-term power outages, and connectivity. Relevant skills deficiency hinders successful facilitation of online learning through discussion boards, timely response to students, and promotion of active learning strategies. "Online instructors specifically need to be able to facilitate online discussions that are rich and meaningful, respond in a timely manner, and model active learning strategies" (Burns, 2011 p. 87). However, universities in Ghana lack the appropriate infrastructure to offer courses online, thereby resorting to face-to-face tutorial sessions in the form of tutorial center operations throughout the country by using untrained tutors who have little or no experience in distance learning. Students who are enrolled in the distance learning programs have to attend tutorials every weekend or bi-weekly.

# 3. THE CONTEXT

## 3.1 Description of the Ontology

This paper used qualitative approach, framed under the paradigm which postulates that reality is relative and depends on multiple systems for meaning. *On-to-logy*, a Greek word, relates to the nature of reality as seen in the lens of a person in his experiences, this experience may lead the individual to seek meaning. There are two schools of thoughts: the objectivist and subjectivist. The objectivist approach correlates with a quantitative research paradigm, while the subjectivist approach sees the world as socially constructed – a qualitative paradigm (Hudson & Ozanne, 1988; Lincoln & Guba, 1985; Neuman, 2000; Bogdan & Biklen, 2006; Corbin & Strauss, 2008; Creswell, 2014).

In a typical university distance learning classroom in Ghana; there are students who come directly from the Senior High Schools (17 to 21 year olds); Top-up students (21 – 27 year olds) coming from the nation's Polytechnics, Colleges of Education, and diploma (or associate) degree programs who enrol into the universities for degree purposes; mature students who are permitted to enrol into university degree programs after attaining the age of 25 (25 – 40 year olds); and similar age groups who are workers and are seeking university degrees for professional advancements. A vast majority of these students live in the nation's hinterlands and are not able to take full advantage of online learning due to factors beyond their control.

This paper describes an ongoing research study, which began in January 2017, about how to create an effective distance learning program in a hybrid mode that integrates WhatsApp Messenger as the learning platform for students who live in Ghana's remote areas where connectivity and electrical power supply are limited. The purpose was to better understand the application of WhatsApp Messenger by using its features to construct meaning for learners and instructors in an online learning context. The study was based in a university in Ghana with three campuses and two learning centers with total student population of about 10,000. Demographic characteristics of the sample participants in the study consisted of 807, composed of 58 percent males and 42 percent females. Students above the age of 25 formed the dominant age group for the study, scoring a total of 83 percent. Sixty percent of the students were married with about 44 percent indicating that about 4 persons depend on them for their sustenance. About 51 percent of the students indicated that they entered the university with other qualifications apart from associate degree or high school diploma. Concerning commitment to study, about 89 percent of the students indicated that they work, while about 54 percent of them were engaged in full time employment. Forty-three percent of the students in the study were committed to study for about ten hours a week.

# 4. BLENDED MOBILE LEARNING STRUCTURE

I present in Table 1, a mobile learning structure indicating a summary comparison between a typical Learning Management System (LMS) and the proper application of the use of WhatsApp as mobile learning platform in a Ghanaian context. The following assumptions were made to explain table 1:

**Assumption # 1**

Why it will not work

a) WhatsApp Messenger as a social media tool is not fit for the classroom – for learning purposes.

b) A typical LMS delivers courseware over the internet – lack of internet connectivity and prolonged power outages in Ghana, especially, in the countryside makes it impossible to sustain online learning. Therefore, LMS will not work for students in Ghana who live far away from the cities.

**Assumption # 2**

How it will work

a) For WhatsApp to function properly in online learning environment, the features must be properly integrated to fit the purpose of teaching and learning in a mobile learning context.

b) WhatsApp Messenger uses phone internet connections of users to send and receive messages. That is, as long as there is data on users' phones, sending and receiving messages are free. Therefore, students in Ghana, who live far from the cities can also access online learning benefits through mobile devices.

Jurado, Pattersson, Regueiro-Gomez, and Scheja, (2014), classified learning management systems features into four different tool groups, namely: distribution, communication, interaction, and administration.

1. **Tools for distribution** allow lecturers to upload documents, available to students. Earlier it was mainly text documents and today it may also be different kinds of media files. Nevertheless, the process is still one-way, that is, teacher-to-learner distribution of information.

2. **Tools for communication** allow information to go either way as well as from student-to-student. The most common example is E-mail.

3. **Tools for interaction** call for reaction and feedback. Discussion boards are the most typical example. These tools are of great interest since they may promote student activity and cooperation, hence enhancing the learning experience.

4. **Tools for course administration** are used to monitor and document the educational process, rather than to facilitate teaching or learning (p.4).

Table 1. Mobile Learning Structure Using WhatsApp Messenger – Ghanaian Context

| **Application:** Online learning tools. Jurado, et al., (2014) | **Key Players:** Students/faculty / support staff/ administrators | **Purpose:** Teaching and learning using blended mode of online learning | **Learning Management System (LMS):** Why LMS will not work in Ghana due to lack of Internet Access | **WhatsApp Messenger for Learning:** How WhatsApp will work despite lack of Internet Access in Ghana |
|---|---|---|---|---|
| Distribution | 1. Faculty<br>2. Student<br><br>Interaction flows from teacher to student | One-way: from teacher to student – one way process | 1. Teacher sends course information to students via the course management system<br>2. Students retrieve course information<br>3. LMS delivers courseware over the internet<br>4. Students lack access to retrieve and view course content via the internet. | 1. Teacher sends course information via PDFs or Word document attachments to students<br>2. Students sign their name (forum signature) before each WhatsApp post;<br>3. Students retrieve course information<br>4. WhatsApp Messenger uses phone internet connections<br>5. As long as there is data on students' phones, viewing course content is possible. |
| Communication | 1. Faculty<br>2. Student<br><br>Interaction flows both ways | Information go either way. Teacher to student, student to teacher | 1. Students respond to teacher via the course management system<br>2. Teacher grades students work and post comments on course management system | 1. Students post completed assignments in more than one format via:<br>a. PDF or Word attachments<br>b. Direct text message<br>2. Teacher grades students work and post comments via WhatsApp Messenger<br>3. Teacher sends transcripts of WhatsApp communication to course administrators. |

| | | | | |
|---|---|---|---|---|
| Interaction | 1. Students<br><br>Peer interactions. Student to student | Discussion boards, students reactions and feedbacks. | 1. Student to student interaction through LMS discussion forums<br>2. Teacher as facilitator guides students | 1. Students to student interaction through:<br>a. WhatsApp 'group-chat'<br>b. Possible video and voice calls<br>2. Teacher as facilitator guides students |
| Course Administration | 1. Support Staff<br>2. Administrators<br><br>Back-end interaction | Course monitoring, management, documentation, and evaluation. | 1. Teacher setup the courses via the LMS<br>2. Teacher post course syllabus and assignments for class discussions<br>3. Teacher grades students work and post grades online<br>4. Students perform teacher and course evaluations online | 1. Support staffs create WhatsApp groups for students and faculty<br>2. Support staff monitors students and faculty interactions through WhatsApp transcripts<br>3. Support staff receives transcripts from teachers regularly and monitors for course content and interactions<br>4. Teacher sends WhatsApp transcripts to program office for archival purposes.<br>5. Support staff archives course materials for quality control purposes. |

# 5. DISCUSSION AND CONCLUSION

## 5.1 Discussion

This paper depicted an ontology of an ongoing research study. The purpose of the research was to better understand the application of WhatsApp Messenger by using its features to construct meaning for learners and instructors in a blended mobile online learning context. The study was based in a university in Ghana with three campuses and two learning centers with total student population of about 10,000. A sampled total of 807 students from three campuses and two learning centres of the university adopted the use of WhatsApp Messenger in a blended online learning mode.

Total sample size for the study was 807, composed of 58 percent male and 42 percent female. Students above the age of 25 formed the dominant age group for the study, scoring a total of 83 percent. Sixty percent of the students were married with about 44 percent indicating that about 4 persons depend on them for their sustenance. About 51 percent of the students indicated that they entered the university with other qualifications apart from associate degree or high school diploma.

Concerning commitment to study, about 89 percent of the students indicated that they work, while about 54 percent of them were engaged in full time employment. Forty-three percent of the students in the study were committed to study for about ten hours a week. The results from the demographics report fit traditional adult learners as described in the literature. According to Ross-Gordon (2011), adult students, referred to as – non-traditional students form sizeable presence on university campuses and also constitute a substantial share of the undergraduate student body. The National Center for Educational Statistics (NCES, 2009) survey reported that 38 percent of student enrolment for the 2007 academic year were 25 years of age or older. Choy (2002) cited the 2002 NCES statistics that defined seven characteristics of non-traditional students as follows:

1. Entry to college delayed by at least one year following high school,
2. Having dependents,
3. Being a single parent,
4. Being employed full time,
5. Being financially independent,

6. Attending part time, and
7. Not having a high school diploma.

Ross-Gordon (2011) described characteristics that separate re-entry adults from other traditional university students to be; "the high likelihood that they are juggling other life roles while attending school, including those of worker, spouse or partner, parent, caregiver, and community member" (p. 27).

## 5.2 Conclusion

In designing the blended mobile learning structure, I applied agile methodologies using WhatsApp Messenger as a learning platform, that meets the current infrastructural conditions in Ghana.

Seth Earley (2017), stated that, there must be the need to interpret user signals accurately to "enable the system to present the right content for the user's context," this may "require not only that our customer data is clean, properly structured, and integrated across multiple systems and processes but also that the system understand the relationship between the user, his or her specific task, the product, and the content needed" (pp. 58-64).

According to Yeboah and Ewur (2014), the adoption of WhatsApp in the classroom is anathema. To them, the technology is nuisance to university students. They concluded that, "if students bring their mobile phones to class, they get bored of the lesson and find their way onto WhatsApp. These detracts their attention from the main lesson, and are not able to fully understand what is going on, hindering participation and drawing them even further into WhatsApp making it more difficult for them at the end of the day" (p. 162).

Contrary to Yeboah and Ewur's, assertions, the current paper has proven otherwise. In this study, I made several assertions that, for WhatsApp to work properly in any classroom in Ghana, there must be intentional designs and step-by-step approach to teach both the faculty and the students how to use the application to achieve the utmost outcomes (see table 2, above). Because, I believe that, "seemingly intractable problems have been solved by advances in processing power and capabilities. Not long ago, autonomous vehicles were considered technologically infeasible due to the volume of data that needed to be processed in real time. Speech recognition was unreliable and required extensive speaker-dependent training sessions. Mobile phones were once "auto-mobile" phones, requiring a car trunk full of equipment" (Earley, 2017, pp. 58-64).

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# EFFECTS OF INTERACTION STRATEGIES ON STUDENTS' MUSIC LISTENING WITH A MOBILE APPLICATION

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**ABSTRACT**

The purpose of this study is to explore how three interaction strategies through mobile applications affect students' music listening. Data was collected from 225 high school students and analyzed using the ANCOVA procedure in the three domains of music listening: analytic, aesthetic and sensory. Research showed that the interaction with teachers was most influential in the analytic listening of the participants. Interaction with peers was most influential in aesthetic listening of the participants. Interaction with the application was most influential in sensory listening of the participants. Differences in students' satisfaction according to the three interactions through the mobile application are discussed. This study has implications on how interactions could be designed for students' music listening.

**KEYWORDS**

Music Listening, Mobile Application in Music Listening, Music Listening Strategies

## 1. INTRODUCTION

Music listening is about understanding and enjoying the meanings and the aesthetics of music. It is an activity perceiving and understanding the characteristics and principles of the musical elements such as rhythm, melody, harmony, form, dynamics, tempo, and timbre. Moreover, music listening activities include the process of exploring the aesthetic elements in music through understanding of the contextual factors related to music (Boardman, 1996).

Recent technologies including digital media such as computers, iPods, and cellphones help us understand concepts and skills required for music listening, play, and creation. Various websites and online podcasts provide easy access and ample opportunities for students to stream and appreciate various genres and styles of music anytime, anywhere. A variety of mobile applications are special in that they are very popular with students nowadays and provide students with music understanding and skills in more individual environments (Bauer, 2014).

Much research has been performed on technologies as effective tools for facilitating learning in music; for example, Riley (2013) introduced the usage of tablet PCs, iPads and mobile device applications. He introduced seven types of applications which can be used in music education: rehearsal/performance assistance, creating music, teaching instruments, providing virtual instruments, audio/video recording, listening resources and organizational support. Williams (2014) suggested tablet PC's role as an instrument in music education. He mentioned that using iPads has a myriad of possibilities for ensemble performance and music learning. Rajan (2014) reviewed how children experience music through technology, and provided ideas for encouraging music listening, music making, and music watching at home and in the classroom. He further argued that parents as well as teachers should use such technologies in music education. Similarly, Heath-Reynolds & VanWeelden (2015) introduced apps which can enhance music education and helped National Core Arts Standards (See http://www.nationalartsstandards.org/) introduce them into music class. They analyzed fifteen apps for creating music, six apps for performing, four apps for responding and two apps for connecting in order to suggest how apps can help music education. Dunbar

(2016) presented the usefulness of seven free notation apps: Anyone Can Make Music, NotateMe Now!, Score Creator, Studiolab, Stave'n'Tabs, iWriteMusic, Melody Pro - specifically in creating music after analysis with rubrics of layout, intuitive, content accuracy, playback capabilities and export capabilities. Giebelhausen (2016) introduced paperless music class by providing a hybrid model of various hardware and software programs. Furthermore, he listed grants organizations and websites which can help establish such environments in schools.

In the same context of using technology in music education as with the above research and experience, this study aims to utilize an application and reveal its effectiveness in music listening. The primary objective of this study is to verify that three interactions through mobile applications can increase students' music listening. An auxiliary objective is to find any differences in satisfaction according to the three interactions through the mobile application.

## 2. STRATEGIES FOR MUSIC LISTENING

Recently, a variety of strategies have been tried to increase active and positive participation of students in music listening. In this effort, attention was suggested as one of the critical elements for meaningful music listening (Madsen & Geringer, 2008). In order to enhance students' attention, research has been focused on adopting listening maps or verbal description as a learning activity in music (Cassidy, 2001; Flowers & O'Neill, 2005; Gromko & Russell, 2002; Johnson, 2011; Sims, 2005). Also research has been done on the collaborative music listening and interaction with others (Johnson, 2011; Smialek & Boburka, 2006).

Johnson (2011) performed a study on the effects of critical thinking instruction on fifth-graders' music listening measured through written survey responses. This study suggested a constructivist approach to music listening instead of teacher-directed listening as a way to provide learning music. That is, this study tried to enhance students' thinking of musical context through analysis and exploration initiated by each student, as shown in Bamberger's study (2000). A contextual analysis of music was a main research topic of Walby (2011). He performed research on music terms acquired by analysis and comparison of music context among middle school students. This study suggested explanation and discussion in verbal form after having the students listen to the music. In this study, verbal communication was able to gain interest among the students, allowing them to form musical concepts consistent with fellow members of their musical culture. Talking about the music can also be a satisfying and culturally expected response to the concert experience.

The above studies suggest a proactive approach to music listening. Miller (1968) classified music listening into four types: passive listening by listening to music as is, sensory listening, with emotional listening to listen to music with its context and with bodily responses, and finally intellectual listening to listen to music with understanding and judgement about its structure and components. Later Wingell (1983) proceeded with the idea that people respond to music at first on a sensory level that prompts their senses, then on an associate level that relates to their previous experience and imagination, and finally on musical or formal level that analyzes the music in more detail. Hoffer (1988) classified music listening into three types. One way of listening to music is to absorb the physical sensations of the sounds. Enjoying music can be a pretty sensory, physical experience. The second way to listen to music is to be aware of its expressive qualities. The third way to listen to music involves concentrating on what is happening in the music – i.e., what notes are being played or sung, at what speed, in what range of pitches, in what combination with what other notes, and so on. Bauer (2014) admitted that people respond to music in various ways and that music educators should strive to develop students' abilities to listen to and describe music, analyze and evaluate it, understand its historical and cultural contexts, and appreciate its relationships to other disciplines, including other art forms.

From the preceding studies, three apparent ways of music listening could be extracted: One way is to appreciate music with senses as it is. Another way is to appreciate music with analysis of expressive characteristics, and the last way is to appreciate music with relation to its historical events, cultural context, and other genres of the arts. These three ways could be named sensory, analytic and aesthetic listening, respectively.

In this study, participants received one of the three strategies of music listening together with listening note embedded in the app. Table 1 shows three ways of music listening with their explanations and activities.

Table 1. Three Ways of Music Listening, Definitions and Activities

| Ways of Listening | Definition | Activities |
|---|---|---|
| Sensory | A strategy of music listening in which people enjoy sensory pleasure of music through its flow and beauty. | To express his or her own feelings in words after listening to music and in gestures when music is playing |
| Analytic | A strategy of music listening in which people understand music through analysis of its components, such as rhythm, tone, beat, melody, tempo, and dynamic etc. | To listen to music with understanding of its thematic melody, its tempo and tone, its repetition and changes, and its tune. |
| Aesthetic | A strategy of music listening in which people explore music with its intrinsic and extrinsic elements and evaluate its values. | To understand the music's social and cultural backgrounds.<br>To search its usage, role and values.<br>To evaluate the music itself and its play. |

# 3. RESEARCH METHODS AND TOOLS

## 3.1 Participants

A total of 225 students were purposely selected from a high school located in Daejeon, South Korea. All of them were in 10th grade and owned a smartphone. One hundred fourteen students were boy and one hundred eleven students were girls. Two classes were chosen at random and were allocated in each one of the three treatments: the interaction with peers, the interaction with teachers and the interaction with the application. The number of students in 'With Peers' treatment was 77, 'With Teachers' treatment had 72, and 'With the Application' had 76 students.

## 3.2 Music Listening Test

The music listening test was composed of three sections: analytic, aesthetic and sensory listening. The analytic section was comprised of six multiple choice items. The aesthetic section was comprised of three short essays and the sensory section of three short essays. All items were developed by researchers and revised three times by a music teacher who holds a master's degree in music education. The Cronbach Alpha for the analytic section was .91 and the test-retest reliability was .94 for this section. The aesthetic and sensory sections were graded by three music teachers with master's degrees in music education and the final scores were obtained by averaging the three scores. This test was utilized as pre and post-tests with random reordering.

## 3.3 The Application

The application used in the study was developed by Cho (2014). This application was designed for students' active music listening in that they can express their feelings by clicking 'Likes' as in Facebook. This application allows for students to listen to uploaded music and to write notes on analytic, aesthetic and sensory listening. Students can share their ideas by communicating with texts, attaching files and replying to peer posts.

A total of thirteen titles of music were uploaded to this application. They were selected by the researcher with the criteria of difficulty level and hierarchy of music learning. That is, in the analytic music listening, several elements are to be taken into account such as melody, sound level, tempo, dynamic, tone and beat. Not all music contains all these elements, but each title of music varies in their elements. The thirteen titles were ordered in sequence according to difficulty level. For example, the order of the music was arranged

from the one with focus on tempo which might be easy for students to understand to the one focused on rhythm, beat, melody and dynamic in order. Each title was added to the preceding music's focused element. For aesthetic music listening, music was selected in consideration of their historical, cultural and social contexts. The information and explanation were attached to each music for better understanding of the music.

## 3.4 Procedures and Data Gathering

Before the listening started, the application was installed, and students were informed on how to use it. Twenty-six students, whose devices were not compatible with the application, were provided with smart phones with the application already installed. The participants were given one class hour of instruction on how to appreciate music, which included all three types of listening. They also had time to appreciate music, and practiced how to take a note in the application. Thus, all students became familiar with music listening with the app, taking notes and communicating with others.

A pretest was administered to all participants. This pretest was a music listening test before the assigned interaction for each group. For the treatment period, music was delivered each week, and the students were asked to write a listening note. Each preordered music was uploaded every Monday with its streaming video clip, tune, and its context information. They were also allowed to upload their own images together with text as a way of music listening note. The interaction group with the app listened to music provided on the app without any interaction with others, read the explanation and wrote a note. The interaction group with peers, after writing their notes, could open and comments on others' notes, share their opinions on the music. The interaction group with teachers could interact with teachers after writing their notes, asking questions regarding each topic. They could hear teachers' opinions on their notes. All interactions with peers and teachers were made through the comments menu in the application. A posttest was administered after about three months. This posttest was identical to the pretest, but the order of items was rearranged.

# 4. RESULTS

Before the treatment, homogeneity of the groups was tested for the three domains of music listening using ANOVA procedure in SPSS. As a result, the participants were homogeneous in music listening before the treatment regardless of the group to which they belonged. In order to test the effects of the three interactions, the ANCOVA procedure with pretest scores of music listening as covariates was applied for three domains of music listening: Analytic, Aesthetic and Sensory.

Below are the results of the ANCOVA in the order of Analytic, Aesthetic and Sensory. The interaction group with teachers shows the highest mean which is 9.20, the interaction group with peers shows the second highest mean with 8.54, and the interaction group with the application shows the lowest mean of 7.75. The whole participants' mean was 8.48. In order to test if these differences are statistically significant, the ANCOVA procedure was applied with the pretest score of analytic listening as a covariate. The result is presented in Table 1 below.

Table 2. ANCOVA for Between-Subjects Effects on Analytic Listening

| Source | SS | df | MS | F |
|---|---|---|---|---|
| Corrected Model | 67.248[a] | 3 | 22.416 | 5.495** |
| Intercept | 399.734 | 1 | 399.734 | 97.984** |
| Pre_Analytic | 2.039 | 1 | 2.039 | .500 |
| Group | 63.769 | 2 | 31.885 | 7.816** |
| Error | 26.165 | 178 | 4.080 | |
| Total | 13875.000 | 182 | | |
| Corrected Total | 739.412 | 181 | | |

**p < .01

According to Table 1 above, the differences were statistically significant. Therefore, the mean of the interaction group with teachers was highest, and that of the interaction group with peers was the second highest while that of the interaction group with the application was the lowest. To explore all possible pair-wise comparisons of means, the Least Significant Difference (LSD) procedure was applied. As a result, the biggest mean difference was found between the interaction with teachers and the interaction with the application, the difference of which was 1.438. The mean difference between the interaction with the application and the interaction with peers was also significant with a .802 difference. Meanwhile the difference between the interaction with peers and the interaction with teachers was not significant. Therefore, the interaction with teachers was most influential in analytic listening of the participants. The interaction with the application was least influential in analytic listening of the participants.

The same pattern of the analysis was applied to the case of aesthetic listening of the participants. The analysis shows that the interaction group with peers shows the highest mean which is 2.71, the interaction group with teachers shows the second highest mean with 1.88, and the interaction group with the application shows the lowest mean of 1.71. The whole participants' mean was 2.13. In order to test if these differences are statistically significant, the ANCOVA procedure was applied with the pretest score of aesthetic listening as a covariate. The results are presented in Table 2 below.

Table 3. ANCOVA for Between-Subjects Effects on Aesthetic Listening

| Source | SS | df | MS | F |
|---|---|---|---|---|
| Corrected Model | 46.803[a] | 3 | 15.601 | 33.074** |
| Intercept | 62.989 | 1 | 62.989 | 133.538** |
| Pre_Analytic | 6.121 | 1 | 6.121 | 12.976** |
| Group | 38.454 | 2 | 19.227 | 40.762** |
| Error | 93.867 | 199 | .472 | |
| Total | 1060.000 | 203 | | |
| Corrected Total | 140.670 | 202 | | |

**p < .01

According to Table 2 above, the differences were statistically significant. Therefore, the mean of the interaction group with peers was highest, and that of the interaction group with teachers was the second highest, while that of the interaction group with the application was the lowest. To explore all possible pair-wise comparisons of means, the Least Significant Difference (LSD) procedure was applied. As a result, the biggest mean difference was found between the interaction with the application and the interaction with peers, the difference of which was .975. The mean difference between the interaction with peers and the interaction with teachers was also significant, with a .790 difference. Meanwhile the difference between the interaction with teachers and the interaction with the application was not significant. Therefore, the interaction with peers was most influential in aesthetic listening of the participants. The interaction with the application was least influential in analytic listening of the participants.

The same pattern of the analysis was applied to the case of sensory listening of the participants. According to the analysis, the interaction group with the application shows the highest mean, which is 2.64. The interaction group with peers shows the second highest mean with 1.47, and the interaction group with teachers shows the lowest mean of 1.34. The whole participants' mean was 1.83. In order to test if these differences are statistically significant, the ANCOVA procedure was applied with the pretest score of sensory listening as a covariate. The results are presented in Table 3 below.

Table 4. ANCOVA for Between-Subjects Effects on Sensory Listening

| Source | SS | df | MS | F |
|---|---|---|---|---|
| Corrected Model | 76.115[a] | 3 | 25.372 | 53.027** |
| Intercept | 304.996 | 1 | 304.996 | 637.446** |
| Pre_Analytic | 1.090 | 1 | 1.090 | 2.277 |
| Group | 75.634 | 2 | 37.817 | 79.038** |
| Error | 101.913 | 213 | .478 | |
| Total | 908.000 | 217 | | |
| Corrected Total | 178.028 | 216 | | |

**p < .01

According to Table 3 above, the differences were statistically significant. Therefore, the mean of the interaction group with the application was highest, and that of the interaction group with peers was the second highest while that of the interaction group with teachers was the lowest. To explore all possible pair-wise comparisons of means, the Least Significant Difference (LSD) procedure was applied. As a result, the biggest mean difference was found between the interaction with teachers and the interaction with the application, the difference of which was 1.302. The mean difference between the interaction with the application and the interaction with peers was also significant with a 1.185 difference. Meanwhile the difference between the interaction with peers and the interaction with teachers was not significant. Therefore, the interaction with the application was most influential in sensory listening of the participants. The interaction with teachers was least influential in analytic listening of the participants.

## 5. DISCUSSION, CONCLUSION AND SUGGESTIONS

The interaction with teachers was most influential in the analytic listening of the participants. The interaction with the app was least influential in the analytic listening of the participants. The analytic listening is to understand and differentiate the expressive elements of music while listening to music. One of the results of this study, the interaction with teachers was most influential in the analytic listening of the participants, could be due to the instructors' input. On the other hand, the fact that interaction with the application was least influential in the analytic listening of the participants may be attributable to the non-existence of any help from others in acquiring skills and methods for understanding and differentiating these elements of the music. The interaction with peers was most influential in aesthetic listening of the participants. The interaction with the application was least influential in aesthetic listening of the participants.

The aesthetic listening is to locate overt and covert expressive beauty of music and evaluate its value in the context of the society and culture in which the music was created. This listening accompanies understanding of the music's characteristics, of related stories and of reflections of them into the music. The participants interacting with peers could communicate all of their comments with others. Because the aesthetic listening is more closely related to the contextual knowledge of the music, participants interacting with peers could enhance their aesthetic listening and their contextual knowledge by reading others' notes and sharing comments. The lowest aesthetic listening of the participants interacting with the application is attributable to the same reason stated above.

The interaction with the application was most influential in sensory listening of the participants. The interaction with teachers was least influential in sensory listening of the participants. The sensory listening is to express listener's feelings into words, images, or bodily gestures while listening to music. That is, the sensory listening does not accompany any other kinds of deep thinking or understanding; rather the listeners use their senses to appreciate the music with ease and comfort. In this study, participants interacting with the application listened to the music with the explanation and read how to appreciate the music with no interaction with others. The fact that participants interacting with the application showed higher sensory listening could be due to the fact that they could react to the music with their ease and freedom without others' intervention or control. The other participants interacting with teachers and peers could be distracted during sensory listening in search of analyzing and evaluating the music's context and elements.

The interaction group with the application was most satisfied with music listening. The interaction group with peers was least satisfied with music listening. This may be due to the fact that they feel more freedom without the need to pay attention to others. On the other hand, the participants interacting with peers showed the lowest satisfaction. This might be due to the fact that they had to pay more attention to others' postings and they had written their notes in the application. This should have doubled their work load and they might feel stress.

Implications of this study are that analytic listening can be effective through the interaction with experts, aesthetic listening could be enhanced with interactions with peers and sensory listening could be enhanced with interactions with the application. These results imply that analytic listening needs to be focused on a coaching method involving experts' guidance, aesthetic listening needs to be focused on a discussion with peers and sensory listening needs to be focused on more free and comfortable listening environments.

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# VOCABULARY SKILLS DEVELOPMENT AMONG STUDENTS: AN ETHNOGRAPHY

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**ABSTRACT**

This study is on the development of English vocabulary skills of selected High School and College students of Bukidnon and Cagayan De Oro City. Specifically, it sought to focus on four areas: when teachers develop vocabulary, the teaching techniques employed to develop vocabulary, students' reaction to the activities presented and the behaviors displayed by students to show understanding of new words introduced.

An ethnographic approach to classroom observation was used in this study. The descriptive method served as means to analyze and interpret the gathered data on vocabulary development. The data were gathered through the use of cassette recorder and video tape. Actual observation was also conducted by the researchers to the sample classes. Moskowitz' (2006) behavior categories for language students aided the researchers in describing students' reactions to vocabulary activities presented. A total of four hours was allotted for the gathering of data, equivalent to six lessons. Of the six lessons observed, two were tape recorded and four were video-taped.

Findings revealed that the development of vocabulary skills was generally done at the beginning of the lesson. There were only few instances in which it was done at the middle of the discussion. Vocabulary was unlocked through the use of context clues varying from semantic definition, explanation, description and appositive clues. Students enjoyed guessing the words' meaning when used in context that choral responses were prevalent. They manifested that they understood the meaning of the new words developed by using the words in exact context during the lesson activities.

**KEYWORDS**

Vocabulary Development, Ethnography, English Classes

## 1. INTRODUCTION

There is much agreement among linguists and language experts that inadequate vocabulary development is the basis for many problems associated with underachievement. Vocabulary deficiencies are associated with difficulty in comprehending sentences, depressed IQ test performance, and inefficient reading speed. After students leave school, inadequate vocabulary development continues to affect vocational success adversely (Otto, 2008). Vocabulary development then is an essential skill, which needs emphasis in all English classes.

Yet it is a reality that quite a number of students still belong to the underachiever's category as manifested by their failing marks. The question may be posed "how far have the English teachers gone to provide adequate vocabulary development in their English classes?" Mangiere (2002) posits that despite the obvious importance of vocabulary in the reading process, it is frequently underemphasized by teachers in their classrooms. He further states that it is also a facet of reading about which some teachers have many misconceptions. Therefore, there is a need to find out what is really going on in English classes (Willmott, 2002).

However, knowledge of what actually goes on in the classrooms is extremely limited. In his book on ethnographic approaches to the classroom, Van Lier (2008) justifies that ethnography is relevant and valuable in increasing one's knowledge of classrooms which can only be done by going into classrooms for data gathering. Nunan (2005) also says that there is no substitute for direct observation as a way of finding out about language classrooms. Certainly, if researchers want to enrich their understanding of language learning and teaching, they need to spend time looking in classrooms (Comaroff, 2003). The classroom is where the action is, the place to look for ways to record and investigate action.

Therefore, providing an ethnographic description of the development of vocabulary skills of High school and College English students is deemed necessary. Vocabulary is a necessity in the development of one's speaking, reading, listening and writing skills.

## 2. METHODOLOGY

The ethnographic approach to classroom observation was used in conducting this study. This is an open-ended approach wherein the observers first identified areas of concern and devises what kind of data might seem appropriate as cited by Wallace (2001). Wajnryb (2002) further states that in doing an ethnographic record of the lesson, the researcher notes down chronologically the main events in the lesson and their impact. Events need to be brief and synoptic to keep records in real time. Hence, in this paper, actual classroom lessons in English classes were observed and verbal interactions were tape-recorded and video-taped. These were then transcribed, interpreted and analyzed based on the questions stated towards vocabulary development.

## 3. RESULTS AND DISCUSSIONS

The total of four hours tape-recorded, video-taped and actually observed English classes revealed that most of the vocabulary words introduced were developed at the beginning of the lesson. It was observed that words such as *resonance, wick, intermittent, accolade, sonorous, awry* and *grumpy* were unlocked at the start of the lesson. These words were discussed at the immediate start of the lesson, before the lesson activities were done. Only two words were unlocked at the middle of the discussion. They were: *accolade* and *wick*. These words were developed before the activities were done. Excerpts of the lessons from the two sections support these.

Furthermore, the excerpt shows that all vocabulary words introduced were developed at the beginning of the lesson. Five vocabulary words were introduced as follows: *resonance*, *accolade*, *sonorous*, *grumpy*, and *intermittent*. Another excerpt taken from the high school, a double period class; revealed three vocabulary words developed in the session. One of these three words was introduced at the middle of the discussion, before the students made an application letter for an activity. The word was *accolade*. The rest of the words, which are *intermittent* and *grumpy* were developed at the beginning of the lesson.

From the college classes, six vocabulary words were developed. Five of these were developed at the beginning of the lesson. They were: *awry, askance, impoverish, gird* and *succulent*. The only word developed at the middle of the lesson was the word *wanton*. An excerpt supports this.

During the second meeting of the high school classes, only one word was introduced, the word *whim*. This word was developed at the beginning of the lesson. This is also supported by an excerpt. Another excerpt shows two vocabulary words being developed at the beginning of the lesson. These are *incredulous* and *glean*.

Excerpts 1, 2, 3, 4 and 5 show that most vocabulary words were unlocked at the start of the lesson, before the lesson activities were tackled by the class. The teacher made the students understand the words meaning before they were used in the activities of *filling out an application letter, expressing ability and interest, expressing a wish, having a job interview writing* an *application letter*. The unlocking of words before they were used in succeeding activities facilitated more student interaction. The use of these words, unlocked beforehand, enabled the students to cope with the teachers' activities. There were two vocabulary words unlocked at the middle of the discussion. These were *accrued* and *whim*.

The excerpts show that words like *resonance, intermittent, grumpy, whim* and *accolade* were unlocked as a review for the past lesson. The re-unlocking of the said words was done at the immediate start of the lesson. Some words such as *accolade* and *wanton* were re-unlocked at the middle of the discussion. After these, other words were unlocked also. These were: *sonorous* and *accrued* which were then used for the succeeding activities. The word *incredulous* was used by the students to fill out an application form while *glean* and *intermittent* in were used in making sentences to express ability and interest.

As a summary, the table that follows answers when teachers develop vocabulary.

Table 1. When do Teachers Develop Vocabulary?

| Classes | Words developed | When was it developed |
|---|---|---|
| College | 1. Resonance<br>2. Wick<br>3. Intermittent<br>4. Accolade<br>5. Sonorous | Beginning of the lesson |
| High School | 1. Whim<br>2. Incredulous<br>3. Glean | Beginning of the lesson<br>Middle of the lesson |
| College | 1. Resonance<br>2. Wick<br>3. Intermittent<br>4. Accolade<br>5. Sonorous | Beginning of the lesson<br>Middle of the lesson |
| High School | 1. Whim | Beginning of the lesson |
| High School | 1. Incredulous<br>2. Glean | Beginning of the lesson |

Transcriptions show that vocabulary was developed through the use of context clues. All words were unlocked through the use of context. Excerpts one to five support this claim. Context clues are the kinds of aid that pupils often encounter. Evident from these excerpts are aids like sentences used by the teacher to arrive at word meanings. Semantic definitions and descriptions were the usual kinds of aid given. This is true from excerpt one to six. Not only sentences were used as clues, words were written on the board as answer clues or choices. After the teacher said the sentence clues twice, students chose the meanings from the list on the board. This facilitated gathering of immediate responses from the students.

The teacher developed vocabulary ion both sections with the use of semantic clues. Clues given were derived from the meanings of the words co-occurring with the unknown words. Various kinds of semantic clues were utilized by the teacher to arrive at the meaning of the words unlocked in class.

Table 2. Techniques used by the Teacher in Developing Students' Vocabulary

| Classes | Words developed | Technique Used |
|---|---|---|
| College | 6. Resonance<br>7. Wick<br>8. Intermittent<br>9. Accolade<br>10. Sonorous | Context by definition<br>Semantic Appositive<br>Semantic Definition<br>Semantic Appositive<br>Semantic Appositive |
| High School | 4. Whim<br>5. Incredulous<br>6. Glean | Semantic Appositive<br>Semantic Appositive<br>Definition made by students |
| College | 6. Resonance<br>7. Wick<br>8. Intermittent<br>9. Accolade<br>10. Sonorous | Semantic Appositive<br>Semantic Definition<br>Semantic Appositive<br>Semantic Appositive<br>Semantic Definition<br>Semantic definition |
| High School | 2. Whim | Semantic Explanation |
| High School | 3. Incredulous<br>4. Glean | Semantic definition<br>Semantic definition |

The four –hour video-taped and tape recorded data in both college and high school English classes yielded various reactions shown by the students to the activities presented by the teacher for vocabulary development. Most reactions were similar and patterned after the scheme devised by Moskowitz (2006) for documenting classroom behavior of language students. These are summarized on the next table.

Table 3. Students' Reactions towards Vocabulary Development

| Activities Presented by the Teacher | Students' Reactions |
|---|---|
| Completing an Application letter | Looked blankly at the teacher, made unnecessary noise, repeated what the teacher said, talked using their native language, repeated the word unlocked, choral responses, smiled at the video camera, teased the one reciting, laughed and giggled, corrected the teacher's use of did and do |
| Completing a Bio-data | Repeated the teacher's words, laughed at the word used, voiced out their want to call the sample, talked using their native language, added funny words to what the teacher read, choral responses, made fun of answers, forced classmates to stand, repeated classmates' answers |
| Expressing ability | Gave direct answers, created noise, answered without being called, gave inaudible replies, laughed at their classmates' responses and interest |
| Expressing a wish | Laughed and teased their classmates' answers, shouted and laughed at the camera, scratched the head due to confusion, kept on looking at the watch, asked seatmate, drummed on the chair, did not listen to the instruction |
| Making up an interview | Worked seriously, made minimal noise, laughed while talking, did not face the camera, covered the face while reciting, was shy to face the camera |
| Making an application letter | Frowned, ignored the video camera, concentrated on their work, was hesitant to go to the front, smiled at the video camera |
| Unlocking of Difficulties | Silent, choral responses, answered with a smile, gave appropriate responses easily, provided inaudible replies, winked, scanned notes, touched the hair repeatedly, repeated classmates' answers, played with ball pen, whispered to confirm an answer, listened attentively |
| Filling out an application letter | Took notes of what was heard, meditated, talked softly with people behind them, choral responses, smiled at the video camera |
| Expressing ability and interest | Recited softly, teased their classmates, laughed |
| Expressing wish | Gave direct answers, teased, laughed, covered face, listened attentively to the one reciting |
| Application letter writing | Worked attentively, covered the mouth, smiled, read one's work seriously, laughed, gave inaudible answers, did not listen to the one reciting in preparation for his turn to recite |

## 4. FINDINGS

The study came up with the following relevant findings:

Students from the third section of the high school level The development of vocabulary skills was generally done at the start of the lesson. This was observed from both high school and college classes. The teacher did this since the words unlocked were used to further students' understanding of the succeeding activities. The vocabulary words introduced were used in the lesson activities they did. Unlocking terms before the lesson activities were done, helped most students. The others obviously need no helping in understanding the terms unlocked for the words were too easy for their level. Also, the answer clues and the sentence patterns which were presented helped and led the students to participate actively in the recitation.

Some words were unlocked in the middle of the lesson. This was done before the succeeding activities were tackled.

Vocabulary was unlocked through the use of context clues. Sentences were provided by the teacher to serve as guide to come up with the words' meaning. Most words were semantically defined since the teacher made use of clues derived from the meaning of the words co-occurring with the unknown words. Definition, explanation, and description of the words unlocked were the clues provided for the sentences. Choices were also written on the board which helped the students give answers. The same techniques were used for both sections.

Varied reactions were manifested by students at the time of the unlocking of difficulties and during the presentation of activities for vocabulary development. The students' behavior included specific responses and immediate replies. Some responses were choral and use of the mother language was predominant, only a few non-verbal gestures or facial reactions were seen such as scanning of notes, looking at the camera and blankly looking at the teacher. Only for a few words were students observed to be frowning showing confusion about what they were doing. Generally, students from these classes were attentive during the presentation of activities for vocabulary development.

Students from the third section of the high school level had such a hard time answering the vocabulary reviewed without the context. This was due to their lack of attention to listen to the clues given. Most students responded using their background knowledge coupled by the rendition of choral responses. Silence was only prevalent after the reading of the context. Confusion also occurred among the boys who were not behaving as the teacher wished. Most used the native language in talking and delivering their answers and laughter was dominant as a sign of mockery after a student recited. They laughed every time the video camera was focused on somebody in the room. Non verbal reactions were also observed: frowning, smiles, blank reactions, and unnecessary movements. Most students from this section were inattentive.

These observations are based from the modified pattern of Moskowitz' (2006) behavior categories of language students. Generally, students displayed positive attitude towards vocabulary development. They were able to use the words they learned during the making of the application letter. Words like *sonorous*, *intermittent*, *awry* and *grumpy* at were utilized in the making of the application letter. Most of them were able to come up with sentences during the recitation with the use of the vocabulary words introduced like *gird*, *whim*, and *accolade*. Words unlocked at the start of the lesson were also successfully used when they were asked to have an information transfer activity that is to fill in the blanks in the application letter and during the making of an interview. The word *sonorous*, and *succulent* to fill in the blanks in the application letter. During the interview, the same words were also used.

## 5. CONCLUSIONS

The following conclusions were drawn based from the findings of the study:

The development of vocabulary skills should be done in any part of the lesson whenever necessary. Words which will be introduced should be truly new words, not those that are already part of the students' vocabulary.

The teaching technique employed towards vocabulary development was limited to one technique. This was the use of context clues. Varied teaching techniques should have been utilized for more student participation during the unlocking of terms which would cater for more vocabulary retention. Though the vocabulary words presented were not really difficult, students had quite a hard time recalling the word-meaning discussed from the previous session. The vocabulary words which were introduced should have been more difficult, something new and challenging to stimulate students' thinking and to expand vocabulary and to promote communication.

Unlocking of words through context is of no question especially in eliciting responses from the students. Most students enjoy guessing a word's meaning especially if a context is provided. For this reason, students from both high school and college levels were able to arrive at the exact meaning of the words unlocked. Yet, students should have been given more chances of working out meanings for themselves. The words' meaning should not have been provided on the board to serve as choices. Letting students discover meanings for themselves will make them more independent in defining the meanings of words rather than depending too much on context. This led them to have lesser vocabulary retention although the vocabulary words introduced were too easy.

Students' negative reaction manifested by teasing and mockery towards their classmates who are reciting deeply affected the others. This could hinder vocabulary growth. Patterns were provided on the board for students to come up with desired sentences. Words introduced were too easy. Students obviously found the activities too easy also. Not much vocabulary development was shown by the students. The activities provided were not that meaningful enough to promote vocabulary retention for the researcher to know that vocabulary development was going on. Students were not much involved for a sporadic giving of sentences were done by them. Patterns were on the board. All they had to do was choose to come up with sentences by choosing from the patterns. Spontaneous ideas did not emerge from them for they were always provided with patterns to follow and choices to choose from. The teacher should have given more activities to ensure vocabulary retention through application, such as contexts for using the new words. Vocabulary development was usually done at the start of the lesson. Discovery and contextual clues were utilized as techniques by the teacher in introducing new words. There was vocabulary development during the information transfer activity and the making of an application letter. Words that the students learned were used in the said activities appropriately. There were only two instances in which vocabulary was developed at the middle of the discussion.

## 6. RECOMMENDATIONS

From the written results of the student in the findings and conclusions, the following concepts are recommended.

Development of vocabulary skills should not only be done at the start of the lesson. It should be done whenever there is a need for the benefit of the students.

Words which are initially acquired by the students can possibly be forgotten if not adequately reinforced. This was observed in both secondary and tertiary levels. During the lesson reviews, students showed that the vocabularies they already knew previously were not retained. Hence, teachers must be very careful in choosing suitable techniques that would really ensure definite vocabulary growth and retention. After all, the teachers are not only after the number of words acquired but the competence to use the words functionally. Acquiring new words would mean trivial if not fully understood and retained.

A seminar-workshop on teaching techniques towards vocabulary development must be offered to English teachers. This will help them realize that there is a need to present meaningful; activities for vocabulary development. Teachers must be reoriented on the current trend to develop vocabulary skills of students. They must adapt a communicative way of developing students' vocabulary skill. The activities they should present must be meaningful and really involve the students to facilitate vocabulary development and retention.

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# EXPLORING EMERGING MENTORING PRACTICES IN NEW ECOSYSTEMS OF LEARNING IN FINLAND

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**ABSTRACT**

In this paper we examine the kinds of mentoring models and practices employed in Finnish higher education and working-life to support continuous skill development, focusing especially on the working-life-centric digital mentoring of students. The theme interviews at 11 HE institutions and four enterprises were conducted as part of an eAMK project. The results show that classical and new implementations are employed in mentoring in HE and the workplace. While traditional pair mentoring continues to be the most widely used mentoring model, group and cross mentoring are increasingly utilised. Likewise, an agile combination of different mentoring models is identified as a feature of emerging mentoring practices. Digitalisation is increasingly part of the examined mentoring implementations and in HE especially trials are carried out to develop digital mentoring. Emerging learning ecosystems call for mentoring that is agile, adaptable and digitally accessible. We also examine the viable features and development needs of the presented mentoring models, especially from the perspective of digital devices.

**KEYWORDS**

Digital Mentoring, Mentoring Models, Mentoring Practices, Higher Education, Working Life, Theme Interview

## 1. INTRODUCTION

Centuries old mentoring has recently risen strongly in Finland as a vehicle for developing performance. Concurrently mentoring – and other education methods – seeks new forms as working-life and ways of working are changing. Challenges to mentoring set by rapid changes to work and the creation of new occupations must be articulated. In this state of change, we strive to update learning and expert thinking (Hakkarainen et al, 2004) on the one hand, and on the other meet the challenges and derive the maximum benefit from the affordances created by digitalisation (see Owen, 2015). Updating mentoring for the digital age is ever more rigorously founded on a constructivist dialogue (Crow & Grogan, 2017), in which competence is built and professional development promoted by acting together and crossing borders between HE and working-life. The relationship between digitalisation and mentoring especially arouses a researcher's interest. How is mentoring configured and updated to respond to structural changes in society and digitalisation? There is cause for a specifically proactive setting of this question: How can the affordances of digitalisation be utilised in mentoring? What methods support skill development as required in continuous and lifelong learning? What might the new spaces of mentoring be like?

When digitalisation changes working-life and through this skill needs, it should be seen concretely in mentoring solutions. The need to research new mentoring methods is obvious (Irby et al, 2017). In this article we examine as part of a working-life-centric learning ecosystem theme the mentoring perspectives in digital learning and operational environments raised in the Digital Mentoring of Students action in the Finnish universities of applied sciences' eAMK (means eUniversity of Applied Sciences) project. The initial survey in the project provides perspectives into the kinds of mentoring practices in use to support continuous skill development, especially in the working-life-centric digital mentoring of students. The examination links more broadly to an ecosystem thinking (see Kemmis & Heikkinen, 2012) which argues that new practices take on features from ambient practices. This sample-based research provides knowledge on one European country's approach to modern mentoring. How technology can be harnessed in a diverse implementation of mentoring and the modernisation of mentoring models for the digital age are extremely topical international issues. Comparable studies do not exist, which indicates the novelty value of this study.

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## 2. EMERGING MENTORING

Innovative, agile, lifelong learning models are called for in the Finnish higher education vision (Proposal for Finland 2030). The rapid rate of change in working-life requires learning to continue throughout an entire career. The emerging mentoring for this digital age offers practices that cross traditional boundaries and can be practised while still studying. Mentoring and coaching are, according to Kampylis, Punie and Devine (2015) identified as methods that guide towards continuous professional development in digital savvy educational organisations. Mentoring can be seen as one significant approach in the new ecosystems of learning, that is development environments in which dynamic cooperation is of benefit to all participants (students, educational organisation and working-life), and sharing of expertise and peer development are key (Boulton-Lewis, Pillay & Wills, 2006; Hakkarainen et al, 2004).

There appears to be a societal and social need for mentoring at the moment. Mentoring practices have also reached a decisive point. What kind of mentoring is required to respond to structural changes in society and the development needs of new skills? The following observations can be made when mentoring is examined from the ecological principles of ecosystems (see Kemmis & Heikkinen, 2012). Changes in working-life, digitalisation of education, ubiquitous learning and remote work lead to changes in mentoring as mentoring acquires characteristics from prevailing practices. Establishing a dynamic balance in learning ecosystems may mean that in order to retain its place, practices become more modern to align with challenges arising from the operational environment and changes in work methods. When one model – for example being in a specific physical location at the same time for a mentoring meeting – doesn't work, then another kind of model – a virtual meeting – starts to take life. Changes in mentoring approaches may also be evident in the resonance of mentoring models that support more social, group and peer mentoring rather than one long-term mentoring relationship or even in the building of one's own mentoring network (Leppisaari, 2017; Erickson, 2014).

Developments in learning and expert thinking have led to alternative models to the traditional dyad mentoring model, such as peer mentoring, mentoring groups and networks (Lunsford et al, 2017; Bierema, 2017). Peer mentoring is a typical practice produced by modern developmental mentoring that has increasingly gained ground as the significance of peer learning has strengthened in skill development. Peers mentor each other and increasingly a younger individual mentors someone older. The agile change of roles characteristic of peer mentoring is described in studies (McManus & Russell, 2007) as fluid expertise, in which an individual is as needed a learner, while at other moments s/he is an expert and is able to seamlessly move between these roles. Group mentoring, in which the wisdom and experience of many people is accessible, can be realised in multiple ways. For example Huizing (2012) analyses the models of group mentoring as follows: peer group mentoring, one-to-many mentoring, many-to-one mentoring and many-to-many mentoring. A group may have one or several mentors who represent, for example, different areas of expertise and/or the group may be based on mutual peer mentoring (see Bierema & Merriam, 2002; McManus & Russell, 2007). Belonging, interaction, networking, acting as a role model and psychosocial support are all emphasised in group and peer mentoring. Reverse mentoring, on the other hand, highlights collaboration in which a younger individual with less experience in their career is able to share expertise in specific areas of competence (Murphy, 2012), e.g. digital skills. Cross mentoring refers to mentoring between several organisations (Clutterbuck, 2017). The term is also applied to mentoring between different educational or business fields, or inter-cultural, inter-generational or inter-gender mentoring (Clutterbuck et al, 2017). Network mentoring in this context means that an actor creates a mentoring network for him/herself – either independently or within a specific existing network (e.g. alumni of one's school). Faculty members may through their cooperation with others also assemble for themselves a network consisting of several mentors (Lundsford et al, 2017). The issue is the ability to build diverse relationships that facilitate the development of skills.

The mentoring process can be expanded through the use of digital tools to form virtual mentoring groups and communities. In this case, mentoring is not bilateral interaction, but rather a multilateral learning process with the objective of skill development (knowledge and ability), problem solving, and commitment to working together (cf. Lewis & Allan, 2005). In summary, mentoring is developing in a non-hierarchical, social and comprehensive direction (Bierema & Merriam, 2002; Parsloe & Leedham, 2009) and new lighter deliveries of mentoring are being created, such as flash mentoring (Grindrod, 2016).

# 3. DIGITAL MENTORING IN THE EAMK PROJECT

In the Finnish universities of applied sciences (UAS) and one scientific university's joint New Ecosystems of Learning – eAMK project (http://www.eamk.fi/en/frontpage/), UAS experts, students and stakeholders combine their strengths and update practice and learning. One action in the construction of working-life-centric learning ecosystems is the development of digital mentoring practices on the student - working-life interface. Digital mentoring in this context refers to mentoring in learning and operational environments that are becoming more digitalised. In the examined project, digital mentoring (equivalent to e-mentoring) is defined as cooperation between two or more people in which all participants desire to develop in a common area of interest (e.g. working-life readiness) and share expertise utilising digital methods and tools in their mutual interaction. The mentor of an undergraduate may be a postgraduate student, alumni or working-life representative. Diverse models of mentoring are utilised, such as group and peer mentoring and cross mentoring in which participants come from different HE institutions, organisations and fields (eAMK-glossary). This definition includes group and peer mentoring and learning in which partnerships, interaction and cross-fertilisation are emphasised. The focus of interest in the project is especially how learning on the student – working-life interface can be deepened with digital methods.

# 4. RESEARCH STUDY

In this article the mentoring landscape in increasingly digital learning and operational environments is examined from the basis of a Finnish research sample. The research task was to ascertain what digital mentoring practices are used in HE and working-life. The qualitative research sample illustrates as cases the digital mentoring practices of the target groups. An overall picture of the digital mentoring field and its good practices and development needs was gained through the research interviews conducted in autumn 2017 and early 2018. Networking of mentoring practitioners and researchers was also facilitated. The research questions examined in this article are: 1) What kinds of mentoring models/types are used in HE and working-life? 2) What kinds of mentoring practices are used in HE and working-life? 3) What kinds of good practice and development needs are identified?

The research data (N=15) comprises the interviews of 11 HE representatives, that is of 10 UASs and one university (data codes further as HEI1-11, Higher Education Institution) and the interviews of four national or global large-scale businesses (data codes further C1–4 Company). Altogether 23 people were interviewed as five of the 15 interviews were conducted as group interviews with 2–3 participants. The interviewees were found by surveying the digital mentoring contact persons of the HEI through the eAMK project's electronic platform (yammer) and through the personal connections of the digital mentoring development researcher. The large-scale business representatives were drawn from contacts on the EMCC (European Mentoring and Coaching Council) Finland's board. Interviewees from HEIs were senior lecturers, principal lecturers or project workers and from the companies they were HR managers. The interviewees were therefore mentoring experts in their organisations and were selected because of the knowledge they were thought to possess on the phenomenon under examination (Alastalo et al, 2017; Flick, 2006). The difficulty of an unequivocal definition of mentoring and its related concepts is acknowledged, and it must be noted that this examination includes approaches that the interviewees have understood as mentoring.

The investigation was conducted as theme interviews, supplemented as needed with documents and research provided by the interviewees. These were semi-structured interviews / focused interviews (see Flick, 2006), discussions which progressed according to an interview framework prepared by the researcher. In this way the researcher does not lock in exact interview questions but rather defines the central themes to be discussed in the interview. The themes took shape through the researcher's earlier e-mentoring studies and research literature on the themes. The content explored mentoring models, implementation, links with working-life, and the use of digital tools in mentoring. Additionally, the interviewees' ideas on what added value and the affordances digitalisation bring to mentoring were ascertained. This question is explored separately in another article. In this article the research perspective is limited to mentoring models and practices. Of the approximately hour long theme interviews, 10 were conducted using the Skype for Business application (video/audio connection) and 5 as contact meetings. The interviewees were well used to video conferences, which made video technology a natural tool in expert interviews (see Alastalo et al, 2017).

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The interviews were saved directly in an electronic form and transliterated word-to-word. The data was analysed and categorised according to interview themes, concurrently engaging in dialogue between the literature and earlier research.

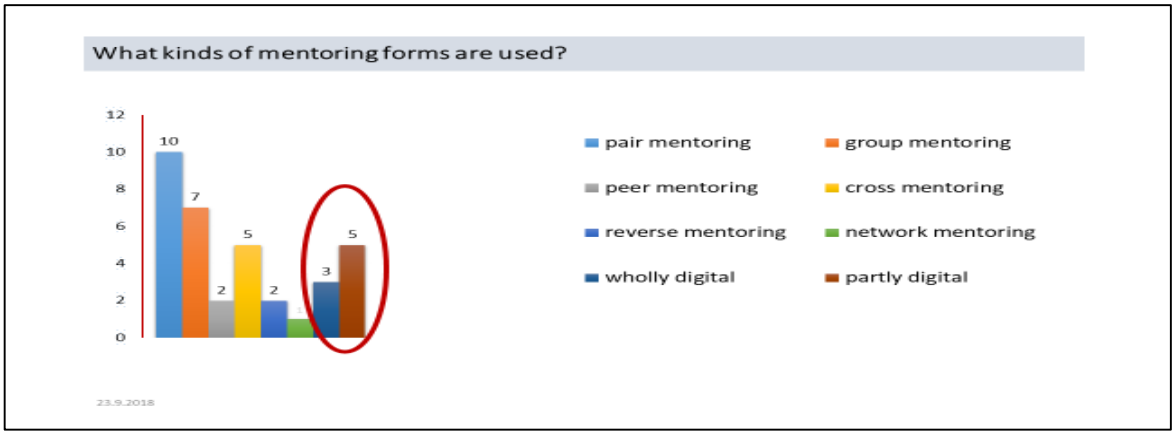
# 5. RESULTS

## 5.1 Mentoring Models

The interviews ascertained the kinds of mentoring models used in HE and working-life. This enabled categorisation of the models as well as ascertaining the role of technology and how it is used in an increasingly digital society.

Finding a common understanding of mentoring as a phenomenon in the interview context was part of the categorisation of mentoring models. In several cases the interviewee expressed uncertainty as to how well his/her case matched the definition of mentoring used in the eAMK project (see chapter 3 above). In the HE context there was reflection on, for example, did mentoring need to be a contract-based sustained long-term interaction or can it be short-term activity on some course? In the business context, mentoring was, at its broadest definition, defined in various terms as learning. One working-life representative described changes in mentoring evident as greater peer and reverse mentoring as follows: ”The relationship doesn’t need to be like from father to son, but it can be as from colleague to colleague, and it could even be like from me the child to you ´my father´” (C3). While difficulties in defining mentoring and its related concepts (e.g. coaching) were recognised, achieving the desired benefits and outcomes from the activity was more important than what terms are used.

Table 1. What kinds of Mentoring Models are used in HE and Working-Life?




As can be seen from Table 1, pair mentoring was the most used mentoring model in HE and working-life (N=10). Group mentoring (N=7) was the second most commonly used model, followed by cross mentoring (N=5). The mentoring models described in Table 1 are not mutually exclusive; rather the practices examined below in this chapter may, for example, combine pair mentoring with a completely digital interaction, or group mentoring and partial digital interaction. Several models of mentoring may exist in a model, often for example peer mentoring implemented in groups.

Digitalisation often permeates the basic models of mentoring and is an integrated dimension. It is present in an agreed way or – as became evident in some companies – is self-evident in the interaction. An example of an entirely virtually implemented mentoring programme in the research data is the global company. In half of the cases, digitalisation was present in the interaction in some way – as more than just email communication. Perceptions on the significance and added value of digitalisation naturally depend on whether the company is a domestic one operating in one location or a global company operating in over fifty countries.

It is noticeable that companies connected mentoring more often with pair work while coaching programmes were implemented in a group context. However, one company acknowledged that group mentoring entered the

picture when for example two mentoring dyads perform tasks together within the mentoring programme. One enterprise implemented reverse mentoring in specific programmes in which they wished to show that mentoring can also work the other way round. It was also evident that many companies had as a guiding principle in their mentoring contracts that the issues dealt with benefit both parties, even though mentoring was based on the actor's needs.

In cross mentoring, for example, a teacher can find him/herself a mentor from working life. In one case a cooperation agreement between a UAS, the city and hospital district facilitated mentoring that crossed organisational boundaries. In student mentoring, cross mentoring may mean that the actor/actors and mentor/mentors are from different fields, in which case pair or group mentoring is cross-sector, as in the eGroup mentoring operational model (see 5.2.2). In a business context cross mentoring is limited by competition legislation barriers which restrict the range of topics that can be discussed.

Various models of mentoring were diversely employed by HE and working-life. Classical pair mentoring continues to be the most used mentoring model, but group and cross mentoring models are gaining popularity. The combination of different mentoring types was seen as the future: "…start as e.g. pairs, but then there are devices that also enable peer activity. This doesn't necessarily become a separate mentoring programme, peer mentoring or group mentoring versions, but is rather a kind of extensive entity, and … is made possible by digitalisation" (HEI6). New light mentoring initiatives are also being created. An emerging mentoring model is flash mentoring (see Grindrod, 2016), referred to by one company representative: "Whatsapp and these types of private group messaging apps are really good, as you get a quick response to a direct question" (C3). In an acute situation, digitalisation allows for the support of a peer or more experienced expert in the network.

## 5.2 Practices in Mentoring

The practices (operational models) employed in the implementation of mentoring at HE and in working-life were surveyed in the interviews. The interviewees were asked to describe their practice of mentoring or their mentoring programme. Sub-questions included: Who are the mentors, who are the actors? What kind of orientation do they receive to mentoring? How is mentoring implemented in practice? How is mentoring activity evaluated? Is internationalisation included in the activity? We endeavoured to identify similar kinds of operational models in the qualitative analysis of the data. This analysis is summarised and illustrated with examples below. Eight different mentoring practices arose from the data. The first five (5.2.1 – 5.3.5) correlate directly with the eAMK project's digital mentoring action of working-life-centric student mentoring, a topic of particular interest, and the final three (5.2.6 – 5.2.8) have an indirect link.

### 5.2.1 Digital Mentoring Integrated in a Course

The first practice to emerge from the interview data was one in which digital mentoring is integrated into a specific course (HEI2, HEI5, HEI10). In one example of this (HEI2), a working-life representative acted as a coach on an e-course (cMOOC) related to the occupational field. The representatives were responsible for, e.g. two small groups. Digital tools employed in this case included: Moodlerooms as a "home base", Padlet and Youtube in learning tasks and Collaborate Ultra in interaction.

In the second case (HEI10) senior students ("the second years") acted as mentors for junior students ("the first years"). Cooperation was implemented in pairs and in groups. Digitalisation was utilised diversely. Students selected digital tools appropriate for their interaction, joint writing tasks and individual reflections (blogs). In certain learning tasks (e.g. production of video interview material), mentors were in contact with alumni around the globe. In this model, students are first actors and then the following year they are mentors. Students themselves plan the process with its functional activities and when acting as mentors they can utilise the experience they gained the previous year. They therefore also act as developers of the operational model.

The third case (HEI5) in which digital mentoring was integrated into a course is the cross-sector course which made use of coaching. Postgraduate social sciences, international cooperation and technical engineering students coached each other and collaboratively developed intelligent solutions for Finland's current social services and healthcare reforms. Social sciences postgraduate students contributed innovations from working-life and these were peer developed with technology students and international partners on the principle that the innovations that best meet future megatrends are created on interfaces.

### 5.2.2 Digital Mentoring as a Course

The second model that arose from the examination of digital mentoring practices is digital mentoring as an individual course (HEI1, HEI5, HEI4). An example of this (HEI1, HEI5) is the collaborative delivery of eMentoring training by three UASs. An elective course for degree programmes was created in an ESF funded project and this educational collaboration continues even though the project has ended. In this model students execute a new kind of mentoring as part of their studies. Postgraduate students (eMentors) and/or alumni mentor undergraduates (eActors). For eMentors the course scope is 5 credits and for eActors 3 credits. The course is 8 months in duration and consists of real-time educational contexts, web-mediated work and mentoring practice. Mentoring is implemented as cross-sector eGroup mentoring and design-based research methods are applied to continuously refine the model further. A diverse trialling of digital tools is a key part of the model: mentor-actor groups choose their own tools for interaction, for collaborative work on documents and instant messaging. Moodle and the Skype for Business video conferencing system are employed in the training. By autumn 2018, 48 eMentors and 43 eActors had completed the course. Another course implementation in the data (HEI4) is the Mentoring and Student Counselling course (5 credits) offered to students in the final stages of a healthcare programme.

### 5.2.3 Mentoring Integrated into Education as a Pedagogic Solution

The third working-life-centric student mentoring practice that emerged from the interview data (HEI4, HEI7) is the integration of mentoring into an entire education programme – more extensively than just one single course – as a pedagogic solution. In the example case (HEI4), students are assigned their own mentor in a satellite education. The students are all in working-life, and working-life needs inform the content of education. This needs-informed model aims to strengthen adult learners' professional performance. The mentor and student draw up a mentoring agreement according to which mentoring discussions are engaged in at least twice during an academic year. The student reflects on his/her learning through writing, video or podcasts in his/her own personal learning environment (blog), where the mentor also gives feedback on the student's learning. This ensures the close involvement of a working-life representative in the student's PLE (Personal Learning Environment). In this practice mentors receive training for their task in a mentor coaching programme. Essential to the mentor's performance are an ability to evaluate knowledge and skills, and an ability to give feedback and guide the student's reflection.

A second case (HEI7) in which mentoring is integrated as a pedagogic solution is the Enterprise Accelerator model. This model has been developed and delivered at a UAS for 20 years and covers the areas of developing a business idea, working as an entrepreneur, and developing a business. A student in the Enterprise Accelerator is assigned his/her own accelerator mentor, who may be a teacher with a business. The operational model is linked to all degree programmes.

### 5.2.4 Project-based Mentoring Programmes for HE Students

The fourth model to emerge from the interview data was project-based mentoring programmes for HE students. An example of this practice (HEI6) is firstly one UAS's partnership with a Chamber of Commerce in delivering a mentoring programme. Thirty mentor-actor pairs participated in the first implementation of this programme with 14 pairs in the second. Mentors were managers or leadership level staff from the Chamber of Commerce's member companies. Actors were provided an opportunity to network with the mentors and leverage the latter's supervisory and leadership experience. Mentors and actors apply for the programme and a selection group from the Chamber of Commerce's work and education committee match pairs. The mentors and actors are often from different fields and this cross-sector dimension enables reciprocal challenging and sparring. The one year programme begins with coaching of mentors and includes one interim meeting. At the time of the interviews, the actors' participation had not been assigned any credit point value, but in future the programme will be linked to the final stages of Professional Growth studies.

The second case (HEI11) in project-based HE student mentoring programmes was the use of alumni as mentors in career guidance. Mentoring is executed in pairs in this model. Mentors were sought "by hand" to meet the actors' specific needs in mapping a career path. Student interviews played an important role in the recruitment of actors. One hundred mentor pairs participated in the three year programme which includes orientation and closing events; otherwise the pairs engage in self-directed work, meeting 4-8 times during the year. Mentoring is an elective course (max. 2 credits) in the final stages of studies. The learning process is verified through the students' learning journals. The school has deliberately decided on face-to-face meetings,

unless exceptional situations, such as a mentor's move abroad during the process, prevent this. Digital elements can, however, be included in the process, as each mentor pair has the freedom to choose how they work and which tools of communication they use.

### 5.2.5 Alumni Mentoring in a New Way

A model, still in the development stages at a HEI, representing new mentoring practices is alumni mentoring to foster career guidance through career narratives (HEI9). Mentoring is deliberately "turned upside down" and instead of previous mentoring programmes with a credit scope a new lighter operational model in which alumni share their career narratives on an electronic platform is developed. The HE representative justified the development of the model by explaining that students resonate with different career alternatives. The student listens to the narratives and chooses who s/he wants as a mentor and may, if s/he so wishes, contact several individuals. This provides the student an opportunity to form a mentor network to meet his/her needs, rather than identifying one "perfect" mentor (see Erickson, 2014). The school in question has an extensive and robust alumni register system which creates the right infrastructure for the trialling of this new kind of practice. Networking and a sharing of career narratives as a form of coaching is considered a more agile practice than the pair formation previously conducted by the school. A digital platform appropriate for career narrative "shopping" has yet to be found. The aim of the development work is to support cross-sector collision of students which allows them to think and see "out of the box". This is a non-credit model based on voluntary participation of both parties, which is considered to strengthen commitment to the activity. If a student wants credits for the programme, a means of verifying learning is customised with the student. Opportunities for a mentor to meet other mentors are created in the programme, for example in events and a common digital platform.

### 5.2.6 Digital Mentors Developing Staff Digital Skills

Digital mentoring of staff to develop digital skills indirectly impacts student mentoring and is a timely practice in Finnish higher education (HEI1, HEI4, HEI5, HEI8, HEI10). Digital mentors are staff members who support their colleagues in the uptake of digital devices in teaching. In this context digitalisation is the target of mentoring that is it is the content to be learned, while in our research digitalisation is primarily a tool in working-life-centric mentoring of students. Digital mentors mentor other teachers in the use of digital devices; this activity is also seen as peer mentoring. For example, an entire department may be supported in this way. Mentoring related to the development of staff performance may also include orientation of a new teacher or pair mentoring between colleagues to develop teaching practice or a specific course. The nature of teaching is increasingly perceived as mentoring or coaching (see Kampylis et al, 2015). Teachers act as coaches in, for example, learning projects in which first-year students are "thrown" into working-life. The use of mentors in staff development also provides teachers with models for their own work.

### 5.2.7 Develop and Produce Mentoring Services for Working-Life

Over half the interviewed HEIs and two of the companies develop and produce mentoring services for working-life. This occurs in RDI education development projects in which HE teachers or project workers develop working-life. The integration of theory and practice concurrently benefits HE instruction. One UAS implemented a peer mentoring project (which also included cross mentoring and digital mentoring) to support encounter and workplace wellbeing of professionals in a small-scale workplace. In this case, the role of the HE project worker was to provide, using a partner approach, technical support for the mentoring process and the partner in turn provided content facilitator support. In one case, peer mentoring between micro-businesses and large-scale businesses was implemented in workshops in which HE teachers facilitated the process and students contributed the latest knowledge in their area of study.

Mentoring training with various content and targets is sold to workplaces: e.g. coaching for a hospital district, or business successors, or supervisor coaching for city leaders. One HEI offers as paid continuing education mentor training for employed healthcare professionals who provide guidance to UAS healthcare students. The healthcare professionals already have training in supervising students on their practicum. Companies may also have a mentoring programme targeted at external groups, e.g. young female students, as part of their corporate social responsibility and voluntary schemes.

### 5.2.8 Virtual Mentoring Programme for Company Staff

The eighth operational model (C1, C2, C3) to emerge from the interviews is a virtual mentoring programme for staff in a company. All the interviewed companies engage in some model of mentoring: as part of leadership development or global mentoring programmes, integrated into a talent programme, or pair mentoring offered in career development discussions as one alternative to achieve set goals. The aim is also to develop mentoring programmes open to all employees.

When a global enterprise operates in about 30 countries, mentoring naturally has to be organised as a virtual mentoring programme. In-company mentoring in companies operating internationally can be organised between different lines of business/units. In one case company, at any given time 130–150 pairs participate in a mentoring programme, in which pair formation deliberately supports diverse competence as a working-life meta-skill through the formation of ”as disparate pairs as possible” (C2). Pair formation in a mentoring programme can also support inter-cultural skills. Mentoring programmes in companies are usually about half a year comprising 6–9 meetings or they can be shorter, for example 3–6 months. Meetings are arranged through applications and software (e.g. Skype for Business or WebEx) in everyday use and therefore already familiar to participants. One company with mentoring as part of the normal work process (cf. discrete mentoring programmes) has a material bank in its Intra containing explanations of the process, disseminated materials, descriptions of the roles and responsibilities of mentors and actors and confidentiality issues. The typical structure of a mentoring programme includes an initial orientation/info session, possible interim meeting(s) and a closing/feedback meeting. The mentoring programmes of the companies interviewed are based on pair mentoring, but during the interview the interviewees identified peer, reverse and group mentoring dimensions. One company considered that mentoring also built the organisation’s internal support network in problem solving, as ”there is always someone in a big company who knows what should be done” (C3).

Some of the mentoring models and approaches described in this chapter are based on an expert-novice model; in others elements of community and peer learning as well as shared expertise more strongly underpin practice. The practices fit along a continuum. The following models can be identified as the continuum’s extremes in a HE context: a) an experienced mentor guides a soon-to-graduate student, b) the group comprises people at different stages of expertise from different fields and the mentor’s and actor’s roles change seamlessly in the process. Also typical is that the operational model has features from several mentoring models, even though one specific solution might be the so-called main solution. Cooperation and interaction models which include student participation and diversely benefit the various parties (university, UAS, micro-businesses, large-scale enterprises) emerge as especially interesting in an examination of mentoring as part of a working-life-centric learning ecosystem. The cases also indicate that digital mentoring as an operational model expands learning networks in an international direction.

## 5.3 Emerging Mentoring – Viable Practices and Challenges for Development

### 5.3.1 What Works in our Practice

The strengths and development challenges of the employed mentoring practices were diversely and reflectively considered in the interviews. Identified strengths included learning partnerships between HE and working-life, support in the development of professional expertise, and a joint development of working-life practices. A “robust and direct connection” (HEI11) to working-life, to quote one interviewee, was evident in the HE models. In practice this connection was formed by, for example, postgraduate students already in the workplace or alumni mentoring undergraduates. In one HEI’s three-stage mentoring model (see chapter 5.2.1) alumni are the student mentors’ learning resource. A connection with working-life is also created when a working-life representative acts as a mentor in workplace commissioned learning projects. In the above case of alumni mentoring (see 5.2.5), UAS students need to engage in self-directed networking with working-life.

Mentoring was considered a viable means to develop performance. One company representative described mentoring as a skill development model that is light, scalable for different contexts and easy to implement as compared to other educational type solutions. Concurrently self-direction and taking responsibility is realised so that there is no “spoon feeding of ready packaged issues into people’s mouths” (C2). Another company representative summarised the significance of mentoring as follows: “I strongly believe in this mentoring, it is like one of the stronger tools to develop individuals and organisations, in leadership and also in these hard professional skills” (C3). The interviewees all perceived that the mentoring models they described supported

learning of meta-skills (e.g. problem solving skills, self-direction and self-regulation, interaction skills, teamwork skills, cf. Binkley et al, 2012). Networking as an advantage and strength of mentoring was specifically raised by HEIs. In this data, mentoring programmes in companies were in-house.

Students often participate in the development of mentoring models in HE. For example, they plan the mentoring process group-specifically or are involved in the development of new kinds of digital mentoring implementations. In a few cases the opportunity to build a mentor's career path was identified as a good practice. Also, students who are first actors have experience-based knowledge on how to develop the model when they work as mentors. Constructing the process allows students to define the level of challenge and strive towards exceeding their own learning while simultaneously linking theoretical knowledge as a mentor to reflection on learning. Open spaces and complex processes as authentic tasks (see Herrington, Reeves & Oliver, 2010), for which participants gather research knowledge, teach, according to the interviewed HE teachers, working life skills more effectively than ready-made models.

Both HE and companies felt that it was a considerable advantage if the operational model provided a genuine opportunity to learn encountering on the internet, engage in dialogue and build trust. Company representatives raised investing in encounters that build trust in a digital operational environment at the start of the process as a good practice. One global company representative felt that contact meetings, however, increased trust much more than mere virtual contact:" (Digitalisation) is a good helper in a global environment, but does not rule out the need for some kind of face-to-face dimension." (C1) The online sessions of companies established connections between people in various visual ways, for example, by using images and lifelines. Good practices identified in virtual multicultural mentoring deliveries included the use of participatory digital tools other than those based on speech, e.g. writing on a whiteboard, mini survey or tick the box. The need to strengthen visual communication was recognized, as video and image mediated communication is universal digital communication which can transcend language barriers.

### 5.3.2 Areas of Development in our Practices

The practices described in the interviews also have development needs and ideas. Of the mentoring models, reverse mentoring is the one that is most felt to need developing: "The average age in our company is quite high, so it might do real good" (C2). HE representatives were also interested in cross mentoring as a focus of development. Mentor dyads could come from different schools: "It would in fact be great to have mentor dyads formed between different HEIs. In such a way that backgrounds are totally divergent…so that one really refutes the thinking that they haven't come from too similar a mould" (HEI9). Digitalisation was seen to afford good opportunities for cross mentoring.

The use of postgraduate students as mentors interested several HE representatives. The development of alumni mentoring was also raised as a development challenge. Alumni should be utilised more strongly in the final stages of study as student support, e.g. partner mentors within group mentoring. Development of alumni mentoring should also be informed by work experience needs: "…when students leave us for their practicum, alumni could take them under their wings and be a link between HE and graduation…you know about the school culture a little bit more than someone who has studied at another school" (HEI9).

HE and companies both considered the digital development of mentoring as a development need: a digital platform is needed to administrate mentoring activity and digital tools for the mentoring process. A viable, mobile-usable and diverse digital platform needs to be found for mentoring programmes. In a virtual environment, the accumulating documents are a basis for monitoring the development of the mentoring process with the affordances of learning analytics. One interviewee observed that mentoring programmes based on pair mentoring also needed "…a virtual platform for sharing experiences during the mentoring programme, tools that enable peer and group activity" (HEI6). Companies identified video conferencing as a basic tool of digital mentoring, as discussion is the primary activity in mentoring. Various solutions were found for the sharing of material and other functions. Tools used in other forms of communication were primarily employed in mentoring. According to one interviewee, mentoring programmes should support readiness to uptake new digital devices: "… they would be such that could also be utilised elsewhere…using a few of these and of course that they would inspire to trial and find something new and to try…as technology develops so rapidly that if you use a lot of time in learning something, in a year's time it is wasted time" (HEI1). On the other hand, interviewees who were seeking a specific mentoring tool/app indicated that there wasn't just a need for a bunch of tools, but rather the tools in question needed an in-built methodology based on mentoring research and good practices identified in this. Existing social media or learning environment-based solutions did not meet these needs, as they have not been built for mentoring spaces, but are often a collection of tools (material bank,

discussion forum, chat, blogs, etc.) that aim to share information and are not underpinned by a deeper understanding of mentoring as a phenomenon and interaction contexts.

One development need that emerged both in HE interviews but was especially raised in company interviews was the need for a real-time mentor bank/pool and its maintenance. A mentor bank would be an advantage for companies, as one representative describes: "Of course it would be really great if there was some kind of mentors-actors bank. Where you could just go and get and make contact and say, hey, you are in that bank and your profile seems to fit, so could we begin a partnership?" (C2) The need to create and match profiles could be met by the affordances of artificial intelligence (AI): "I dream about there being a robot who is able to make that pairing, that it just needs key words fed into" (C2). Digital methods could also be used to update profiles in real-time – a real-time list of alumni mentors available at the start of a mentoring programme.

Further areas that emerged as development needs were orientation to mentoring in digital operational environments and appropriate organisation of process support for busy professionals. The use of digital devices in shorter and lighter models was seen to require thorough orientation for interaction to support learning. It is noteworthy that digital mentoring does not only require mastery of digital tools, but above all the mastery of interaction in a digital environment, or a "dialogue leap", as one interviewee (HEI5) expressed it. How each device supports dialogue and what kinds of frameworks it creates for interaction needs to be explored further. How should technology develop for it to support a feeling of presence? The significance of video image in creating presence was emphasised in undivided attention in interaction. Interaction in digital mentoring also needs to be a focus in inter-cultural communication, as a mentoring process may be a learning experience that changes attitudes and even the participant's life if the participants can learn together how to overcome cultural clashes. A need for an open mentoring orientation material bank that teaches how to act as an actor and/or mentor online emerged in the interviews. Working in a digital world also raises ethical questions related to mentoring, guidelines for which the interviewees wanted general rubrics (cf. ethical guidelines of EMCC).

In several cases, monitoring and evaluation of the process as well as development research were raised as development challenges in mentoring. These need to be more deliberately integrated to the mentoring process. Many of the cases described in the interviews lacked an in-built systematic process evaluation of the mentoring programme. Feedback was collected at the end of the programme and in some cases also in interim meetings. One practitioner described that during the process, "above all else, how the relationship worked was monitored" (HEI6). In companies, post-monitoring of a mentoring programmes' impact might occur, for example, one year after participation. Emerging learning analytics may bring new tools for structuring and monitoring the mentoring process as well as examining the qualitative impact of mentoring. The in-process quality assurance challenges which emerged in the interviews will partially be met by the digital mentoring quality cards to be produced in the eAMK project.

## 6. REFLECTION AND CONCLUSIONS

Digital mentoring models and practices used in HE and companies were surveyed through theme interviews in an eAMK project. The examination particularly focused on working-life-centric student mentoring. We also endeavoured to outline how digital mentoring, and mentoring more broadly, is situated in the new ecosystem of learning (cf. Kemmis & Heikkinen, 2012) and how it presents as a pedagogic solution on the interface between HE and working-life. On the basis of the interview research results, it can first be stated that mentoring as a concept is understood broadly and defined context-specifically. Especially in the HE mentoring cases, features of mentoring and coaching were often combined (see Parsloe & Leedhamn, 2009). Both classical and new models of implementation are used in mentoring. Digitalisation is increasingly included in the examined mentoring deliveries and HEIs in particular engage in trials which aim to develop digital mentoring as separate social implementations. The increasing need to use digital devices in mentoring generated by a new generation of students and workers is acknowledged, resulting in more and more new mentoring models which combine different models and practices being trialled.

Work, learning and development will in the future form an even stronger indivisible entity. Ubiquitous learning with its decentralised learning spaces will strengthen (Heikkinen, 2017). Mentoring seems to situate into this new emerging ecosystem of learning well. Digitalisation enables the crossing of physical and organisational barriers and the construction of new kinds of social and cross-sector learning spaces on the interface between education and work. When best chosen, the needs of HE to develop new kinds of

working-life-centric pedagogic operational models and methods to develop professional development for increasingly digital operational environments meet the needs of working-life to create new skill development models. Companies identified a clear need to modernise skill development practices in such a way that it is possible to move from local implementations to wider operational environments. The slow rate of change in an organisation's operational culture, also in mentoring, was acknowledged by company representatives. This study did, however, indicate that alongside classical mentoring concepts, HE is engaged in innovative trials of new kinds of agile and also lighter mentoring models, listening to both students and working-life representatives. HE recognises that in the digital world there is a need for interactive skills in completely new arenas, and mentoring processes facilitate the learning of these skills. Do global large-scale companies have something to contribute to HE in this area, for example as experiences and accrued knowledge in the building of virtual relationships based on presence and trust? These kinds of needs and perspectives could lead to fruitful collaborative development among HE and working-life organisations. Learning spaces in which learning from each other is facilitated will be created in this current eAMK project through a joint development webinar.

The research results indicate that emerging ecosystems require mentoring in which digitalisation is embedded into the mentoring process. Participation in the mentoring process should be easy wherever one is through mobile mentoring, where mentoring travels "with you in your pocket". In the future, digitalisation will lose its significance as a prefix in mentoring and will inherently meld into the different practices of mentoring. The research data indicate that mentoring with its long tradition as a form of learning is agile and able to adapt according to current challenges and affordances of digitalisation. The modernisation process may result in new models and methods of mentoring applicable to today. The new practices in peer and group mentoring which take advantage of digital mentoring, and are therefore rapidly scalable, offer equitable ways to coach and support people. Likewise the flexible combination of different mentoring models appears to be a strengthening feature in emerging mentoring practices. Cross-sector participation can be meaningfully employed in mentoring. It efficiently fosters learning of working-life meta-skills. The newest models of mentoring support learning in networks and peer networks. A student creates for him/herself, for example, a mentoring network for flash mentoring rather than seeking one mentor who should be able to meet his/her different learning needs.

It is obvious that agile and customised mentoring type approaches occupy a central position in career-long professional development (cf. Proposal for Finland 2030). Therefore familiarisation with mentoring models and practices while still at school presents as a significant part of working-life skill accruement in HE. Student-centric mentoring implementations also support the career path of mentoring. At its best, a HE student can during his/her studies first be an actor and in later stages of studies a mentor. The result of this process is equipping the student with models that can be applied in career-long professional development.

The landscape opened up by this study challenges the various mentoring practitioner groups, developers and technology experts to a closer collaborative development of modern mentoring. Further research is needed to deepen knowledge on the use of technology in mentoring as well as for a comparison of digital mentoring practices of different countries and learning from each other.

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# CODECHUM: AN ONLINE LEARNING AND MONITORING PLATFORM FOR C PROGRAMMING

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**ABSTRACT**

Teaching an introductory programming course to an average of 40 students while monitoring their performance can be a challenge for instructors. Preparing coding exercises with test cases and checking students' programs can prove to be time consuming at times. Moreover, programming has been known to be quite difficult for students to learn. To address these concerns, a web-based Integrated Development Environment (IDE) for C Programming called CodeChum was developed. CodeChum provides instructors with an easier way of creating programming exercises, an automated way of checking student codes and a dashboard for monitoring students' performance. CodeChum allows students to apply their skills using problem stories attached to learning outcomes, test their solutions, get instant feedback and monitor their current status through a leaderboard system. CodeChum was tested within a span of two months on 120 undergraduate students taking up introductory programming courses and 6 programming instructors from Cebu Institute of Technology- University. A usability and feedback survey for students and instructors was conducted getting inputs of their experience while using the IDE. Results of the survey show that the system was well received both by students and instructors. Moreover, with the continued use of CodeChum, data can be gathered that can be used towards learning analytics.

**KEYWORDS**

Online Monitoring and Learning Software, Web-based Tool for Teacher Support, Student Assessment

## 1. INTRODUCTION

In this fast paced world of emerging technologies, it has become an undeniable fact that the Information Technology industry is already rapidly growing and does not intend to stop. Because of this, a lot of jobs in relation to the field have started to emerge and the demand for people with the necessary skill set in both hardware and software engineering is becoming significantly high. In fact, startups and big companies alike are looking for creative, innovative developers and software engineers to design and refine computer programs. According to the U.S. Bureau of Labor Statistics, there is an expected growth of more than 17% with regards to the demand for software engineers by 2022 – an increase far faster than average, giving a median salary of $102,280.00 (Lopaze, 2018). In the Philippines alone, IT related programs have emerged as one of the top 10 degree programs students took with 398,765 students enrolled, making it the fourth most popular career path for incoming college students in the Philippines (Enriquez, 2018). However, although the demand both by recruiters and aspiring professionals seem to be high, the problem with incompetent graduates still arise. A study done last 2017 showed that over 50% of college students under Information Technology courses in the Philippines deemed incompetent and lacked programming skills that could pass for international standards (Suarez, 2017). Another survey showed that an extensive amount of data on perceived difficulties were related to programming concepts and program construction (Ala-Mutka, et.al, 2005). With this in mind, a solution that could help programming instructors monitor a student's performance, an easier way to create programming exercises, automate checking for outcome based problems and monitor the student's performance relative to his/her peers through a web-based Integrated Development Environment (IDE) called CodeChum was developed. CodeChum would also allow students to better understand the applications of each problem relative to its learning outcome through producing problem stories that would stress the practical applications of the said outcome. In general, CodeChum aims to

provide an accessible IDE for C programming that aims to become a fun, interactive and challenging platform for novice student programmers and an easy monitoring and assessment tool to complement a programming instructor's teaching strategies. CodeChum was deployed within a span of two months in Cebu Institute of Technology- University and was used by 120 undergraduate students taking up introductory courses in programming and 6 programming instructors. A usability survey was conducted in order to assess the usefulness and value of the proposed IDE to its users.

## 2. LITERATURE REVIEW

Programming has been a relevant skill to learn as it can be applied in various fields. However, the learning curve for learning basic programming concepts seem to be high for most novice programmers. Drop out, unmotivated and high level retention of student's in the first year are problems that is imperative to solve (Costa & Piteira, 2012). A previous study last 2007 was conducted, with participating universities all over the world, in order to assess whether there is an alarmingly high failure rate for CS1 students (Bennedsen & Caspersen, 2007). Unfortunately, due to lack of participants it was hard to conclude with 33% that the failure rate was alarming enough. However, a follow up study was conducted revisiting the said matter in 2014 (Watson, & Li, 2014), and similarly it was proved to show a worldwide pass rate of 67.7% which did not necessarily increase over the years.

With that said, studies relating to the difficulties of novice programmers have been conducted in order to know why and in what aspect they find it difficult. A study conducted (Muraina & Rahman, 2014) revealed that practical classes and laboratory usage have significant contribution in improving a student's achievement in computer programming (Costa & Piteira, 2013, Muriana & Rahman, 2014). Another similar study (Lahtinen, et.al) suggests that the biggest problem of novice programmers does not seem to be the understanding of basic concepts but rather learning to apply those (Boudouvis, et.al, 2011, Mhashi & Alakeel, 2013). Also, another factor that may result to the difficulty in learning programming concepts is the gap between the understanding of the instructor and the students. The same study also suggested to construct different learning materials that could assess the student's program generation, modification and debugging skills.

Currently, programming instructors use traditional methods in evaluating a student's performance in class namely paper-and-pencil testing (PPT) and computer-based assessment (CBA) among others, with studies leaning more towards a successful skill assessment for novice programmers using the CBA method (Boudouvis, et.al, 2011, Nouri & Öqvist, 2018). A study conducted to assess a novice programmer's progress while using virtual appliances (Pardo, et.al, 2012) resulted in a significant correlation with student academic achievement while using online methods. Furthermore, it also validated the use of a prediction mechanism for further improvements (Pardo, et.al. 2012).

With the acceptance of computer-based assessment for novice programmers and the recommendation of laboratory activities and more advanced learning materials, CodeChum implements the following features that can both aide the students to better their performance and instructors in better assessing and monitoring a student's performance:

F1- automated checking for students' coding exercises

Common advantages of automation are the speed, availability, consistency and objectivity of assessment (Ala-Mutka, 2007). However, a disadvantage would be not being able to monitor the structure and design of a student's code. CodeChum addresses this problem through the ability to be able to revisit a student's code after every activity, which can be accessed by the programming instructor.

F2- creating problem stories to better understand programming concepts and their real-life applications

CodeChum would present different coding exercises as problem stories in order to support the study mentioned above and how it could possibly provide a real-life application for different programming concepts for the student's to better understand why they are taught certain concepts, which will potentially lead to an improved learning in introductory programming.

F3- leaderboard system to encourage additional personal motivation

CodeChum implements a leaderboard system in order for the students to access their performance and to know their current standing in class. The leaderboard system is accompanied by time-bound activities which can provide a game-like effect to students answering the activities (Tan, et.al, 2009). This is also beneficial for teachers in monitoring the performance of their students which can encourage further consultations and a more personal teaching style depending on the student.

F4- online IDE

CodeChum is presented as an online IDE for C programming which is accessible to students and teachers anytime, anywhere. This enables teachers to monitor their students right away, instead of using traditional or conventional IDEs like Dev-C++. This also places a student's learning data in one place which can be used for further learning analytics to improve the instructor's teaching style depending on the student.

# 3. METHODS

## 3.1 Development of the System

The system has been developed on the web platform. It is specifically made with a solid and well-known Python web framework, Django. For its database, it uses MySQL. The tool has two major parts:

I. Integrated Development Environment
II. Teacher's Panel

### 3.1.1 Integrated Development Environment

This is the part of the whole system where the student solves programming problems made by their teacher. Currently, it only supports the C programming language. Its appearance is somehow similar to existing competitive coding platforms online such as Hackerrank and Codefights. It basically has 5 major parts:

1. Problem Description - This shows the description of the problem (which was made by the teacher) currently solved.

2. Code Editor - This is where the student types his/her code. The programming language to be used is the programming language set by the teacher for this specific task. However, for this research, only the C programming language is supported.

3. Playground Input/Output – This is where the student can supply a sample input for his code and test run his code. When the student clicks the Run button, the value in the sample input field will be supplied to the student's code and the output of his/her code will show in the output section.

4. Test Cases – This is where the shown test cases for the problem are listed. When the code is submitted, these test cases will be executed to score the answer of the student.

5. Leaderboards – This shows the ranking of each student taking the same exercise after the allotted time is finished.

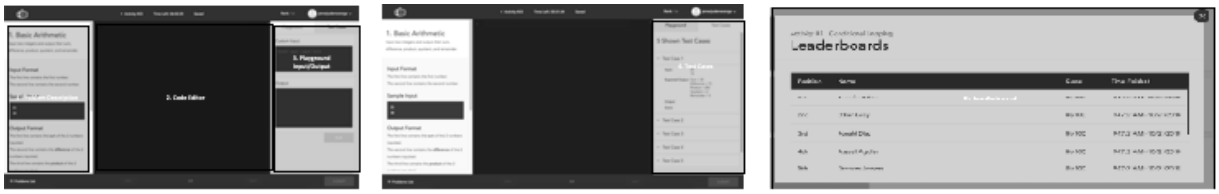


Figure 1. System's Integrated Development Environment

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### 3.1.2 Teacher's Panel

This is where the programming instructors monitor the status and performance of each of their students for each of their respective classes. The teacher's panel contains the features that are needed for teachers to interact with their students. It has 3 major sections:

1. Courses Section – In this section, the teacher can create a course at the start of the semester (see Figure 2). Furthermore, the teacher can view his/her courses and their corresponding details such as the number of tasks created, students enrolled, schedule, and etc. (see Figure 3).

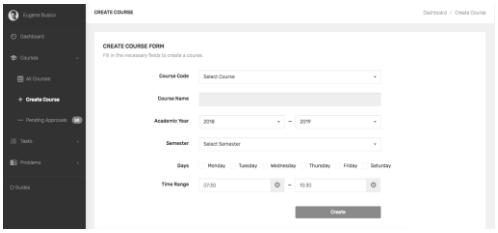


Figure 2. Create Course

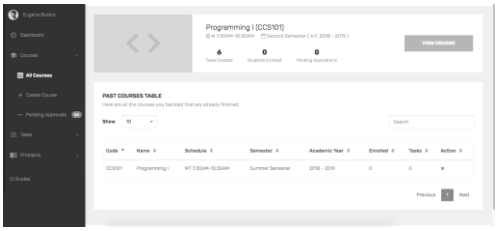


Figure 3. All Courses

2. Problems Section – In this section, the teacher can create programming problems that can be used in the tasks he/she creates (see Figure 4). In the creation of the problem, the teacher adds the details of the problem, the moderators of the problem, and the test cases of the problem, which will be used for the automatic checking feature. Also the teacher can view all the problems he/she has created (see Figure 5).

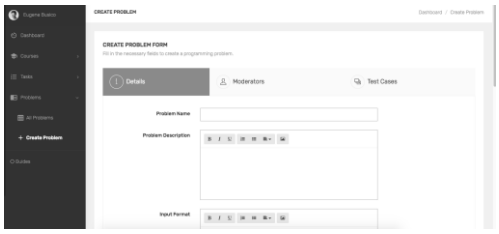


Figure 4. Create Problem

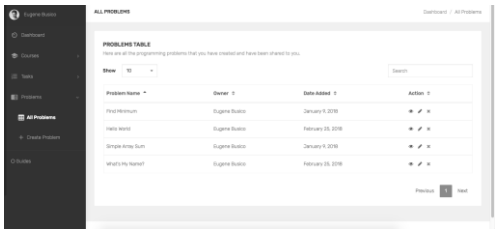


Figure 5. All Problems

3. Tasks Section – In this section, the teacher can create a task for a specific course he/she has. In doing so, the teacher needs to input the basic details of the task and then assign problems to it from the problem he/she has created or has been shared with (see Figure 6). The teacher can then view all the tasks he/she has created for all of his/her courses (see Figure 7).

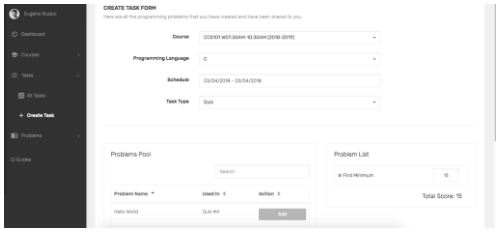


Figure 6. Create Task

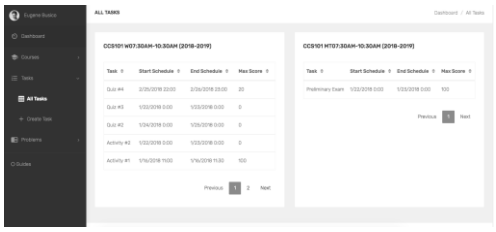


Figure 7. All Tasks

Then, the teacher can view all the details of a task. Aside from the main details of the task, the teacher can view the average actual scores of the students who answered the task along with their individual actual scores (see Figure 8).

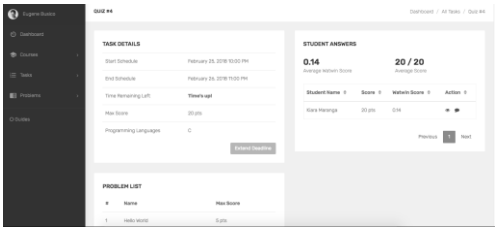

Figure 8. Single Task Details

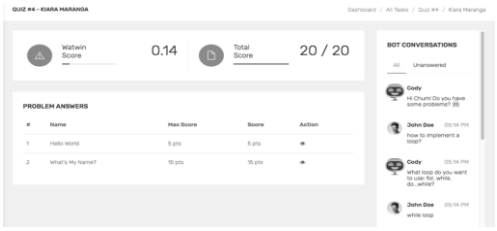

Figure 9. Monitor Student

The teacher can also monitor further his/her student (see Figure 9). In this page, the teacher can view the score of the student in each of the problems of the task. From here, the teacher can monitor further down his/her student by viewing how the student really answered the programming problem. This solves the problem that programming teachers are facing: all they know is if the student was able to answer or not, but do not know the details in between (see Figure 10).

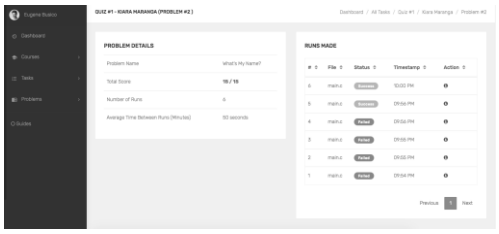

Figure 10. List of runs made by student

Figure 11. Specific details per run made by student

For each run the student made on that problem, the teacher can view the actual code of that run, the errors in that run, and the test cases status (see Figure 11).

## 3.2 Testing

The participants are 120 undergraduate students taking up introductory programming courses and 6 programming instructors from Cebu Institute of Technology- University. All of them were able to use CodeChum in the span of two months for their laboratory exercises. A total of 120 surveys for the students were returned with a response rate of 100%, and a total of 6 surveys for the programming instructors were returned. Two separate surveys were prepared in order to assess the usability of CodeChum for the students and the instructors. Tables 1 and 2 show the questions prepared for the students and the programming instructors respectively. The questions below were formulated in order to assess specific features and the scale of how the users would accept the system. Data will be presented by displaying the frequency of answers in percentage and average depending on the question type.

Table 1. Student Usability Survey Questions

| ***No.*** | ***Question*** | ***Question Type*** |
|---|---|---|
| 1 | Overall, how satisfied were you with CodeChum? | 4-point Likert Scale |
| 2 | How easy was CodeChum to use? | 4-point Likert Scale |
| 3 | Rate the problem stories based on its ability to explain the problem? | 4-point Likert Scale |
| 4 | Are the problem stories fun and interesting? | Yes / No |
| 5 | Would you recommend CodeChum as a way of testing and learning? | Yes / No |
| 6 | When answering activities in the lab, which of the following do you prefer to use | Multiple Choice (CodeChum / Dev-C++) |
| 7 | List down all the things you like about CodeChum. | Open-ended |
| 8 | List down all the things you dislike about CodeChum. | Open-ended |
| 9 | If you were the owner and developer of CodeChum, what would you do to improve it? | Open-ended |

Table 2. Instructor Usability Survey Questions

| *No.* | *Question* | *Question Type* |
|---|---|---|
| 1 | The software and its features are easily understandable. I did not find it hard to navigate through each page even though I am a beginner. | 4-point Likert Scale |
| 2 | I was able to create coding exercises for students easily. | 4-point Likert Scale |
| 3 | The existing database of questions available in CodeChum is aligned to the intended learning outcomes of the course. | 4-point Likert Scale |
| 4 | CodeChum made it faster for me to check and evaluate my student's coding exercises. | 4-point Likert Scale |
| 5 | I would prefer to use CodeChum over other C Programming IDEs because of its usability and accessibility. | 4-point Likert Scale |
| 6 | I will recommend my fellow instructors to use this online environment for monitoring their students. | 4-point Likert Scale |
| 7 | Before CodeChum, what did you use in assessing your student's performance? Please input all possible answers. | Open-ended |
| 8 | List down all the things you like about CodeChum. | Open-ended |
| 9 | List down all the things you dislike about CodeChum. | Open-ended |
| 10 | If you were the owner and developer of CodeChum, what would you do to improve it? | Open-ended |

For questions involving the 4-point Likert Scale question type, a response average will be computed for each using the formula show in Figure 12 where the sum of the frequency of the results *(f)* multiplied to their corresponding points *(p)* will be divided by the total number of responses *(n)* and will result to a response point ranging from 1-4. The proponents have chosen a threshold of 3.0 as an indicator for good performance.

$$AVERAGE = \frac{\sum f * p}{n}$$

Figure 12. Response Point Average Formula

## 4. RESULTS AND DISCUSSION

Tables 3-6 show the responses from 120 undergraduate students taking up introductory programming courses. As shown in Table 3, the data are presented as frequency percentages for the 4-point Likert scale. Responses for the Yes/No and multiple choice question types are shown in Table 4 and another separate table (see Table 5 and 6) shows the results for the open-ended question types from the same student usability and feedback survey.

Table 3. Responses: Student Usability and Feedback Q1-Q3

| *No.* | *Frequency of Responses* | | | | *Response Average* |
|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | |
| 1 | 2 | 7 | 36 | 75 | 3.53 |
| 2 | 2 | 14 | 40 | 64 | 3.38 |
| 3 | 2 | 11 | 56 | 51 | 3.30 |

For Q1, majority of the participants (62.5%) responded that they were *very satisfied* with CodeChum, with an average point of 3.53 out of 4 points. For Q2, 53.3% agreed that CodeChum was *very easy* to use with an average point of 3.38. For Q3, majority of the participants (46.7%) said that the problem stories were *fairly easy to understand* with an average point of 3.30.

Table 4. Responses: Student Usability and Feedback Q4-Q6

| *No.* | *Frequency of Responses* | | *Favorable Average* |
|---|---|---|---|
| | **YES** | **NO** | |
| 4 | 116 | 4 | 96.67% |
| 5 | 114 | 6 | 95.0% |
| | | | |
| | *Frequency of Responses* | | *Favorable Average* |
| | **CODECHUM** | **DEV-C++** | |
| 6 | 83 | 37 | 69.2% |

For Q4, majority of the participants (96.67%) found the problem stories fun and interesting to answer, leaving 3.3% thinking otherwise. For Q5, majority of the participants (95.0%) would highly recommend CodeChum as a way of assessing and learning introductory programming concepts, leaving 5% thinking otherwise. For Q6, 69.2% would prefer to use CodeChum for their laboratory activities, 30.8% would prefer to use Dev-C++.

Table 5. Top 5 Responses: Student Usability and Feedback Q7-Q8

| *No.* | *Q7: Good Points* | | *Q8: Bad Points* | |
|---|---|---|---|---|
| | **Description** | **Frequency** | **Description** | **Frequency** |
| 1 | User Interface | 43 | Slow Compilation Time | 18 |
| 2 | User Experience | 33 | None | 16 |
| 3 | Test Cases | 22 | Hidden Test Cases | 14 |
| 4 | Problem Stories | 22 | Codes in C++ Don't Work in CodeChum | 10 |
| 5 | Improves Critical Thinking | 14 | Internet Lag | 9 |
| 6 | Leaderboard Feature | 9 | Code Can't Be Revisited After Activity | 6 |
| 7 | Time-bounded Activities | 8 | Questions Are Too Hard | 5 |

For Q7 and Q8, the participants were asked to list down the good and bad points of CodeChum. Listed in Table 5 above shows items with a significant number 5 frequent responses and above. Other items suggested were not included as they didn't meet the said minimum number of frequent responses. Based on the aforementioned table, most of the participants felt the user interface and user experience, test cases and problem stories were good points of CodeChum. They also mentioned that the time-bounded activities which improve critical thinking and the leaderboard feature also make it more fun and challenging. However, majority of the participants also felt the need to improve on the slow compilation time among others, but a significant number of participants also felt that there were no bad points for CodeChum.

Table 6. Top 5 Responses: Student Usability and Feedback Q9

| *Q9: Improvement Points* | | |
|---|---|---|
| **No.** | **Description** | **Frequency** |
| 1 | None | 36 |
| 2 | Practice Exercises Outside the Course | 18 |
| 3 | Faster Compilation Time | 8 |
| 4 | Improved User Interface | 7 |
| 5 | Better Server Connection | 5 |

Similarly, for Q9, listed above (see Table 6) are the significant items which the participants felt were improvement points for CodeChum and although majority responded that they had nothing to suggest as improvements, a significant number of participants pointed out that more practice exercises outside recorded activities, and a faster compilation time among others could be seen as points for improvement for CodeChum.

Tables 7-10 shows the responses from 6 programming instructors from Cebu Institute of Technology- University. The participating programming instructors are the ones who facilitate the laboratory activities of the 120 undergraduate students participating in the testing as well. A ratio of 1:20 corresponds to the number of programming instructors to students under introductory programming courses. Data presented in Table 7 shows responses for questions 1-6.

Table 7. Responses: Instructor Usability and Feedback Q1-Q6

| ***No.*** | ***Frequency of Responses*** | | | | ***Response Average*** |
|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | |
| 1 | 0 | 0 | 1 | 5 | 3.83 |
| 2 | 0 | 2 | 2 | 1 | 2.8 |
| 3 | 0 | 0 | 1 | 5 | 3.83 |
| 4 | 0 | 0 | 1 | 5 | 3.83 |
| 5 | 0 | 1 | 1 | 4 | 3.5 |
| 6 | 0 | 0 | 1 | 5 | 3.83 |

For Q1, 83.3% of the participants strongly agreed that the system was easily navigable for beginners indicating its user-friendliness with an average point of 3.83. For Q2, majority of the 5 respondents (one did not choose to answer) found it *hard* to create coding exercises using of CodeChum, with an average point of 2.8. For Q3, majority of the participants (83.3%) *strongly agreed* that questions present in CodeChum's database is aligned to their current intended learning outcomes, with an average point of 3.83. For Q4, majority of the participants (83.3%) *strongly agreed* that CodeChum made it faster for them to check and evaluate their student's performance, with an average point of 3.83. For Q5, 66.7% of the participants would *highly prefer* to use CodeChum over other programming IDEs mainly because of its usability and accessibility. For Q6, 83.3% of the participants would *highly recommend* CodeChum to their fellow instructors as an online environment for learning and monitoring their students, with an average point of 3.83.

Table 8. Top 5 Responses: Instructor Usability and Feedback Q7

| ***Q7: Assessment Methods Before CodeChum*** | | |
|---|---|---|
| **No.** | **Description** | **Frequency** |
| 1 | Traditional | 1 |
| 2 | Offline Practical Exam | 2 |
| 3 | Dev-C++ | 3 |
| 4 | Manual Checking of Activities | 1 |

Based on the answers of the participants, their main method for assessing student performance with regards to their programming skills would be the traditional or conventional way with specifics on hands-on or practical exams, exams using Dev-C++ as the IDE and these exercises are then assessed using manual checking of activities, quizzes, seatworks and the like.

Table 9. Top 5 Responses: Instructor Usability and Feedback Q8-Q9

| *No.* | *Q8: Good Points* | | *Q9: Bad Points* | |
|---|---|---|---|---|
| | **Description** | **Frequency** | **Description** | **Frequency** |
| 1 | Automated Checking | 5 | None | 2 |
| 2 | Database of Exercises | 2 | Does not check algorithm logic | 2 |
| 3 | Student Performance Monitoring | 2 | Site Bugs and Crashes | 2 |
| 4 | UI/UX | 2 | | |
| 5 | Leaderboard System | 1 | | |

For Q8 and Q9, listed in Table 9 shows the good and bad points of CodeChum based on responses from the programming instructors. Based on the aforementioned table, most of the participants felt that the automated checking, database of exercises, student performance monitoring, the user interface of CodeChum, and the leaderboard system were its good points. However, majority of the participants also felt the need to improve on fixing the site bugs and crashes, as well as improving the checking system for exercises.

Table 10. Top 5 Responses: Instructor Usability and Feedback Q10

| *Q10: Improvement Points* | | |
|---|---|---|
| **No.** | **Description** | **Frequency** |
| 1 | Include Item Analysis | 1 |
| 2 | Implement Student Dashboard | 1 |
| 3 | Check Algorithm Logic for Exercises | 1 |
| 4 | Improve Scoring System | 2 |
| 5 | Fix site bugs and issues | 1 |
| 6 | Check for Cheating Anomalies | 1 |

Similarly, for Q9, listed above (see Table 10) are the significant items the participants felt were improvement points for CodeChum and although majority responded that they had nothing to suggest as improvements, a significant number of participants pointed out that more practice exercises outside recorded activities, and a faster compilation time among others could be seen as points for improvement for CodeChum.

## 5. CONCLUSION AND FUTURE RESEARCH

Based on the usability and feedback survey conducted, results show that the system was well received both by the students and the instructors. The user interface and user experience were major factors for the choice, but the results also pointed out the effectiveness of the problem stories, time-bounded activities, and leaderboards in creating a better leaning experience during coding exercises. It can also be significantly inferred that students would prefer to use CodeChum over other conventional or traditional programming IDEs. Although certain factors like slow compile time and hidden test cases among others, are some of CodeChum's weak points, majority of the participants were still very satisfied with CodeChum and would highly recommend it for learning and assessing one's programming skills.

As for the instructors, although they found it fairly hard to create coding exercises, overall positive feedback was shown in features like automated checking, CodeChum's current problem database, student monitoring, leaderboard system, and the overall user interface. Although certain factors like site bugs and crashes are some of CodeChum's weak points, majority of the participants were still very satisfied with CodeChum and would highly recommend it for monitoring and assessing their student's performance. Participants also suggest to improve on the scoring system, implementing a Student Dashboard, and fixing bugs and crashes, among others.

For future works, the proponents would like to incorporate learning analytics through using the data collected from each of the student's activities while using the IDE in order to provide more data to the programming instructors on how they could incorporate different teaching styles and strategies depending on what the students need the most. In addition, another usability survey is likely to be conducted again for both instructors and students, now using the SUS scoring method to properly calibrate and quantify the effectiveness and usability of CodeChum.

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# CAPTURING MOBILE COLLABORATION IN ACTIVE LEARNING: LESSONS FROM A LONGITUDINAL MIXED METHODOLOGIES STUDY

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**ABSTRACT**

This paper reflects on an attempt to introduce smartphones into a blended learning context and highlights several methodological considerations relevant to the collection of mobile data. While mixed methods are now common, using this approach for investigating the challenges of mobile data collection is not as common. This study employed a mixed method longitudinal exploratory multiple case study design. The study collected qualitative and quantitative data on student interactions within a yearlong series of collaborative language learning activities. This paper describes the methodological issues that emerged during the planning and implementation of the study. The participants were undergraduate students studying English translation at a four-year private university in Tokyo, Japan. This paper adds to the knowledge of employing mixed methodology design for mobile data collection and analysis. In particular the advantages of incorporating Multidimensional Scaling (MDS) analysis with qualitative data. The results suggest that separate forms of data collected at similar frequencies and times and then triangulated provided an effective methodology for studying collaborative learners in a highly mobile context. This can be seen as evidence for the inclusion of various data collection cycles within a single mobile learning research study.

**KEYWORDS**

Mobile Learning, Mixed Methods, Triangulation, Multidimensional Scaling

## 1. INTRODUCTION

The dramatic impact of smartphone technology on society suggests the potential for a similarly significant effect on education. This study explores a specific sector of education affected by this technology; it focuses on the impact on students from integrating mobile phones in collaborative language learning activities at the university level. The object of the research study designed around the following methodology was to add to the understanding of this interaction, such as, how the affordances mobile technology offers, like anytime and anywhere communication and data gathering, affect student approaches to the activities.

The study demonstrates that valuable results can be gained from such an approach and that the strength of the findings can be increased through triangulation. Also, the design of the data collection frequency was shown to have a relationship with the pattern of triangulation. This finding may be of value to other researchers during the research design phase and the coding phase.

## 2. LITERATURE REVIEW

There is a deep variety of methodologies employed in mobile research. Wu et al. (2012) reviewed 164 papers published from 2003 to 2010 from the perspective of methodology in relation to four research purposes; purpose one being mobile learning systems and the evaluation of their effectiveness, purpose two being designs of mobile systems and the evaluation of their effectiveness, purpose three is investigating the affective domain during mobile learning, and purpose four is designing a mobile system for learning. They discovered that for purpose one, researchers primarily relied on surveys (26 studies), followed by experimental research methods (20) and descriptive methods (7). For purpose two, experimental research methods were used most often (4), followed by surveys (2), descriptive methods (1) and observation (1). For

purpose three, only two methodologies were used: surveys (6) and interviews (1). For purpose four, surveys were the most commonly used methodology (16), followed by experimental research methods (14), descriptive methods (8), case studies (2) and observation (1). Similarly, Baran (2014) found that for mobile learning in the teacher education literature most methodologies were case studies or mixed method. Data sources they report included questionnaires, interviews, blogs, recordings, observations, journals, artefacts, usage data, and audio and video transcripts.

## 3. STUDY DESIGN

The research design presented here is a case study to explore the impact of mobile phones on collaborative learning activities in a university setting. The methodology utilised in this study can best be described as a longitudinal mixed methodology (qualitative and quantitative data), exploratory, multiple case study approach adopted for a period of one academic year. The objective was to gain a greater understanding of the processes and consequences that result from incorporating mobile phone interaction capabilities into collaborative learning activities for Japanese university undergraduates.

The participant sample in this study was drawn from a larger population of undergraduate students studying English as a foreign language at a four-year private university in Tokyo, Japan. The students were all between the ages of 18 and 20 years and living in Japan during the study period. Four groups of between five to eight members were formed from volunteers and followed a three-step process. A gender balance of males and females was attempted but was infeasible owing to the high percentage of female students in the school. Group one had 5 girls and 2 boys, group 2 had 8 girls, group 3 had 6 girls, and group 4 had 6 girls.

## 4. DATA COLLECTION

Evaluating mobile device use is challenging because of the wide variety of usage patterns (Trinder, Roy, & Magill, 2009), locations, and circumstances, in which they are employed make it infeasible to follow the user around. When compared to laptops or fixed computers, mobile or pervasive technologies present a challenge to methodology designers (Lim & Rogers, 2008). For this reason, a range of both qualitative and quantitative data was gathered so as to provide a wide "net" with which to capture a diverse range of data.

Quantitative data collection followed van'T Hooft's (2009) proposed six types of quantitative research data for collection with mobile devices were followed; spatial data indicating where the device is being operated; temporal data indicating when the device is being used; user data showing what they are being employed for; learner data indicating what content is being accessed; connectivity data recording who the learner communicates with; assessment data which deals with how the learners know that they are learning and what they are learning. This study incorporated the collection of spatial data through a short survey done during each mobile log in, but no specific location coordinate data was collected. The website logs recorded temporal data of website entry and actions (Figure 2) but could not resolve the precise time spent online. The online time was worked in as an interview question to obtain an approximate sense of how long the participants spent online during each activity. User data was gathered on the actions while logged into the research website to provide a coherent picture of how they carried out the activities. Also, the MDS data was collected to provide a visual representation of any changes in relationship between user and device in the context of the activities (Figure 3). The learner data was recorded and included all online actions and artefacts related to the collaborative activity (Figure 2). The connectivity data was gathered solely for the forum post interaction logs, but any contact outside of the Moodle course website was not recorded in the website logs. The students could declare any alternative communication channels (Twitter, Facebook, face-to-face, etc.) employed each week by filling out their weekly E-Journal which is similar to log books used in some studies (Corlett, Sharples, Bull, & Chan, 2005). The course assessment data comprised the forum answers but was not part of this study because the researcher wished to separate any grading of student participants and the research.

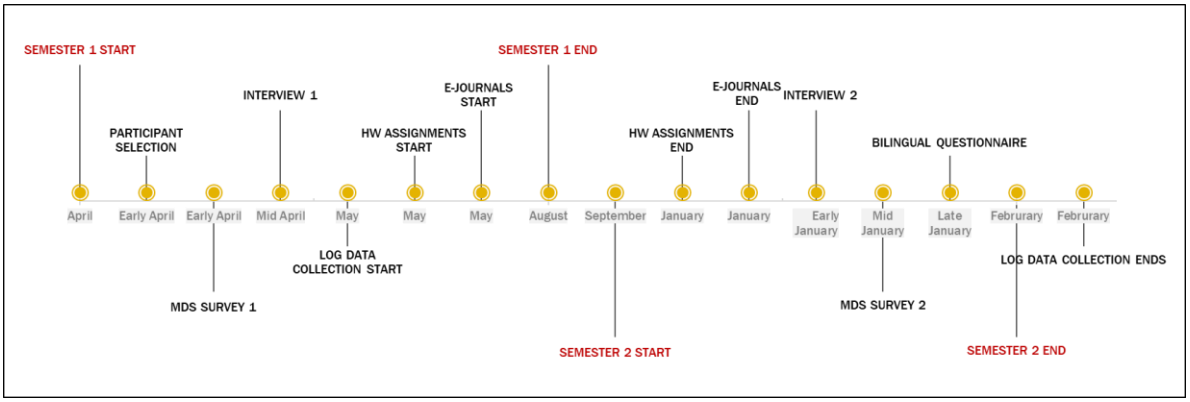


Figure 1. Study Timeline

Qualitative data generally consists of attitude surveys, interviews, and questionnaires which typically rely on memory after the event for developing theory and interpretations from the perspective of the individuals being studied (Ezzy, 2002). Theoretical questions and answers were continuously updated in an ongoing dialogue with the experience being investigated which in turn allowed for the transformation of interview questioning producing a much more sophisticated understanding of the experience under study (Ezzy, 2002). This process of examining the data as it is collected continued until a point of saturation had been attained where the researcher could find nothing new (Glaser & Strauss, 1967).

A timeline of the major data collection periods can be seen in Figure 1. Student online website log data, e-journals, student artefacts, and face-to-face interviews comprised the principal sources of data. Retrospective interviews were also carried out to resolve the queries raised from preliminary examination of student e-journals, artefacts submitted such as posted comments to the website, and online logs. Website data aggregation Triangulation was employed to strengthen the validity of findings by correlating data from these various sources and noting when they converged on a similar result (Mathison, 1988).

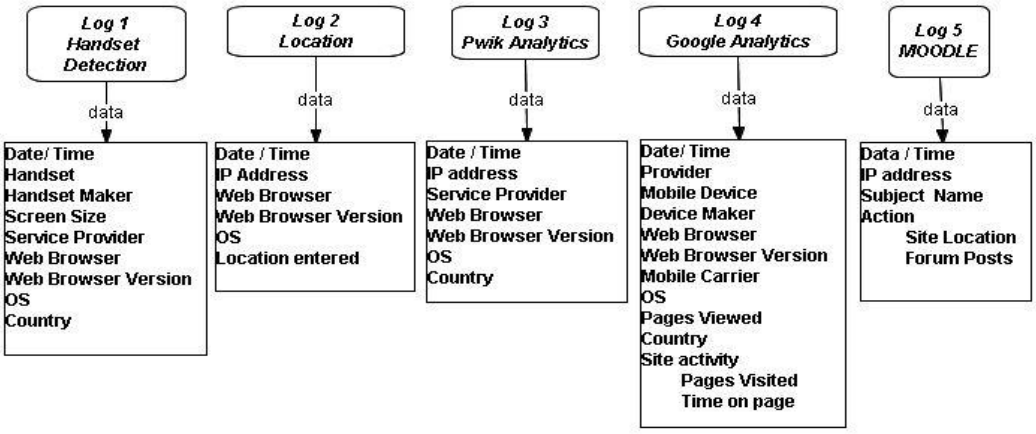


Figure 2. Log Data Collected

## 4.1 Web Site Logs

Several computer logging systems were employed to monitor the participants' interaction with the website. These logging systems enabled the researcher to distinguish interesting usage patterns that could be later correlated with the other findings. The array of data compiled from these logging systems is set out in Figure 2. All initial entrance to the Moodle page went through Handset Detection service which distinguishes the entry device - mobile phone, tablet, computer, etc.- characteristics.

The e-journals and the final questionnaire proved to be rich sources of data. Many of the findings from the interviews and other data sources were corroborated through triangulation with the e-journals and questionnaire; this can be seen in. In addition, they provided a way to monitor back channel communications between students that took place outside of the course CMS.

Artefacts in this research refer to text, video, picture, audio, or any other files that students made while using their mobile phone. The activities used in this study was in the form of small group collaborative learning activities consisting of weekly modules that were accessible on private class website by either mobile phone or computer. These activities consisted of homework questions related to translation issues that are relevant when moving between the Japanese and English languages.

Two semi-structured individual interviews were conducted over one academic year. The first was held at the tail end of the first semester; the intention was to obtain information on participant attitudes to using mobile phones and to ensure that they were completing the weekly homework activities without difficulty. The second interview was held at the end of the second semester and consisted of follow-up questions from the first interview and any clarification questions required to explain access patterns.

# 5. DATA ANALYSIS

## 5.1 Qualitative Data Analysis

The qualitative coding included the interviews, website logs, location survey, e-journals, questionnaire, and artefacts. The first stage of data analysis was content analysis, the organising, tracking, categorizing, and contextualizing the data obtained at distinct stages within QSR International's NVivo 10 Software to improve the reliability of the study (Maxwell, 1996; Stake, 1995; Wickham & Woods, 2005; Yin, 2009). A inductive form of thematic analysis coding (Ezzy, 2002) was adopted to identify themes or concepts in the data, build a systematic account of what has been observed, identify any emergent theory, and highlight issues and problems not anticipated.

## 5.2 Quantitative Data Analysis

In this study, at the beginning and the end of the data collection period, the participants were given an online word association questionnaire to complete, and the results were analysed using a MDS technique. MDS is a method for capturing efficient information from observed dissimilarity data by representing the data structure in lower dimensional spatial space. The reasoning behind using this technique was that it could provide a picture of how students perceived mobile technology in relation to the other aspects of their school life within the context of the study. By comparing this image pre-study and post-study, any changes in their views may be observable.

MDS is a well-known group of data analysis techniques which spatially represent the data's structure to make it easier to assimilate. In this study, the purpose for using MDS was to obtain a picture of the participants' relationship to school in general, homework, and mobile phones. It was expected that by analysing these word association questionnaires, the researcher could observe any variation in participant attitudes in the changing relational position of the words.

The output from MDS is in a two-dimension plot (Figure 3) of all the objects (words), and the distance between them indicates the value of dissimilarity. The closer the words appear visually in the plot the stronger the participants' perceived similarity between them. The advantage of MDS is that it represents the data spatially to allow a visual interpretation of the distances between the points plotted in two dimensions, so the interpretation of distance is visual. As mentioned, there are two sets of data: one from semester one and one from semester two. These two data sets were combined into a super matrix which allowed any pre and post data change in perceived similarity value reported by the participants between the beginning and end of the study to be represented by a movement in the second set of plotted points. The first set of data points are represented by the number of the word, followed by the letter "a," so all numbers followed by the letter "a" are from the semester one response data. Likewise, the second set of data is the number of the word followed by the letter "b," so all numbers followed by a "b" are from the second semester responses. The arrows were added later to indicate any change in the position of the points which represent a change in the perceived similarity of the words among all the participants. When a word is recorded as moving closer to another word, it indicates that the second semester data point has shifted closer to another second semester word, which suggests those two words are now perceived as having more in common at the end of the study than at the beginning. This information combined with the other data sources in this research enhanced the triangulation.

Here we can see that the MDS results correlated around research questions one, two and three. In Figure 4, the MDS analysis is in cluster B along with "Interview 1", "Interview 2", and "Final Questionnaire" indicating that the findings from the original MDS analysis in Figure 3 closely correlated with data from these three sources.

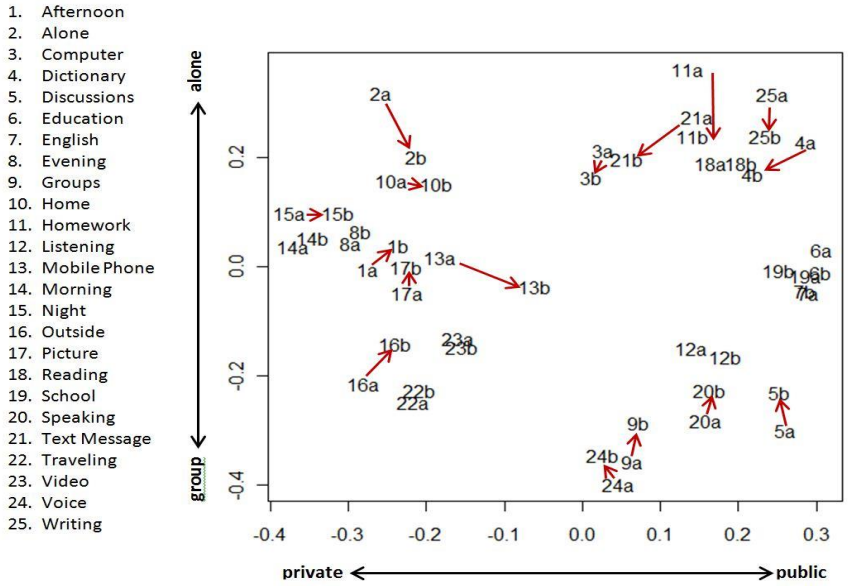


Figure 3. MDS Plot All Groups

## 5.3 Triangulation

Many mobile learning research projects have utilised interviews, questionnaires, diaries, and focus groups to collect information (Sharples, 2009). When these methods are employed individually, in mobile research (Traxler, 2007) as well as other forms of research (Wali, Oliver, & Winters, 2009) there can be uncertainty in the reliance on the memory and honesty of participants. In this study, an additional problem with relying on users to articulate their actions is that they may not possess the language skills to report their experiences. Triangulation is a research strategy that incorporates several such research methods in a single research study to yield a more comprehensive view, to clarify a complex phenomenon, or when a conventional approach generates a distorted picture (Cohen, Manion, & Morrison, 2007). Also, it can strengthen the validity of findings, such as when data from disparate sources or compiled with diverse methods "converge" (Mathison, 1988) on the same result.

The value of the triangulation is clear from large number of supporting data points for each code represented. The data points are both qualitative and quantitative so supporting the idea that mixed methodology studies can provide a rich multidimensional view of a complex collaborative activity such as mobile learning. The clarify this point, in Figure 4 this same data has been analysed using MDS to produce a two-dimensional plot of the triangulation data in Figure 4: MDS Analysis of Data Triangulation. In this plot, the distance between the data sources represents the similarity – the number of times the data sources supported each other. There are three clear outliers; these include "Time online", Read Write Count, and "Location." "Time online" can be explained by the technical difficulties in measuring mobile connect time as discussed earlier. This made the data source unreliable alone which made the researcher hesitant to use it. "Location" data was collected from the small three-question survey the students were to answer each time they connected to the mobile website. However, it was found through the interviews that many students set book marks for the mobile site which linked to internal pages of the website so bypassing the small location survey. This again meant that the data was not utilised to a great extent because the number of student answers was limited. The "RW Count" was accurately measured but appears to have had little impact on the triangulation of data. This may have been an oversight on the part of the researcher or could mean that the data was of little value. This could be an area for further research.

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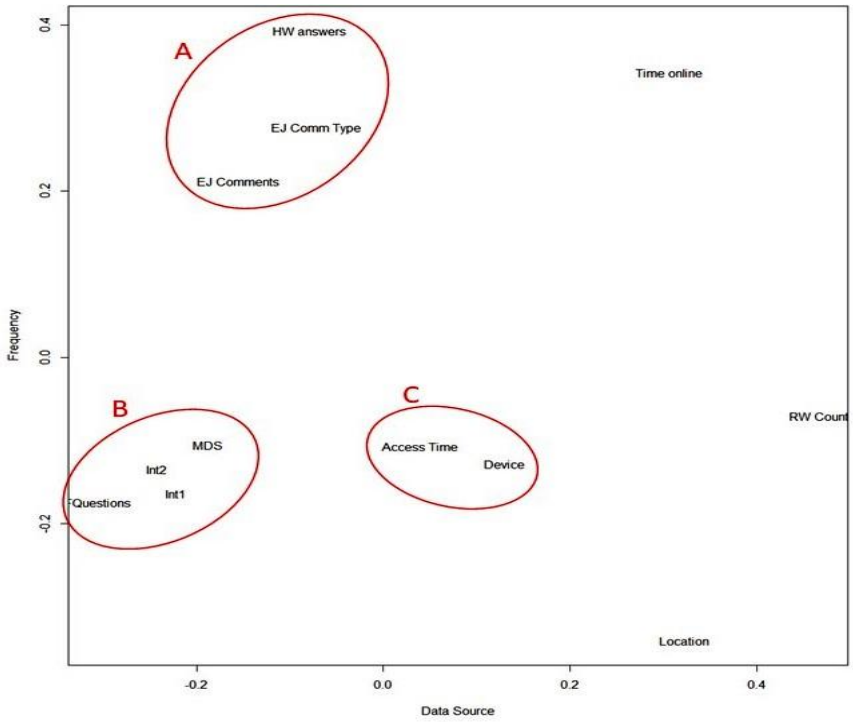


Figure 4. MDS Analysis of Data Triangulation

Cluster A includes "Homework Answers", E-Journal Communication Types", and "E-Journal Comments". One possible explanation for this cluster is that this data was collected on a weekly basis at the same time as the homework activities. This means that the issues directly related to homework completion and submission would likely appear in these three sources. If a participant had trouble with a homework discussion online they would likely mention it in their weekly E-Journal along with the type of problem -face-to-face, texting, etc. This can be seen with the code "ease and speed of use" which is supported by these same three sources. Cluster B includes "MDS Analysis" (Figure 5), "Interview 1", "Interview 2", and "Final Questionnaire." These four sources were clearly separate from the course in which the homework assignments were completed. Without the final questionnaire these took place twice during the research which may account for the similarity of topics. Also, they were heavily affected by the researcher reflections during the ongoing process of exploratory research. The interviews and the final questionnaire provided a way to collect the participants' detailed views of the experience of working with the mobile devices. An example of this is the code "increased control" under research question one.

These results suggest that separate forms of data collected at similar frequencies and times may increase the likelihood of triangulating those data. Again, this can be seen as evidence for the importance of various data collection cycles within a single research study. Cluster A was a weekly collection cycle and the three types of data collected clearly supported each other. The same can be seen for the yearly collection cycle in cluster B. The distance between these clusters indicates that there were fewer triangulated data points between the clusters then there was within them. One question that must be asked is whether this reduced triangulation between cluster A and cluster B data sources is due to differences in data findings alone or researcher actions. The coding phase of the research involves several iterations to isolate the codes but this result suggests that a deeper comparison of the findings between these two clusters may yield another layer of codes.

## 6. CONCLUSION

This research study provides several implications for further mobile learning research. In terms of methodology related recommendations that may overcome issues with mobile data collection and mobile

interface. The results suggest that separate forms of data collected at similar frequencies and times increases the likelihood of triangulating data points so compensates for the difficulties related with studying this fluid phenomenon. This can be seen as evidence for the importance of various data collection cycles within a single mobile research study. The researcher feels that these multiple data sources and case study design did add to the validity and reliability of the findings in this research by providing many points of data triangulation. The difficult of studying a phenomenon of this type that takes place at all times of the day and in all imaginable spaces is clear. The log data provided an invaluable source of confirmation for the interview data and the MDS plot provided a further graphic representation that greatly help in identifying changes that correlated across data sources.

In the future, the relationship to the mobile phones and the position they hold in student lives could be better understood through another a series of longitudinal studies following the same methodology. Since the relationship that students have with technology changes as fast as the technology advances, this could include a new cohort of students each year for several years. Each progressive year will have had a different history with the technology, and it is this slight difference that could provide important insights on the relationship between mobile device affordances and learning.

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# KM SOFTWARE SOLUTION AT VARNA FREE UNIVERSITY – COMPARATIVE ANALYSIS

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**ABSTRACT**

The role of Knowledge Management (KM) in the educational institutions is of great importance and the main function of educational organizations is the KM. KM includes the process of capturing, creating, disseminating and applying all forms of knowledge within an organization in order to fulfill institutional goals. The use of the KM solutions and principles can lead to more flexibility in teaching and learning processes and in university management. This paper presents findings of a case study conducted at Varna Free University (VFU). KM solution has to optimize the processes of development, dissemination and storage of knowledge at the Institute of Technology. Comparative analyses are provided to outline proper software for implementation and a prototype of KM system to be designed. The focus is to connect people, processes, and technology for the aim of leveraging knowledge. The success of this project depends on the active participation of the whole team of the Institute of Technology. This solution will allow for the creation of a common knowledge base to be developed in cooperation. The loss of personal knowledge can be prevented by sharing implicit knowledge in a wiki module. By accessing the organizational knowledge base, valuable information can be extracted and thus reduce the problems of leaving staff and training new staff. By linking structured content, it is possible to optimize search processes and support joint and individual research, training and administrative activities. Interdisciplinary references to additional information can improve the quality of learning processes, research and project activities, as well as administrative management.

**KEYWORDS**

KM, Educational Organization, Software Solution

## 1. INTRODUCTION

Nowadays Higher Educational Institutions (HEIs) face great challenges and KM has increased in credibility as a management tool. There are numerous definitions describing KM as a systematic process of capturing, creating, structuring, disseminating and applying all forms of knowledge throughout an organization in order to fulfill some objectives such as to optimize work, reuse best practices and reduce costs (Nonaka & Takeuchi, 1995; Ruggles & Holtshouse, 2001; Dalkir, 2011).

The transfer and reuse of tacit knowledge is important in every organization. As universities are an important part of our society and play a significant role in the transfer of tacit knowledge, it is vital that teaching staff engage in transferring tacit knowledge not only to their students but also amongst their peers too (Chugh et. al, 2015). The findings have revealed there is a high level of discontent towards making tacit knowledge transfer mandatory, particularly because it can be challenging to measure.

Cranfield & Taylor (2008) presented the initial findings of a case study conducted at seven HEIs within the United Kingdom with perceptions of KM and its challenges for implementation within the HEI sector. Priti Jain (2012) presented an empirical study of KM in University Libraries in SADC (Southern African Development Countries) and concluded that the majority of the participating librarians have recognized the importance of KM by distinguishing the practicing KM.

Te Fu Chen (2011) developed practical KM 3.0 System Model with Semantic Web 3.0 Technology. The semantic Web provides an approach that fosters richer repositories with better and smarter tags. Focus should no longer be on simply collecting or sharing everything and anything, but rather on use to avoid information overload.

HEIs are highly involved in business of knowledge; however, they are taking responsibility for knowledge creation, sharing, transferring, storing, dissemination, reuse and learning. In a review of KM in HEIs Nishad Nawaz (2014) analyzed how knowledge is managed and useful in HEIs. He studied in details two of the highly discussed models: Strategic Knowledge (SK) and Innovations Knowledge (IK). Strategic Knowledge states that the basic source of knowledge is tacit and explicit, while on the other hand Innovations Knowledge (IK) describes that basic source of knowledge is Strategic Knowledge. Finally, the conceptual models of Strategic Knowledge (SK) and Innovations Knowledge (IK) are compared emphasizing how KM adds value to the HEIs.

The Impact of KM on Organizational Performance is investigated by Mohammad Ahmad Al-Qarioti (2015) in an Empirical Study of Kuwait University. The research shows how faculty members evaluate KM influence on organizational performance. Study findings provide insights into the infrastructure and process capabilities needed to provide knowledge support for organizational activities. The study was based on a stratified random sample consisting of (355) faculty members from various colleges at Kuwait university. Study results show that faculty members evaluate KM as "very good" with a (3.52) mean score in a Likert five-point scale, which indicates that KM components are highly related to organizational performance.

Omotayao (2015) defines KM as a key driver of organizational performance and a critical tool for organizational survival, competitiveness, and profitability. According to him, attention must be paid to three key components - people, processes and technology. In essence, to ensure an organization's success, the focus should be to connect people, processes, and technology for the purpose of leveraging knowledge.

Educational organizations are the main instruments of society for the constant pursuit of knowledge. The role of KM (KM) in the Educational Institutions (EIs) is critical and important. Examine the promises and potential pitfalls, challenges and opportunities of KM in education and educational institutions, especially the role of KM in teaching and learning processes (Abbas Khakpour, 2015). Every academic institution contributes to knowledge. The generated information and knowledge is to be compiled at a central place and disseminated among the society for further growth. It is observed that the generated knowledge in the academic institute is not stored or captured properly. It is also observed that many times generated information or knowledge in the academic institute is not known to anyone and remains as grey literature, which might be useful if proper recoding is maintained in the organization. In fact, the academic environment is a treasure of knowledge but it is not organized properly and hence utility is also lacking and cause for the repetitions of the activity (Sangeeta 2015).

Asrar-ul-Haq & Anwar (2016) elaborated a systematic review of KM and Knowledge Sharing (KS) to highlight the possible antecedents and factors that facilitate or impede KM and Knowledge Sharing in organizations. The review includes both quantitative and qualitative studies related to antecedents and barriers to KM and Knowledge Sharing. Cooperation bias was the most frequent limitation in most studies included in this meta-review as the respondents were likely to overestimate their participation in KM and KS.

However, universities have been slow to adopt KM. Agarwal & Marouf (2016) came up with a 10-step process and a framework for initiating KM in universities. The steps were organized within 4 phases of plan, design, implement and scale-up. After getting top management support, forming a KM team, and identifying KM goals and priorities, the third step of their process (within the design phase) was determining the extent to which the university is ready for KM i.e. an assessment of its current state of readiness. Agarwal & Marouf propose design and a research model, a survey instrument, and an interview protocol for KM readiness assessment in universities. Readiness assessment could mean individual faculty readiness as well as organizational readiness.

The role of HEIs as knowledge providers has been scrutinized and challenged by the various stakeholders. Therefore, HEIs, especially in developing countries, are putting efforts to manage their knowledge based strategic assets. To answer this challenge, KM tools and techniques have been proposed to make use of HEIs knowledge assets in accordance with the demands of the time. Different factors affect the main agents of KM in the context of their professional practices as faculty, administrative staff, librarians, and information professionals in HEIs (Nunes Jose, Kanwahl & Arif 2017).

Global mobility of professionals and the transfer of tacit knowledge in multinational service firms is investigated by Ying Guo, Pavlina Jasovska, Hussain Gulzar Rammal, Elizabeth Rose, (2018). Using Nonaka and Takeuchi's SECI model of knowledge transfer, the authors study the intra-organizational knowledge transfer practices of an Indian multinational service firm. Semi-structured interviews were conducted with 20 key informants involved with the organization.

Soile Hakkarainen, Outi Saramäki & Jenny Makkonen (2018) analyzed the transfer of tacit knowledge in organizations. This small survey in four different organizations in Finland reveals the lack of knowledge in management procedures. None of the work places had a system for collecting, storing, and sharing tacit knowledge that the interviewed employees were aware of.

# 2. KM SOFTWARE SOLUTION AND ANALYSIS

## 2.1 Background

The Institute of Technology at VFU is responsible for the software and hardware provision of the university management and the educational process. It conducts research, and supports coordination in administrative tasks related to the central university and faculties' administration.

There is a need for a KM solution in the tasks of the internal distribution of knowledge and of the departmental administration. Staff turnover and the need to train new staff are a major reason for using a KM solution.

KM processes could be supported by all categories of tools presented in the Figure 1.


Figure 1. Tool Categories for KM Processes Support

The implementation of KM system starts with development of a central information storage platform in which employees store and retrieve information. The organizational knowledge base could include topics in the areas of research, training, and administration. The knowledge platform can provide information on working processes, procedures, job descriptions, and guides with possible comments on content. KM system must also be available on mobile devices and outside the university network. Friendly user interface should help broad acceptance and staff involvement. At administration level, full management of the rights to extract, create, and edit content is required.

It should also be possible to back up the organizational knowledge base. All administrative tasks need to be executed as quickly as possible, and when an administrator leaves, the assignment of an editor's rights must be immediately compensated. The proposed KM solution should be as cost-effective as possible, be easy to expand and integrate into the information architecture of the university.

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## 2.2 Observations and Discussions

According to the above mentioned requirements a structural model of KM system is developed. (Figure 2):

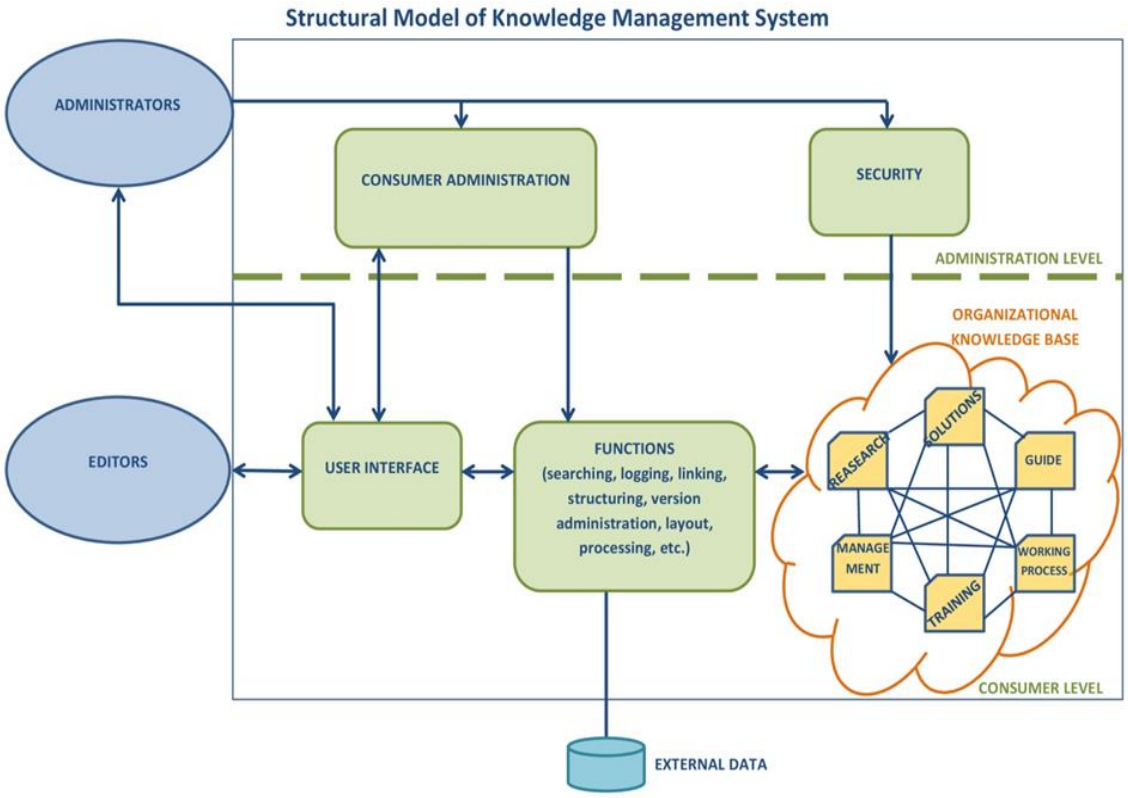


Figure 2. Structural Model of KM System (Author Illustration)

Employees act as an editor or administrator. On the one hand, editors need to be able to create content on their own and keep it in the organizational knowledge base. On the other hand, they must be able to extract content from the organizational knowledge base, modify it if necessary, and store it in the common knowledge base and link it to other content. Administrators have the same rights as editors. In addition, their tasks include consumer administration (including roles and rights management) as well as data backup.

The user (consumer) level includes the user interface, features, and organizational knowledge base.

User access (both by editors and administrators) must be through a graphical user interface that represents the interface between users and the KM system. Users are identified by their user ID and password. Upon successful identification, the user is allowed to call certain features.

These functions provide users with the ability to search, store, connect, structure, and refine information. All modifications of the knowledge base must be documented to track the changes by identifying exactly which user they are made by and in case of inconsistencies to be reset. These contents must be interconnected through links and stored according to intelligible structuring schemes.

Thus, the content of the knowledge base should form a semantic network. In addition, it should be possible to extend the organizational knowledge base through external system data. The data stored within the institute and the university or even outside the university units must be able to be integrated into the knowledge base.

User administration and archiving must be provided at administrative level. Guest and extension access must be possible through new user roles. Archive function guarantees back–up copies of the organizational knowledge base.

## 2.3 Results

For optimal choice, Typo3 applications, Moodle wiki features, and Alfresco Community Edition are analyzed.

Freeware CMS system Typo3 has been chosen since Typo3 is already being applied in a number of universities. Wiki module in Moodle as an open source learning platform is also a possible solution. It is possible to use entirely own development as a central SQL database together with Microsoft Access, but with alternatives as Typo3, Wiki and Alfresco is not cost-effective. Efforts to develop a separate solution, especially with regard to the integrity requirements and strict security measures, appear to be unprofitable as compared to the adaptation of a ready-made system. The final choice is made through a cost-benefit analysis (Table 1).

Table 1. Comparative Analysis of Typo3, Moodle Wiki and Alfresco According Criteria (Author Illustration)

| **Tool** | Relative weight (**w**) | Typo3 CMS | | Moodle Wiki | | Alfresco Community | |
|---|---|---|---|---|---|---|---|
| **Criteria** | | Utility (**u**) | **w** x **u** | Utility (**u**) | **w** x **u** | Utility (**u**) | **w** x **u** |
| Functionality | 0.35 | 2 | 0.7 | 2 | 0.7 | 2 | 0.7 |
| Easy-to- use | 0.25 | 2 | 0.5 | 2 | 0.5 | 3 | 0.75 |
| Costs | 0.25 | 2 | 0.5 | 3 | 0.75 | 2 | 0.5 |
| Integration | 0.15 | 2 | 0.15 | 3 | 0.45 | 1 | 0.15 |
| Total benefits (Σ w x u) | 1 | | 1.85 | | 2.4 | | 2.1 |
| **Ranking** | | | **3** | | **1** | | **2** |

Typo3, Moodle Wiki and Alfresco are evaluated using criteria: Functionality (weight w = 0.35), Easy-to-use (w = 0.25), Costs (w = 0.25) and Integration (w = 0.15). The most important functionality criterion describes the extent to which requirements are met and the ability to expand the KM system (Expandablity). The second criterion includes the ease of use, as this is essential in order to increase the motivation of users to participate actively. This criterion includes aspects such as intuitive control, easy operation, single input, user-friendly interface, and more. Costs include the necessary operating costs, such as costs for purchasing new hardware, licensing costs, and total operating costs. The latter criterion refers to the efforts to implement and adapt the software tool in the existing system.

During the benefit analysis, the four target criteria for functionality, easy-to-use, costs and integration for the three alternatives Typo3, Wiki and Alfresco are evaluated using a scale ranging from 0 (insufficient) to 3 (very good). Then the utility is multiplied by the weight of the criterion under consideration (w x u). The sum of the results obtained gives the total benefit (Σ w x u). Results go from 1 (highest) to 3 (lowest) total benefit.

### 2.3.1 Functionality

Key features include: web based access of a group of users to a common knowledge base; roles and rights management; content structuring options; workflow management; data integration; ability to comment; backup.

Typo3 CMS offers web-based administration of an organizational database through workspaces. Role and rights management, as well as content structuring are supported. Data archiving is possible through additional extensions, and data entry is limited to Typo3-specific data. Integrating software features such as commenting on features or discussion forums is only possible through the additional use of extensions. The wide range of extensions increases the scope of CMS (TYPO3 2017).

Although it is possible to meet the requirements, using extensions, there are security risks. Extensive safety checks are centrally performed, but there is no guarantee of safe and flawless work on extensions. Overall, the functionality of Typo3 CMS is assessed with two points.

The wiki in Moodle also provides shared access to the knowledge base over the Internet and includes roles and rights management. Backups of the knowledge base can be created. In addition, many software features can be used (e.g., comments, audio, discussion forums).

Content may be structured as desired. External data can be linked to the knowledge base through links. Like Typo3, there are freely available extensions for Moodle. Also, the use of wiki in Moodle is assessed by two points, as extensions are needed here to achieve optimal performance.

The alternative edition "Alfresco One Edition Community" also includes a wiki feature as well as many other social software elements, rights management, web-based access and workflow management. The use of open standards and interfaces allows the integration of non-systematic data and applications and provides extensibility. Additional features (such as automated data backup) are only available using add-ons. The functionality of Alfresco One is also evaluated with two.

### 2.3.2 Easy to Use

Typo3 looks intuitive and easy to use. In some cases, additional knowledge is required to create pages, as well as TypoScript knowledge or the use of TypoScript templates to adapt the layout and content. In an intranet, Typo3 can be linked to LDAP (Lightweight Directory Access Protocol) directories through extensions, so a centralized single entry is possible. The ease of use is estimated at a value of two.

Moodle is known to all members of the university as it is often used in education. Employees can log in through their usual user account. Interacting with users in some places can be more meaningful and making content easier. The usability of wiki is categorized based on integration into the familiar environment and the simplified user input and is valued at 2.

Alfresco Community Edition is a simple and clear software. Because of the functional and graphical reference to common applications, users must be able to work with Alfresco as intuitively as possible. Alfresco can be synced to specific LDAP directories to enable single sign-on. In this case, it will also be necessary to check if synchronization with the university's user directory is possible and allowed. The easy use of Alfresco is assessed at 3.

### 2.3.3 Costs

Since Typo3 is licensed under the GNU General Public License version 2 (http://www.gnu.org/licenses/gpl-2.0.html), including later versions, there is no license or acquisition cost for the application (https: // typo3.org/typo3-cms/). For the operation of Typo3 CMS, it is necessary to install a new virtual machine on a VFU server, hosted by the Institute of Technology. Due to these additional operating costs, the value of this alternative is attributed to the value of two.

The use of wiki functions through Moodle will get the highest result on the target cost criterion because wikis lack any additional installation, hosting, and licensing costs, and only need operational costs for administering wikis that are actually part of the administration of the entire e-learning platform.

Alfresco Community Edition is distributed under the LGPLv3 license (https://www.alfresco.com/alfresco-community-editions), there are no license fees. Like Typo3 CMS, operating costs and hardware costs need to be taken into account. That’s why two points are awarded to this alternative.

### 2.3.4 Integration Activities

Typo3 CMS has difficulty in multi-user work. In case of using Typo3 application hosted by the Institute of Technology it is necessary to create its own environment. If a separate server is used, it must be integrated into the system environment of the Institute.

Integration of wiki gets three points because only administrative settings (such as user registration, roles assignment, and rights) need to be done. This is a sufficient condition for the wiki to be structured and gradually filled with content.

The integration of the Alfesco Community Edition is complicated compared to the wiki version, as it is necessary to install and integrate a new server or an additional virtual machine.

Typo3 CMS offers the lowest total benefit. Possible self-use of the instrument has a negative effect on individual utility values. However, since the overall benefit differs significantly from other alternatives, the use of Typo3 system, managed by the Varna Free University data center, will not be a big change in overall benefit.

Using Moodle's wiki functionalities is the most common benefit. Especially in terms of cost and integration efforts, this solution is best.

The software of Alfresco Community is second, but the software solution is inappropriate due to relatively high licensing costs.

Since the use of a wiki promises the most common benefit, this alternative is chosen.

## 2.4 Future Development

The main framework of the KM solution will be a wiki on the Moodle central platform, developed and maintained by the Institute of Technology.

Users will have access to the virtual campus via regular Internet browsers by entering their URL. This will allow web-based access via mobile devices. After successful authentication with their universal user ID and password, users will be redirected to their personal platform page. Employees enrolled in the KM course can call the KM decision. Authorization will be done automatically according to the user role in the central user administration.

All wikis integrate a search function to find all content according to the search term you entered. Users can load and format wiki pages themselves, as well as insert images, videos, pre-formatted texts and graphics. Pages can be linked to each other so that they become part of the semantic knowledge network. Links can also be used for external data. It is also possible to integrate other features and elements that are usually available in the Moodle system. Audio, galleries, chats, or databases can be integrated. In addition to the organizational knowledge base, editors and administrators can also create personal wikis that can not be accessed by other users.

Administrators can archive the course and, as a result, wiki data and metadata are stored centrally on servers. These archive files can be imported later to restart the wiki.

# 3. CONCLUSION

The implementation of the proposed KM solution in the form of a wiki is the basis for developing a common knowledge base at the university. The initial phase includes content preparation and its integration into the platform. Subsequently, it is necessary for all staff of the Institute of Technology to document each new information, such as descriptions of working processes and current projects, guidelines for a specific task and to share them with their colleagues.

An advantage in the KM process is the extraction of tacit (hidden) knowledge and its sharing. The success of KM solutions depends on the usability of KM tools. Additional factors increase the chances of success of KM systems, such as developed technical infrastructure, team discussion of potential benefits, incentives and motivation.

Organizations and companies have access to many different IT tools, but most instruments support specific KM objectives and as a rule cannot be used as a universal step to build, maintain and develop an organizational knowledge base. Therefore, it is necessary to carefully examine and balance the potential of the possible tools with regard to the job profile and the objectives pursued.

The success of KM solution depends to a large extent on the active participation of all members of the organization. The task of the high level management is to take measures to enable an exchange of information. This can help to create a corporate culture based on knowledge and to overcome individual barriers to implicit knowledge.

Universities have different fields of application of KM systems - in research, training and administration. There is a wide range of IT tools for developing, distributing, using, preserving, evaluating and acquiring knowledge. However, there are often unused opportunities to optimize joint research, educational and administrative activities and thus meet current requirements.

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# KIMUN PLATFORM: WEB TOOL AS A PEDAGOGICAL RESOURCE FOR TEACHING AND LEARNING MAPUZUGUN

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**ABSTRACT**

In this article we present a knowledge management platform called Kim un (which means knowledge in Mapuzugun) as a technological web resource for teaching and learning Mapuzugun language. We discuss how we can generate a richness in multicultural education and diminish the otherness between different cultural groups in a society of XXI century towards a change of knowing and understanding, towards a cultural development for an e-society world. Today Mapuche language is going through difficult times, it's struggling for not ceasing to exist. As we know, the language is one of the patrimonies that defines a people identity, if the language dies, then the people and all their worldview disappears. Currently, Mapuche children are not learning Mapuzugun as their mother tongue for a variety of reasons. This situation further aggravates the problem of maintaining the Mapuche language and, with it, all the cultural richness of this ethnic group. Due to this complex scenario is that the government has implemented laws that allow a revitalization of this language, including teaching in those schools that have a high density of Mapuche students. The objective of this work is to bring together actors such as teachers, non-Mapuche and Mapuche students, researchers, Mapuche and native speakers to put the pedagogical resource for the teaching and learning of the Mapuche language as a multicultural tool as technological linguistic tools which are transversal to the disciplines of nowdays. The advances of this work are the base to create a platform focused on orienting a framework in the creation of learning virtual objects (OVAs in spanish).

**KEYWORDS**

Intercultural Education, Otherness, Linguistic Technologies, Mapuzugun Language, Learning Virtual Objects

## 1. INTRODUCTION

In Chile, the term Mapuche - or "earth people"- has been used by the majority indigenous peoples of Chile as self-denomination and generic term. This term has also been used as a synonym for Araucano, a lexeme by which the Spaniards designated the Mapuches. After Quechuas and Aymaras, they are the third largest indigenous society in the Americas, with a total of 928,060 inhabitants according to the Chilean census (CENSO, 2017); and the majority and best preserved indigenous culture of Chile (Lenz, 1895-1897).

The XVII national census of population and the VI of housing, both made in 2017 indicate that the population of Chile is 17,574,003 inhabitants, of which 2,284,620 people (13%) said they belong to one of the 9 indigenous peoples considered in the census instrument. The Chilean indigenous population according to their ethnicity is very heterogeneous. The Mapuche population stands out in the first place, corresponding to 79.8% of the total population. They are followed by the Aymara (7.2%) and the Diaguita (4.1%). The rest of the ethnic groups (Colla 0.9%, Rapa Nui 0.4%, Quechua 1.6%, Y´amara 0.1%, Colla 0.9% others 1.3%), together account for 4.5% (CENSO, 2017), (Gundermann et al., 2009).

Table 1. Distribution of mapuzugun competence according to age strata in southern Chile (regions of biobio, araucania, the rivers and the lakes), (CENSO, 2017)

| Age | Without competences | Basic | Intermediate | high |
|---|---|---|---|---|
| 10-19 | 27,559; 85,7% | 1,993; 6,2% | 1,378; 4,3% | 1,209; 3,8% |
| 20-29 | 30,864; 80,6% | 2,748; 7,2% | 3,177; 8,3% | 1,488; 3,9% |
| 30-39 | 31,349; 69,1% | 1,617; 3,6% | 5,258; 11,6% | 7,121; 15,7% |
| 40-49 | 2,341; 61,2% | 1,345; 3,1% | 5,383; 12,5% | 9,968; 23,2% |
| 50-59 | 16,586; 47,5% | 1,578; 4,5% | 4,354; 12,5% | 12,428; 35,6% |
| 60-69 | 12,530; 44,5% | 183; 0,7% | 3,003; 10,7% | 12,422; 44,1% |
| 70-79 | 5,205; 26,7% | 170; 0,9% | 1,016; 5,2% | 13,082; 67,2% |
| 80-more | 1,417; 25,4% | 264; 4,7% | 270; 4,8% | 3,624; 65,0% |
| Total | 151,851; 61,5% | 9,898; 4,0% | 23,839; 9,7% | 61,342; 24,8% |

It is notorious and worrisome the setback of Mapuzugun, the Mapuche language, and its replacement by the Spanish. Phenomena of linguistic displacement are common to the continent Amerindian languages, even when they retain a several number of speakers. The disappearance of some indigenous languages and threats to the survival of others is one of the cultural concerns of indigenous politics over the last 20 years (Gundermann, 2005). Their action is not only a gesture of ethnic recognition; but also a way of facing the ongoing linguistic setback.

Table 1 shows weighted and projected figures for the entire Mapuche population of southern Chile, rural and urban, according to age groups in decades. A simple data inspection is sufficient to highlight the correlation between the increase or decrease of competence and the high age brackets or those of young and adults. Thus, for example, only a 14.3% of those between 10 and 19 years are proficient, focusing on basic and intermediate levels and with a good number of passive speakers. Something similar is repeated with the members of the group between 20 and 29 years, among which only 19.4% shows competence. Among the elderly, the situation is reversed. A majority of those in the age group of 70-79 years shows competence (73.3%), most in the high level (CENSO, 2017), (Lenz, 1895-1897).

Mapudungun, which means “the speaking of the earth”, is one of the languages that, as mentioned above, is still used, but that is gradually disappearing, this defines the identity of Mapuche people including their philosophy, customs, rituals and their way of life. The Mapuzugun non-use by the Mapuches is due to the fact that most of people belonging to this ethnic group reside near the big cities, depending economically on them. Having to work in these cities and not in the countryside forces them to use the Spanish language instead of their native language, to be able to carry out marketing processes, attend school or carry out paperwork.

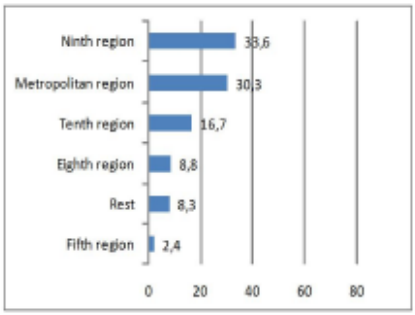


Figure 1. Mapuche distribution in Chile regions (CENSO, 2017)

The research question arised in this work is; How is it possible to preserve the vitality of Mapuche language given a model of linguistic displacement as a language dominated by Spanish in a dominant position?

This work suggests a platform for knowledge management that acts as teaching and learning of Mapuzugun as a pedagogical resource in the educational actors for Mapuche as the ethnic recessive language.

The work structure is done with Mapuche native backgrounds, therefore, here we explained the fundamentals of the alphabets, learning styles, the importance of technologies and information in classrooms, mapuzugun syntax, Kimun platform development, results, conclusions and references.

# 2. ALPHABETS

## 2.1 Ranguleo Alphabet

The Raguileo alphabet was created in 1982 by Anselmo Raguileo, an intellectual who, according to data provided by Ruby Raguileo (Wittig, 2015), (Scott et al., 2013), participated in Mapuche movements emphasizing the political importance of maintenance the language for the existence of the Mapuche people, he was professor of Mapuche language at the Pedagogical Institute of the University of Chile in the 50's and in 1973 he graduated as Engineer in Chemistry Execution. In the 1980s, back in Temuco, he did fieldwork in mapuche communities in different regions for a CAPIDE linguistic project, and to test the reliability of the alphabet between 1982 and 1990 he did different Mapuche language courses at CAPIDE, Ad Mapu and the Newen Mapuche Society. We agree with Wittig (Wittig, 2015) that "the Raguileo Alphabet is based on a position of differentiation and autonomy of the Mapuche language in relation to Spanish; the language of the dominant society" in what differs fundamentally from the Unified Alphabet. This alphabet is composed of the following graphemes: a, c, z, e, f, q, i, k, l, b, j, m, n, h, , g, o, x, u, v, w, y.

## 2.2 Unified Mapuche Alphabet

In the Unified Mapuche Alphabet presentation, Mario Bernales (Chilean Society of Linguistics, SOCHIL in spanish, 1988) (Sochil, 1988) points out - perhaps anticipating future discussions about this subject - that: The deliberate development of a writing system for the language of an unlettered society has place within a complex of historical and sociocultural factors and exceeds the purely technical problems of representing a phonology by an alphabet. The Unified Mapuche Alphabet was thought from a schooling that provides literacy in the Spanish language, and in a historical moment in which Mapuche movements did not manifest the current political protesting force. The proposal reached a high level of diffusion. As Wittig points out (Wittig, 2015), The fact that this alphabet is supported by the academic community promoted its use in teaching Mapudungun. It is a Roman alphabet with five additions (l, n, , t, ) and four digraphs (ch, ll, ng, tr), thus it is made of 28 graphemes (Salamanca et al., 2009), (CONADI, 2008): a, ch, d, e, f, G, i, k, l, ll, m, n, ñ, ng, or p, r, s, t, t, tr, u, ü, w, y, sh.

## 2.3 Azümchefe Alphabet

This proposal (CONADI, Azümchefe, Study for the definition, 107) (CONADI, 2008) is born as an attempt to generate and legitimize only one alphabet for the Mapuche people - that responds to the aspiration of people dream, so as to transcribe the phonetics of the mother tongue and that can be used as a means of advancement to the utopia of Mapuche people" (CONADI, Azümchefe., Sole Graphite, 23). Based on the analysis of six previous alphabets (Antinao, Caulef, Painequeo, Huilcamn, Raguileo and Unified), it consists of 28 linguistic codes or letters (6 vowels and 22 consonants). Two of the consonants represent expressive sounds: one affective and one derogatory. Azmchefe means person who learns. This alphabet was created by CONADI and gathers features of the Rangileo and the Unified alphabet and consists of 28 letters: a, z, u, m, ch, e, f, i, k, t, nh, tx, y, q, g, lh, n, r, s, ll, p, u, w, l, n, sh, t.

# 3. LEARNING STYLES

At school there is a consensus about the need to observe the diversity of students, and based on this, to develop technological tools appropriate to current educational contexts. This implies a challenge for the education system. In this sense, the main approaches are directed towards the individual preferences, which would enhance the cognitive capacities (Alvarez-Santullano et al., 2015) and the student performance. From this perspective, studies are positioned around the students learning styles (Bisol et al., 2015), the learning styles refer to the habitual mechanisms to perceive, interact and respond in a teaching and learning context.

The learning process is facilitated when the professor teaches from the predominant style of the student, both visual and auditory.

The model called visual-auditory, it is named so because it takes into account two large systems to mentally represent the information. The visual representation system is used whenever we remember images. The system of auditory representation allows us to hear voices, sounds and music in our minds. Using visual and auditory activities influences student learning. When information is presented, or when you have to do an exercise, in the preferred representation system, it is easier to understand and learn (Lévano, Albornoz and Venegas, 2017), (Turcsanyi-Szab, 2012).

## 4. INFORMATION TECHNOLOGIES IN CLASSROOMS

Between the advantages of information technologies in classrooms we find (Lévano, Albornoz and Venegas, 2017), (Lévano and Fernandez, 2015):

- From the pedagogical point of view: It allows a greater differentiation of students and create personalized activities according to their learning styles, teaching becomes more interactive and students become more involved in the teaching process.
- It generates autonomous learning: The fact that teaching becomes interactive and therefore the student becomes more involved in the teaching process contributes to the students assuming a greater responsibility in their own learning.
- Motivation: Today we have a generation called “digital natives” in which the use of technology is a fundamental part of how they relate to the environment, which is why the use of interactive content and multimedia materials causes greater attention and motivation of the student to learn.
- More teacher support: The use of IT provides the teacher with a greater number of tools, content and didactic resources that help him to develop a more interactive teaching environment.

## 5. TECHNOLOGY AND LANGUAGE LEARNING

ICTs have attained a significant role as support for learning, the acquisition of new knowledge and the development of new abilities. Nowadays, the use of technology applied to education can be seen through the use of different resources: Webquest, augmented reality, educational gamification, etc. (Gutierrez-Castillo, Puig, and Romero, 2018) Within the games-based learning (GBL), the most recurrent areas are mathematics, health, science and languages. The latter, recently explored in platform games, with computers being its main instrument (Hung et al., 2018).

The setback that can arise is the access or knowledge about technologies, which translates into a barrier especially in rural sectors where digital gaps are greater. Therefore, ICT represent an opportunity to amend differences between educational systems taught in the countryside and the city. The previous idea ought to consider a context of participation and social inclusion (UNICEF, 2017).

Linking this fact to the teaching of Mapuzugun, there will not only be a cultural recovering but also incorporation of useful technologies for the digital connectivity of the new generations (UNICEF, 2017).

## 6. MAPUZUGUN SYNTAX

As is known, the syntax is the correct construction of grammatical sentences, without the notions of syntax you would not know how to combine and relate to each other the language primordial elements. In simple words, the syntax teaches the order and dependence of words in the sentences.

In there is also an order and dependence of the words that make up the sentences, the Mapuzugun syntax (SOCHIL, 1988; Salamanca et al., 2009) has the following structure.

- In Mapuzugun we find phrases without a verb, in this case the syntactic order of the sentence would be: first the adjective and then the noun (See table 2).

Table 2. Mapuzugun Syntax Example without Verbs

| Adjective | Noun | Example |
|---|---|---|
| Kuru | ufisha | black sheep |
| Futra | kuwü | big hand. |
| Motrin | kawell | Big horse. |

- In Mapuzugun we also find sentences having verb, in this case the sentence syntactic order would be: first the verb, second the adjective and finally the noun (See table 3).

Table 3. Example of Mapuzugun Syntax with Verbs

| Verb | Adjective | Noun | Example |
|---|---|---|---|
| Nien | Epu motrin | Kawell | I have two big horses. |
| Niey | Küla kadü | Trewa | He has three grey dogs |

- The above syntactic order allows to elaborate any type of sentence in Mapuzugun, but in addition to the use of the verb, adjective and noun can add the use of adverbs. In the case of adverbs, these do not occupy a definite position within the sentence, so they can go to the beginning of this, the end or between the other words (See table 4).

As we can appreciate the adverbs can be used anywhere in the sentence and allow to modify the sense of this and elaborate even more complicated ideas. Following the Mapuzugun syntactic order and applying this language grammatical laws, we can make simple and complex sentences that allow us to communicate in written form through clear and precise ideas.

Table 4. Mapuzugun Syntax Example with Verb, Adjective and Noun

| parts of the sentence | sentence |
|---|---|
| Verb | Muley |
| Adverb | Kiñe |
| Plural | Kechan |
| Adjective | Kurü |
| Noun | ufisha |
| Adverb | Lelfün |
| Adverb | Mew |

# 7. KIMUN PLATFORM DEVELOPMENT

## 7.1 Platform

Use cases (see figure 2) Kimun platform is designed with eight functionalities as described below:

- Registration: in this use case the functionality is centered on the player's registration, which is entered into a database of players who are part of the class or group of learners.
- Games: in this use case the functionality allows to offer games such as the human body, puzzle, flora and fauna, sentences, exploring agent and tones.
- Levels: in this use case the functionality consists in as the player achieves reward, the system offers you new levels of adventure.
- Worldview: in this use case the functionality lies in showing the Mapuche world where multimedia is integrated, such as sound, image and texts.
- Evaluation: in this use case the functionality allows the trainer / teacher to evaluate the progress of Mapuzugun learning schemes.
- Reflections: in this use case has the functionality that the learner or student notes learned situations about contexts.
- Feedback: in this use case, the functionality is focused on leaving notes by the instructor / teacher for the mistakes that the learner makes.
- Scores: this use case has the functionality to give reward for each level of advance that the learner achieves, which in software is denominated as gamification

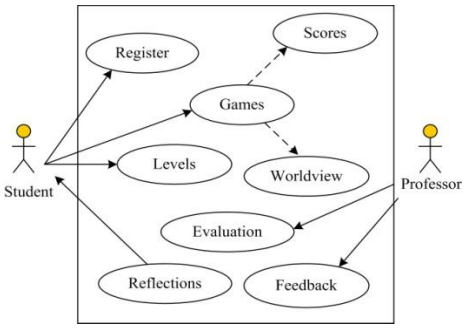


Figure 2. Kimun Platform

## 7.2 Pedagogical Treatment Design for Learning

The proposed instrument is an experiential learning centered on the student with focus on knowledge: being, doing, and knowing. An instrument to safeguard the cognitive process balance is based on the fact that it must maintain the triple concordance in methodology, learning outcomes and knowledge assessments.

The instrument systematization to be addressed by the teacher is: Identification, Learning sense, Closed examples, Activities, Assesments schemes and Support sources.

# 8. PLATFORM RESULTS

Among the platform results responding to the process of cognitive development.


Figure 3. Mapuche Alphabet Interface


Figure 4. Interface of Games that develop the Cognitive Process

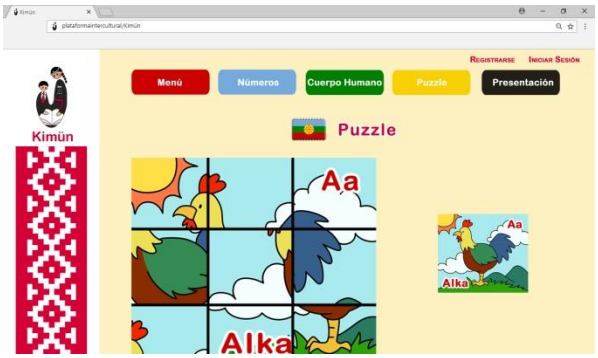


Figure 5. Working Puzzle

Note:
Step 6: Contextualize the solution to another problem.
Step 5: Discuss and criticize the solution.
Step 4: Break down the parts of the result.
Step 3: Modeling application to the problem.
Step 2: Phenomena interpretation to the model.
Step 1: Modeling and Knowledge.

Table 5. Cognitive Process Framework for Mapuzugun

| Methodology | Bloom taxonomy | Mapuzugun |
|---|---|---|
| Step 6 | Creation | Worldview association. |
| Step 5 | Assesment | Reflect. |
| Step 4 | Analysis | Association and sense in paragraphs. |
| Step 3 | Application | Alphabets: sentences |
| Step 2 | Understanding | Interpret the alphabet meaning. |
| Step 1 | Knowledge | Alphabet. |

In Figures 3, 4 and 5 it can be observed that each component designs learning objects (OVAs) as a student learning resource.

## 9. CONCLUSIONS

Facing the phenomenon of the socio-cultural linguistic displacement model can be incubated from the original indigenous peoples without causing cultural disturbances in an invasive way. In spite of the predominance of the Spanish against Mapuzugun language with the help of the communication and information technologies support we can diminish the disappearance of Mapuche language.

Nowadays, in a knowledge society, users are the generators of our own knowledge and we can give the paths to the native speakers to be transported by this Kimun platform, because it is possible to generate Mapuzugun transculturization and conservation. The separability gap between cultures because of conquests can lessen the otherness between different worldviews with technologies help such as web 3.0 (Bisol et al., 2015), (Dabbagh and Reo, 2011).

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# TOWARDS AN E-LEARNING 3.0 CONTEXT-AWARE NOTIFICATION SYSTEM

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**ABSTRACT**

At present, E-Learning 3.0 is becoming more and more dynamic as it is a rapidly growing learning strategy. This paper focuses on designing and developing an E-Learning 3.0 Context-Aware Notification System for The University of Queensland Blackboard in order to improve students' university activities management and enhance their learning experiences. The conceptual and technical knowledge of Web and E-Learning was studied to form the prototype foundation. A number of design and development stages with various techniques were used to build the Front-end and Back-end of the prototype. The final E-Learning 3.0 Context-Aware Notification System prototype was made up of four components, which were Notification Data Extraction, Prototype Website, RESTful API and Prototype Database. This research project offers conceptual and technological contributions towards E-Learning 3.0 in both of the Front-end and the Back-end perspectives. Prospective works will be focusing on completing the rest of the proposed functions.

**KEYWORDS**

E-Learning 3.0, Web 3.0, Context Aware Notification System

## 1. INTRODUCTION

E-Learning is one of the most rapid growing industries in the world now and it will keep continue to grow fast. The market has increasing by 900% since 2000. The total European population that used the self-direct learning increased from 25% in 2007 to 32% in 2013. Besides, nearly 4.6 million students are undertaking one or more courses online in the United State, which is 46% of the total college students in France. The total number of college students who use E-Learning will rise to 50% by 2019 (Laskaris 2015).

The Blackboard Learning System is the current E-Learning system used by The University of Queensland (UQ). It provides a standard course management system for the classroom as well as an online educational assistance for the UQ students and staff (Bradford et al. 2007). In spite of this, different students have various needs and requirements in terms of study load management based on their enrolments. Therefore, the research question of this study is "How to Develop an E-Learning 3.0 Context Aware Notification System for UQ Blackboard?" As a result, this research aims to develop an E-Learning 3.0 Context Aware Notification System (CANS) that can help the students to manage their educational progress more effectively. It can add value by providing more comprehensive learning information through personalised notifications for each individual student. This notification system will also offer students convenience by providing them with integrated learning information, and will reduce the time spent on information searching and browsing.

This paper will first emphasise the literature relevant to the E-Learning 3.0 as well as the CANS. Then the methodology section will describe the design and building process for this CANS prototype. This is followed by the prototype result and outcome of the CANS prototype. After that, there will be discussions to analyse the CANS prototype as well as recommendations for future work.

## 1.1 Research Question

The research question is stated as follow: “How to Develop an E-Learning 3.0 CANS for UQ Blackboard?”

## 1.2 Research Aims

As a result, the project aims to develop an E-Learning 3.0 CANS that can help the students to manage their educational progress more effectively.

# 2. LITERATURE REVIEW

## 2.1 Web and E-Learning Concepts

According to Miranda, Isaias and Costa (2014), Web originated from Web 1.0 as Read Only Web. There was no direct communication between the users and the web owners. Then the web evolved into Web 2.0. as the Dynamic Web, which allows users to read, write, collaborate, social interaction and information sharing (Hussain 2013; Miranda, Isaias & Costa 2014). Web 3.0 will be the next generation web, which is also called the Semantic Web, which can understand the meaning of the content and it will predominantly rely on databases (Miranda, Isaias & Costa 2014).

Dominic et al. (2014) suggest that E-Learning 1.0 was created in parallel with Web 1.0. E-Learning 1.0 was a one direction system that provided interactive functions to connect to the students and instructors (Miranda, Isaias & Costa 2014). Then E-Learning evolved into the 2.0 version, where it became a platform that supported collaborations and interactions (Hussain 2013). Based on Hussain’s (2013) study, it is found that Web concepts and technologies have significant contributions to that of the E-Learning. The E-Learning 3.0 is evolving in parallel with Web 3.0, and it is built based on the Web 3.0 principles.

## 2.2 Web 3.0 and E-Learning 3.0 Concepts

Amarin N.Z. (2015) summarises four Web 3.0 technologies. The first technology is the Semantic Web, which means that the computer can understand the meaning of contents. The second one is Openness, and it indicates the openness among the Application Program Interfaces (APIs), data format, protocol and Interoperability between devices and platforms. Another one is the Global Repository of Data, where the data can be accessed through different applications and platforms in Web 3.0. The Distributed and Cloud Computing is also one of Web 3.0 technologies, being a service rather than a product.

E-Learning 3.0 technologies are predicted to be different from the previous E-Learning generation (Hussain 2013). This author also suggests that E-Learning 3.0 will contain five main technologies, namely Personal Learning Environments (PLE), Mashups, Social Semantic Web, Second Life and Personal Avatars.

Based on Dominic et al. (2014), it is found that E-Learning 3.0 is made up of a number of distinct technologies, which are identified as PLE, Mashups, Social Semantic Web, Personal Agents, Big Data, Linked Data, 3D Visualisation, Virtual Reality, Smart Ubiquitous Device, Augmented Reality, AI, Distributed Computing, Cloud Computing and Global Database.

## 2.3 Related Work

Three existing notification systems designed and built with Web and E-Learning principles and technologies are analysed and evaluated as case studies for the proposed CANS. The first case study develops a context-aware notification application named AlterMe and it is based on the Semantic concepts and personalisation. AlterMe is developed by using ontology languages. Web Ontology Language (OWL) is used for reasoning of the decision making, and the final decision is achieved by Reasoner with Semantic Web Rule Language. There are three modelling techniques used including Modelling people and course, Modelling alerts and Modelling teams and categories (Leonidis et al., 2009).

From the study of Haron et al. (2010), a Radio Frequency Identification (RFID)-based context-aware and personalised notification system is developed for university students. The context-aware indicates that the program or the application can recognise and respond according to users' requirements. In addition, it can change based on users' behaviours. The article identifies four types of context for the project, and three out of four types are selected to form the notification context.

In Amelung's study (2007), the notification system is based on the learner's social context and individual's preferences. The Context-Aware Activity Notification System (CAANS) provides activities' notifications relevant to the users based on the social context and personal interest. The paper then defines the social context and discusses the social context hierarchy. After that, the authors identify the principles of the CAANS framework, where those principles form the foundation of the CAANS.

# 3. PROTOTYPE DESIGN AND DEVELOPMENT

There are four major parts in the prototype design and development section. The first part is the prototype conceptual approach, which is applying the suitable conceptual approaches for the E-Learning 3.0 CANS prototype. The second part is the prototype UI design, where it contains three phases of the UI design. This is followed by the prototype structural design part, where the prototype structure is separated into three components. The last part of this section emphasises building the prototype in the context of coding.

## 3.1 Prototype Conceptual Approach

The proposed notification system is designed and built based on the concepts and technologies of Web 3.0 and E-Learning 3.0. Those concepts and technologies are studied in order to gain a profound understanding of the knowledge, where those Web 3.0 and E-Learning 3.0 practices are discussed and analysed in a collective way. Furthermore, three different notification systems are analysed and evaluated as case studies for the proposed notification system. The reason for those three systems being selected is because they are developed by implementing relevant frameworks and technologies. This CANS also needs to be consistent with its relevant principles, while various technologies will be applied for the application to ensure it can achieve the desired functionalities.

## 3.2 Prototype User Interface Design

The notification UI design of the E-Learning 3.0 CANS prototype is in the second part of this section. The prototype website UI went through three design phases. In the first phase, there is a single UI called Notification Display Board (NDB) which is designed with functions: enable create, update, delete, edit and save actions on the five information segments for every notification at the first phase of the UI design.

Then, the original NDB page is replaced by a new webpage called Student Notification DashBoard (SND) in the second stage of the UI design to enhance the user experience of the prototype type. The SND is changed to be the main page of the CANS prototype. The SND page contains three parts, which include the Header section at the top, the Event Modification section on the left and the Event Display on the right. The Event Modification section enables the users to modify the notifications in the six different notification precincts in the Event Modification section. Those notifications precincts are personal, assignment, school, faculty, university and club.

More transformations are made in the third phase of the UI design. The layout of the SND webpage is changed into left and right. A fixed vertical navigation bar is on the left with seven tabs, where those first six tabs are linked to six corresponding notification webpages. Those six webpages correspond to the six notification precincts. Every notification row in those six pages provides edit, save and delete functions for notification, and the seventh tab on the navigation bar allows users to create the new notification on the related notification page (Figure 1).

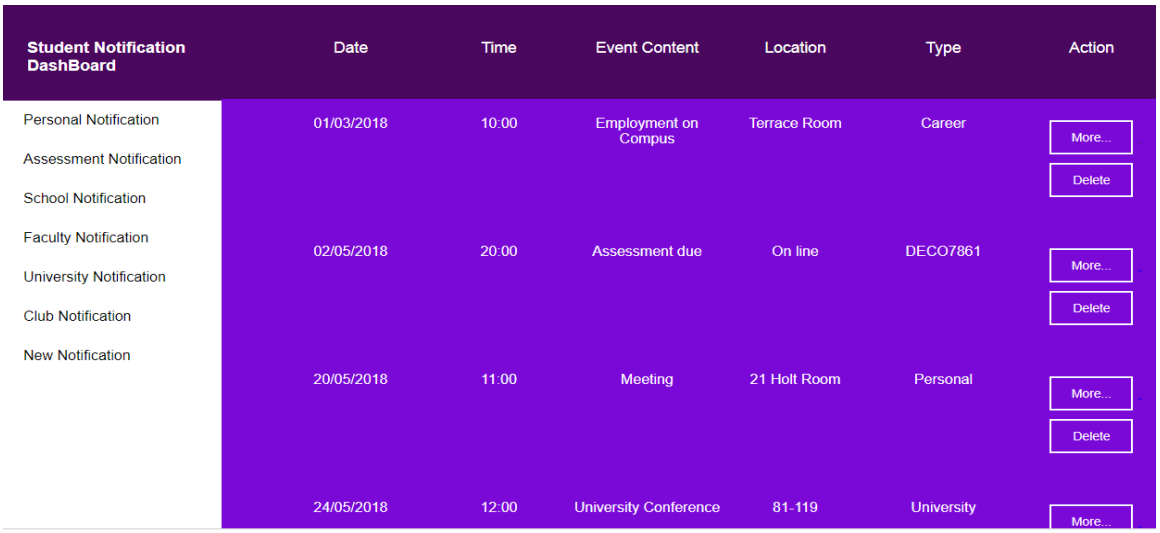


Figure 1. Student Notification Dashboard

## 3.3 Prototype Module Structure

The proposed CANS prototype structure is made up of two parts, which are the Front-end and the Back-end. The Front-end is made up of the Notification Data Extraction (NDE) and CANS website. The client side displays all the notification information and operates the simple functionalities of the notification system. The Back-end of the CANS prototype is designed to provide the RESTful API and Database functions. Therefore, it is necessary for the structural design of the prototype to be sophisticated enough to meet best practice standards and requirements in order to satisfy the proposal. The structure of the E-Learning 3.0 CANS prototype is designed at the different phases of the prototype structural design.

Notification Data Extraction (NDE) Module is proposed to extract notification from relevant webpages of the UQ website and it needs to sort personalised notification information into six notification categories. Then the information is stored in the Back-end Database and can be displayed on the prototype webpages. The NDE module resolves tasks on the notification data extraction and formatting.

Prototype Website Module of E-Learning 3.0 CANS is designed with three sets of functional webpages, where each set of the webpages is designed with different UI illustrations and functions to achieve their distinct purposes.

The third section of the E-Learning 3.0 CANS prototype structure is the Representational State Transfer Application Program Interface (RESTful API) and Database. RESTful API operates within the Model-View-Control (MVC) architecture. The Model (M) can pull data from the Database without knowing the complexity of the Database, and it also provides an abstraction layer with the Database. The Controller (C) manipulates the information flow between the model and the view. It controls what data is retrieved from the Database and what data is sent to the view by programmed logic. It also receives information from the client and applies the logic by changing the view, or modifying the data through the view, or both (The Django Book, n.d.).

The last component of the CANS prototype is the Back-end Database. The Student Table has relations with the Faculty, School, Club and Course Table, which in turn, all have relationships with the Event Table. This Back-end database relation design can link all the notification data together, in order to realize the Linked Data concept.

## 3.4 Prototype Code

The last part of the E-Learning 3.0 CANS prototype development is building the prototype by coding. The NDB page and the initial SND page are both written by using HTML and CSS. In the later version the prototype, all of the webpages are built using ReactJs and CSS. Then, the Notification Data Extraction module is written by using Python. The Web API is coded by using C# and the Back-end database if coded by using SQL.

# 4. PROTOTYPE OUTCOMES

The end product of the E-Learning 3.0 CANS prototype consists of four components each of which manages particular tasks based on their functionalities.

The final NDE program is written using Python language. It can achieve extraction on five categories of notifications from predefined webpages of the UQ website, and the prototype can save those notifications as Excel files and store them on the desktop computer. Those notification categories include the users' assignment, exam, school, faculty and university. Those assessment notifications are from four random Master of Information Technology courses.

The second component is the CANS prototype website (Figure 1), where all the webpages are built by using ReactJs and CSS. The first six webpages are the six respective notification pages on the left. The vertical navigation bar with six notification options is on the left, and those options are linked to the six corresponding notification webpages. The New Notification option is connected to create new a notification page. Every row of notification in the notification webpages directs to the More and Delete webpages. The More page links to full notification view and it allows Edit, Save and Back, while Delete connects to the delete notification page that enables delete.

The third component of the CANS prototype is the Web API, which is written by using C#. Web API is built to with data manipulation methods to enable the webpages function to modify the data stored in Back-end database.

The last module for the E-Learning 3.0 CANS prototype is the final Database module (Figure 2) and it is set up by using the MySQL Workbench. The Database is built with the different notification tables where they are interconnected. The connections form relationships among the linked tables; hence all the different notification data are linked and accessible. There are seven notification tables in total, each having at least two relationships with other tables.

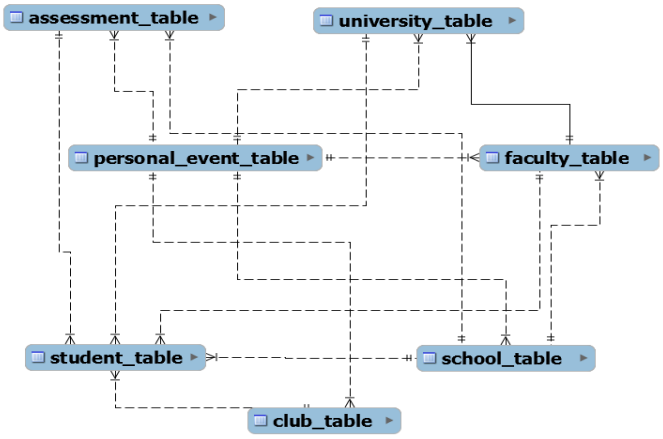


Figure 2. Database Structure and Relationship

# 5. PROTOTYPE EVALUATION APPROACH

For this project, the focus group is conducted at the Institute for Teaching and Learning Innovation (ITaLI) that is located at the UQ St Lucia Campus. Six students who are currently undertaking at least one course during the semester are investigated on the CANS prototype user experiences through focus group interview to evaluate the prototype. The project researcher carries out the focus group activity and collects feedback of the prototype from six UQ students between 3pm and 4pm. The response recording process is achieved by writing down participants' answers on paper as they speak. Taking notes as respondents speak allows the researcher to record complete and accurate feedback of the participants.

There are five questions for the focus group interview, and those questions are selected based on focusing on user experience of the E-Learning 3.0 CANS prototype on various aspects. Before the prototype user experience testing commences, the researcher provides a project introduction which allows the participant to have an overall understanding of this research. After that, the researcher presents a walkthrough based on three tasks on the prototype with the students, where each task focuses on a specific area in order to cover all aspects of the prototype. Afterwards, the researcher asks the students five questions in order to learn their user experiences on the prototype.

## 5.1 Prototype Walkthrough Tasks

Task 1: Check all types of notifications

This walkthrough task's goal is for the participants to determine whether the different notifications in the CANS website pages are accessible, perceivable and understandable for them.

Task 2: Check the complete notifications

This walkthrough task's goal is to show the participants the method of checking the complete details of the notifications and how to use the More button.

Task 3: Create, edit, save and delete a notification

The third walkthrough the on CANS website is to use the Create, Read, Update and Delete (CRUD) functions to assess whether the participants could easily find those functionalities and the effectiveness of those functions.

## 5.2 Focus Group Interview Evaluation

During the focus group session, the researcher asks the six students five open-ended questions relevant to the aspects of the CANS prototype after the walk through is completed:

1. Does the prototype do what it is supposed to do?
2. Do you think the prototype's design matches its purpose, and does the UI look good?
3. What prototype features are missing?
4. Does anything in the prototype seem out of place or unnecessary?
5. When you are exploring the product, does the prototype confuse you?

# 6. FOCUS GROUP RESULTS

## 6.1 Question 1: Does the Prototype do what it is supposed to do?

For this first question, there were three participants with similar answers. They considered that the E-Learning 3.0 CANS prototype was not effective enough in terms of notifying the UQ students on their related activities, as there should be a snapshot of the notification at the Student Dashboard of the UQ Blackboard, where the snapshot user interface shows important notification information. One of these students said that this extra UI can encourage students to check the NDB and be more organised. There was one interviewee concerned that the students could be overwhelmed by the notification. The participant also doubted the logic of the Database in terms of notification editing and updating. The notifications can be the notification category from Assessment to University. Other students thought that the prototype was functioning as they expected.

## 6.2 Question 2: Do you think the Prototype's Design Matches its Purpose, and does the UI Look Good?

The participants mainly had feedback with opposing opinions on the prototype user interface design of the E-Learning 3.0 CANS prototype. There were two students who thought that the SND user interface was not well designed, and both of those students suggested the notifications should be displayed in calendar view. One of the two participants recommended that the calendar view should be exchangeable with the current

notification list view. The other student opposed the notification list view design and the student thought the list was too long to scroll down and view.

From the previous question, there were students who provided the suggestions on the user interface design of notification snapshot mentioned above. Those focus group interviewees expressed that there should be a banner-like area in the Student Dashboard of the UQ Blackboard with notification reminders, where it could display prioritised notifications with the number of new notifications. One of the students suggested that there needed to be a home page where all the different categories of notifications should be in one list and ordered by date. The other participant also underlined the importance of the notification snapshot banner in terms of its colour and location choice. The person indicated the colour must be bright and distinctive, and the location must be easy to find.

Although there are many UI issues raised by the participants, they all had positive feedback on the notification information sorting. Participants agreed that the prototype organised the different event information so that they were neat, easy to read and understand. Two students responded that the prototype notifications were comprehensive and they did not need to obtain the information elsewhere, which was convenient for them.

## 6.3 Question 3: What Prototype Features are Missing?

The feedback for this question mainly focuses on the functional elements. There was one participant who wanted to view the notifications by date or by type. This respondent also recommended that the webpage links should also be provided for all the notifications in the school and faculty categories for accessibility. The interviewee also suggested choosing different colour backgrounds for the various types of notifications in the notification list, so that the notifications could be better distinguished from each other.

Another student also suggested notification filter by the notification type. This student recommended that the updates and edits on the notifications should be highlighted. The fourth participant would like to allow notifications prioritisation. An interviewee suggested that the prototype needs to prevent the users making mistakes with clear displays. This student also recommended adding a notification type for assessment grades.

## 6.4 Question 4: Does anything in the Prototype seem out of Place or Unnecessary?

This question prompted different responses. There was one student who thought it is not necessary for the faculty notification to be editable. Another student advised that the notifications from university are not very essential. One of the participants said the notifications for university and faculty could be combined into one.

## 6.5 Question 5: When you are Exploring the Product, does the Prototype confuse you?

For this question, all the focus group participants had similar responses that the E-Learning 3.0 CANS prototype was not confusing to them. The participants thought that the prototype organises the notification information so that it is neat and easy to interpret. In addition, they also suggested that the functions were not confusing to use.

# 7. DISCUSSION

The E-Learning 3.0 CANS prototype only achieves some of the proposed functions. First of all, ReactJS is effectively used because the CANS website is heavily data dependent. In addition, the prototype can provide notification based on users' learning information from different sources. Apart from that, it can notify university events to the users. In addition, the CANS prototype allows users to add new personal notifications. Furthermore, the CANS prototype organises and demonstrates the notifications in a systematic way.

In spite of this, many of the proposed functions cannot be implemented due to time and knowledge constraints. Those include: show empty time slots to an individual student, auto scheduling with personalised learning activities, auto learning information recognition and sorting and allow users to organise the notification based on their preferences. The four components of the prototype are not combined, and only the dummy notification data is used for the website.

Those functions cannot be implemented, because there is a large amount of new knowledge needed to accomplish them. The researcher needs a significant amount of time to learn and understand the techniques covered in the four components. It is outside the researcher's ability to learn and understand the knowledge mentioned above in the given time frame.

## 8. CONCLUSION

In this paper, there are various approaches and techniques used in order to design and to build an E-Learning 3.0 CANS for UQ Blackboard, as the current UQ Blackboard notification system is not effective. The actual prototype does not achieve all the purposed functions, but the initial idea is to develop the system with the Semantic, Context Aware and Linked Data techniques in order to assist the students to manage their study related activities better and improve their study experiences. The current E-Learning 3.0 CANS prototype provides a foundation for developing more advanced functionalities in order to meet these aims.

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# DIGITAL EDUCATION POLICIES IN ITALY: A RECOGNITION ON THE ACTIONS REALIZED

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**ABSTRACT**

This article covers in its first part the digital educational policies elaborated in Italy as part of the plan known as "Piano Nazionale Scuola Digitale" (PNSD). This plan constitutes in fact the orientation document issued by the "Ministero dell'Istruzione, dell'Università e della Ricerca" (MIUR) for the introduction of a comprehensive strategy of innovation for Italian schools, and a new placement of its educational system in the digital age. In the second part of the article, we report the data (extracted by "Osservatorio Tecnologico" of MIUR) concerning the condition of the digital school in Italy, through a survey of the actions undertaken and the criticalities encountered, deepening the theme of digital skills and media education.

**KEYWORDS**

Digital, Education, Policies, Italy, Good Practices, Competences

## 1. INTRODUCTION

For years now, there have been many enquiries about what kind of education should be promoted in the digital age, and what tools should be used to do that. The debate between experts in media education, media literacy, teachers and policy makers is intense and rich. An important premise is that to speak only about digitalization is no longer enough. That is because we risk to exclusively focusing our efforts on the technological dimension, rather than on the epistemological and cultural ones. The "Piano Nazionale Scuola Digitale" represents in Italy a basic component of Law 107/2015, an operational vision that reflects the position of the Italian Government in relation to the most important challenges of innovation of the public system: the core of this vision is the innovation of the school system and the opportunities offered by digital education. Therefore, it is not a simple application of technology: in fact, no educational step can be separated from an intensive interaction between teacher and student (as recently mentioned by OCSE) and technology cannot be distracted from this fundamental "human relationship", in which the individual is a core part. Therefore, PNSD answers the call for the establishment of a vision of Education in the digital age, through a process that, as far as schools are concerned, is related to the challenges that the whole society faces in the interpretation and support of lifelong learning (life-long) and in all contexts of life, formal and informal (life-wide). This is confirmed by the High Level Conference of the European Commission of December 2014, by several publications of the OCSE's Centre for Educational Research and Innovation, by the New Vision for Education Report of the World Economic Forum, and by research such as "L'Educazione per il 21° secolo" published by Ambrosetti Think Tank. It is, primarily, a cultural action, which starts from a renewed idea of school, intended as an open learning space and not merely a physical place, and as a platform that enables the students to develop their skills needed during their lives. In this paradigm, the technologies become enabling, daily, ordinary, at the service of the school activity, first and foremost the activities oriented to training and learning, as well as to the administration, contaminating - and, in fact, reuniting - all the school spaces: classrooms, common spaces, laboratories, individual spaces and informal spaces. With repercussions that spread throughout the territory. The objectives are the same as those in the educational system: the competences, the learning, the results of the students and the impact that they will have on the society as individuals, as citizens, and as professionals. These objectives will be updated in content and methods, in response to the challenges of a world that is rapidly changing, which requires more

and more mental agility, transversal skills and an active role for young people. These objectives will be updated in content and methods, in response to the challenges of a world that is rapidly changing, which requires more and more mental agility, transversal skills and an active role for young people. This is why it is mandatory - and this represents the greatest cultural and human investment - for all school staff, and not only the teachers, to get involved, and be supported, in order to embrace the essential challenges of innovation: methodological-didactic challenges, for teachers, and organisational challenges, for school leaders and administrative staff. The tools to achieve them, or at least to follow their path, are contained in this Plan, and will probably not be limited to it. Defining the skills that students need is a much wider and more structured challenge than the one that the common feeling synthesizes in the critical use of the Web, or in IT. We need to address it starting with an idea of skills aligned to the twenty-first century: consisting in new literacy, but also, and especially, of transversal skills and attitudes to be developed. Specifically, there is also a need to strengthen skills relating to the understanding and production of complex and articulated contents, within the world of digital communication, where granularity and fragmentation sometimes take precedence. That is why it is essential that we work on information literacy and digital literacy, focusing on the role of information and data in the development of an interconnected society based on knowledge and information. It is in this context that we must consider the challenges represented by the relationship between public and private, the relationship between digital creativity and craftsmanship, and between digital entrepreneurship, manufacturing and work. It is also in this context that the introduction to logical and computational thinking and the familiarisation with the operational aspects of information technology should be placed. In this paradigm, students must be informed users of digital environments and tools, but also producers, creators, designers. And the teachers, on their side and in particular with regard to e-skills, will have to be placed in the right conditions, in order to be able to act as facilitators of innovative educational pathways, based on content that is more familiar to their students.

## 2. POLICIES ABOUT DIGITAL EDUCATION IN ITALIAN SCHOOLS

In 2007, for the first time in Italy, a National Plan for the Digital School was presented, with the main objective of modifying the learning environments and promoting digital innovation in the school (Table 1).

Table 1. Investments for Digital Environments in Schools

| N. of schools involved | N. of realized projects | Amount invested |
|---|---|---|
| 3.600 | 14.983 | € 494.000.000,00 |

We will review the different actions taken by the MIUR on this matter. In 2008, for the first time, the "Azione LIM" - which promoted the widespread use of the Interactive Multimedia Whiteboard (LIM) in classroom teaching - was promoted. The interactive whiteboard was seen as an object with features that were similar to the slate board that was supposed to be used in the classroom, without spoiling them, and allowing teachers to acquaint themselves progressively with these technologies. With this action, 35,114 interactive whiteboards have been assigned and 72,357 teachers have been formed for both the technical and didactic use of the interactive whiteboard. Afterwards, "Action Cl@ssi 2.0" characterized by the slogan "no longer the classroom in the laboratory, but the laboratory in the classroom" had the aim of stimulating the design and implementation of innovative learning environments. The project involved, starting in 2009 and in the following 3 years, 416 classes of all levels on the purchase of technological equipment and for support and training. In 2010 "Azione Editoria digitale scolastica" focused on the production of digital content in 20 schools, across the various school orders and levels; in 2011 "Azione Scuol@ 2.0" allowed 14 schools to pursue a very advanced line of innovation, through strategies that combine innovation in educational planning to new models of human and infrastructural resources' organization of the school institution. In 2012 "Accordi MIUR – Regioni": in order to support the process of digital innovation in a more capillary way on the territory, the previous mentioned agreements "MIUR – Regioni" were created, to ensure greater synergy and collaboration between central and regional levels. These agreements, signed on 18 September 2012, made it possible to assign an additional 1,931 LIM, form 905 Cl@ssi 2.0 and 23 Scuole 2.0. In the same year, the "Azione Centri Scolastici Digitali" (CSD) (Digital School Centres Action), was established in order to meet the needs of schools located in particularly disadvantaged areas from a geographical point of

view (legislative decree 18 October 2012, n. 179), and allowed 45 initiatives to be implemented to support schools located on small islands or in mountain areas, equipping them with technological infrastructures and connecting them to schools in urban centres. In short, the 2008-2012 investment strategy aimed to bring the digital world into the classroom, to address a large number of students, regardless of the disciplines involved. In 2013 was launched "Azione wi-fi" for wireless connectivity in schools. Then was born "Azione Poli Formativi", through which some educational institutions have been identified for the organization and management of digital training courses for teachers (Table 2).

Table 2. Investments on Training of Teaching Staff on New Technologies

| Objective | Actions | Amount eligible for funding | Realized projects | Schools reached (average per y.) | Teachers involved |
|---|---|---|---|---|---|
| To increase the dissemination, access and use of information in schools | Training for teachers and school staff on new communication technologies | € 45.628.737,81 | 5.557 | 495 | 128.618 |
| | Initiatives for the development of the information society through multi-functional service centers | € 5.483.532,00 | 218 | 495 | 15.078 |
| | National Projects | € 7.072.776,84 | 8 | 495 | 147 |

Specifically, following a special public notice, the schools involved (both as individuals and organized in a network) were invited to present their training projects, and the best ones were selected to play the role of the so-called "Training Poles" and, therefore, had the task of organizing and managing the teacher's training as described in the selected project. For the training activities, the Training Poles have employed teachers who are competent in the field, identified on the basis of provincial lists (selection of 2013) or regional lists (selection of 2014), prepared by the respective regional school offices, following the submission of voluntary applications by interested teachers. It is, in fact, an activity of peer training. 25,056 requests from teachers were registered, while 2,473 tutors, chosen from among teachers of all levels, were self-applicants as trainers. During the 2007-2013 programming period, Basic and Advanced Didatec projects were promoted, and about 480 schools were involved as headquarters/presidents of courses. For the Basic and Advanced Didatec projects, 20 teaching units were produced: 15 materials dedicated to kindergarten on the use of technologies for teaching and digital media education, plus 5 materials documenting experiences related to coding

## 3. THE STATE OF THE ART OF THE DIGITAL SCHOOL IN ITALY

There are 326,000 classrooms in over 33,000 "active" school buildings: 70% of them are connected to the network via wire or wireless (but usually with a connection that is not suitable for digital teaching), 41.9% are equipped with interactive whiteboards and 6.1% are equipped with interactive projectors. There is a total of 65,650 school laboratories, with an average of 7.8 per institute. Of these, 82.5% are wired or wirelessly connected to the network, 43.6% are equipped with interactive whiteboard and 16.9% with interactive projectors. A general estimation, summing up the endowments of classrooms, laboratories and school libraries, indicates in approximately 1,300,000 units the technological endowments available to the schools (605,000 in the laboratories, 650,000 in the classes and the remaining amount in the libraries). A summary of the technology/students ratio over the past year has shown a shift from a national average of 1 device for every 8.9 pupils to one of 7.9: although the figure does not allow qualitative interpretations, it is a demonstration that the penetration of the digital school is made concrete. These are the data contained in the Technological Observatory managed by MIUR and referred to the surveys of the school year 2014-2015. In 2000, the Technological Observatory was established as a telematic support service to collect data on the digitization process of schools. For that purpose, surveys were carried out periodically on the spread of new technologies in Italian educational institutions. In 2008, with the formalisation of the Interministerial Working Group for the Development of Scientific and Technological Culture, the survey took on a census importance, and focused on the state of scientific equipment and laboratories in schools. As a research

methodology the surveys relating to the multimedia equipment of the didactics were conducted systematically and periodically by the MIUR. These are surveys to which the schools (state and equal) adhere voluntarily, but a very good response rate has always been recorded (97.6% for state schools and 54.1% for charter schools). The last analysis (in relation with the academic year 2014/2015) was divided into 3 main areas: dematerialisation of services (sites and portals, school-family communication, electronic class and teacher register, centralised management of educational multimedia contents); technological equipment of laboratories and libraries (connections, computers, interactive whiteboards and projectors); technological equipment of classrooms (connections, fixed and mobile devices supplied to students and teachers, interactive whiteboards and projectors). In analogy with the OCSE indicator that monitors the supply of PCs and other educational tools for students, the MIUR survey also offers a summarized data that attempts to measure the degree of digitization of educational institutions (also allowing a geographical comparison between different situations) comparing students and new technologies. As far as digital administration is concerned, the data from the 2014-2015 survey contained in the Technological Observatory showed a fairly good progress in the dematerialization and digitalization of the services of educational institutions. 99.3% of educational institutions have their own website, 58.3% use forms of online school-family communication, 69.2% use a type of electronic class register (no accurate data is currently available for "class" dissemination), 73.6% use the teacher's electronic register and, lastly, 16.5% use forms of centralized management LMS (Learning Management Systems such as Moodle) for teaching and its contents. The administrative digitization of schools is instead a more difficult process: a recent study conducted by the MIUR shows a level of saturation of the paper archives of schools already at 80%; in addition, 68% do not appear to have a document management computer system, and at least 80% do not have the one for substitute storage according to law. As far as digital identity is concerned, article 1, paragraph 28, of Law no. 107 of 2015 introduced the objective of associating a student's profile with a digital identity. So far, the main process through which the MIUR has associated a digital profile to students has been the Student Card, which is currently a personal card attesting to the status of student; it is associated with the student's access to an online area, that allows them to access different kinds of goods and services and to policies on the right of education. There are 2.7 million active "Student Cards" in circulation (and 8 million distributed over the years), on which have been activated 47,000 agreements with public and private partners, 3,000 of which of a national type. In addition, 1 million students are registered on the "IoStudio" portal, for 370.000 accesses per week. As far as digital content is concerned, the Database of textbook adoptions for the academic year 2015/2016 outlines a still rather limited scenario of digital adoptions. The three types of adoption (provided for by Ministerial Decree 781/2013), are divided as follows: in the second grade secondary, 35% adopts mainly paper books with supplementary digital content, 63.9% also digital books and 1.1% only digital materials, while in the first grade secondary the percentages are respectively 33.2%, 66.1%, 0.7%. The official figure for other formulas for the adoption and use of content, thus including self-production, on the other hand, is 2% for the second grade and 1% for the first grade. As far as student skills are concerned, Italy ranks 25th in Europe for the number of Internet users (59%) and 23rd for basic digital skills (47%). This gap is also visible in the case of specialist ICT skills (17th place) and in the number of graduates in Scientific or Technological disciplines (STEM), for which Italy ranks 22nd, with 13 citizens for every 1,000. As for the students, according to recent OCSE data, every fifteen-year-old Italian uses the computer in class 19 minutes a day, against an OCSE average of 25 minutes, with peaks in Greece (42 minutes) and Australia (52). The OECD-PISA tests, on the other hand, show adequate results with regard to problem-solving (510 compared to an OCSE average of 500), but are lacking in terms of skills in mathematics (485 compared to an average of 494) and science (494 compared to an average of 501). However, there was an average growth between 2002 and 2013 for the overall Italian result. As regards the relationship between digital entrepreneurship and work, the recent EU Commission Communication on "Digital Single Market" documents that the demand for workers with "adequate digital skills" is growing by 4% per year across Europe and could reach 825,000 uncovered jobs by 2020 if no concrete actions are developed. As far as teacher training is concerned, the data of the OCSE TALIS 2013 survey sees Italy in first place for ICT training needs of its teachers: at least 36% stated that they were not sufficiently prepared for digital teaching, compared to an average of 17%. Italy is also the leading OCSE country, with a distance from the others, for the percentage of teachers aged over 50 - 62%, compared to an OCSE average of 35% in secondary school (OECD, 2014). This data will improve with the recruitment provided by "La Buona Scuola" but it will remain remarkably high. The Digital Economy Index ranks Italy in 25th place out of 28, with structural weaknesses in connectivity and human capital. This subject has, on one side, a strong impact on the growth of the digital school, on the other side, has a great

stimulation potential. In the last year, the (strictly) digital economy represented 2.54% of total employment in Italy, and 3.72% of GDP (according to OCSE sources). The first data is substantially in line with the OECD average (2.85%). Two key issues cause this: the process of digital school diffusion that in recent years has been rather slow, and actions often not incisive and not comprehensive, although in line with the objectives set at European level. The time has come to invest in an organic plan of innovation for Italian schools, with coherent programmes and actions that include access, learning environments, devices, platforms, digital administration, research, training and, of course, teaching, methodology and skills.

## 3.1 The National Plan for Digital School (PNSD)

The "Piano Nazionale Scuola Digitale" (PNSD) stipulates 27 actions to achieve the objectives listed: **action #1** - Ultra-wideband optical fibre for every school; **action #2** - Indoor cabling (LAN/W-Lan) for the entire school premises; **action #3** - Connectivity fee: the right to the Internet starts at school; **action #4** - Environments for integrated digital teaching; **action #5** - Challenge Prize for the digital school (Ideas' Box); **action #6** - BYOD (Bring Your Own Device) Active Policy Guidelines; **action #7** - Plan for practical learning Synergies - Innovative School Building; **action #8** - Unique Authentication System (Single-Sign-On); **action #9** - A digital profile for every student; **action #10** - A digital profile for every teacher; **action #11** - Administrative digitalization of the school; **action #12** - Electronic register; **action #13** – "School data" strategy; **action #14** - A common framework for students' e-skills; **action #15** - Innovative scenarios for the development of applied e-skills; **action #16** - A research unit for 21st century competencies; **action #17** - Bringing computational thinking to the whole primary school; **action #18** - Upgrade the "Technology" curriculum to the first grade secondary school; **action #19** - A curriculum for (digital) entrepreneurship; **action #20** - Girls in Tech & Science; **action #21** - Digital Careers Plan Synergies - School-work alternation for digital enterprise; **action #22** - Minimum standards and interoperability of online learning environments; **action #23** - Promotion of Open Educational Resources (OER) and guidelines on self-production of educational content; **action #24** - School Libraries as literacy environments for the use of digital information resources; **action #25** - In-service training for educational and organisational innovation; **action #26** - Strengthening initial training on educational innovation; **action #27** - Technical assistance for first cycle schools Synergies - New training for new employees.

# 4. DIGITAL COMPETENCES AND MEDIA EDUCATION OF STUDENTS

Talking about digital competences involves a wider starting point: firstly, it means talking about competences, and then about didactic paths and pedagogical plans. If the objective of our educational system is to develop students' competences, instead of simply "transmitting" study programmes, then the role of competence-based teaching, enabled by digital competences, is fundamental as it activates cognitive processes, promotes relational dynamics and induces awareness. Skills are not taught, they are acquired, and the link between skills and new learning environments is undoubtedly strong. The educational model on which to work is the competence-based learning, meant as planning that focuses on transversality, sharing and co-creation, and as didactic action characterized by exploration, experience, reflection, self-evaluation, monitoring and evaluation. The first step is therefore to take advantage of the opportunities offered by digital technologies to address the skills developed during the course of the project. In this framework, digital technologies support all dimensions of transversal competences (cognitive, operational, relational, and metacognitive). But they also fit vertically, as part of the literacy of our time and fundamental skills for a full, active and informed citizenship, as anticipated by the Recommendation of the European Parliament and the Council of Europe and as even better emphasized by frameworks, such as 21st Century Skills (Skills for the 21st century), promoted by the World Economic Forum. The interpretation of what skills are useful and central in our time cannot be disconnected from the historical phase in which our students are growing up, and is thus constantly evolving. Frameworks, such as 21st Century Skills, are therefore an important link between the general framework in which education operates - teaching and skills - and the need to express the role, both vertical and transversal, of digital skills. In this vision, digital is both Foundational Literacy (new basic literacy), with its important and growing verticality, and a crucial vector for the development of Competencies and Qualities. The e-skills vision echoes in the paradigm of media and media education,

through early dimensions. Digital is, in fact, on the one hand a "conveyor belt", a characterized and unneutral media for developing and practicing skills and attitudes, within and through each discipline; a didactic for problems and projects. It is the "alphabets" of our time - at the centre of which lies computational thought - a new syntax, between logical and creative thought, forming the language that we increasingly speak today. It is, finally, at a higher level, acting as agent of the great social, economic and behavioural changes in the economy, law and architecture of information, and that results in "digital citizenship" skills, essential to tackle our time. With an emphasis on this last dimension, there are very interesting experiences of mapping and reconstruction of skills, such as the Web Literacy framework edited by the Mozilla Foundation and the effort made by Media Smarts on behalf of the Canadian Government. To further support the construction of a conceptual model, there are frameworks such as DIGICOMP (Ferrari, 2013), which identifies a list of 21 described competences for knowledge, skills and attitudes, included in 5 areas: Information, Communication, Content Creation, Security and Problem Solving. These frameworks are therefore useful for identifying the specific skills required, and in close contact with Information Literacy. The development of students' e-skills therefore requires, also in Italy, a dedicated strategy aimed to assist educational institutions in their didactic planning, starting from a first necessary orientation action, through the identification of a clear and shared framework. It is necessary to clarify what are and will be central contents for the students, enhancing their close link with the new learning environments and paradigms facilitated by ICTs.

## 5. CONCLUSION

According to the analysis of the article, an investment must be made in a sustainable vision of a digital school, not limited merely in placing technologies at the centre of the spaces, on the contrary enabling the new educational concepts to be developed and practiced by teachers and students, together with the technologies. The necessity of bringing laboratory teaching back to the centre is strongly felt, as an essential meeting point between knowledge and know-how. The core of this vision is the innovation of learning environments. Each school must have an enough number of environments and equipment allowing digital teaching, chosen and adapted to the needs of teachers and students as well to the contexts of their realization. To make sure that the classroom is no longer a physical limit but a place empowering and accessible, is required a package of investments, primarily, for the creation of "light" and flexible environments fully adapted to the use of digital. Secondly, in terms of policies, we need to overcome a fragmentary system in which the concentration of investment into certain schools, especially in "technology intensive environments", has failed to deliver the benefits of the system. The analyzes presented in the paper, which are the result of a personal reflection, contribute to provide specific information about Italian policies on digital education. Through careful monitoring of all the actions promoted in this field by the Italian government and the MIUR allows an international audience to know the good Italian practices activated.

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# Short Papers

# FACULTY-STUDENTS ONLINE COMMUNICATION CHANNELS

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**ABSTRACT**

In recent years, we have witnessed a significant expansion of the communication channels available to lecturers and students. The purpose of this study is to examine the considerations guiding faculty members in choosing the communication channels they offer their students and the connection between the communication channel chosen and personal and organizational characteristics. The study was conducted using a questionnaire distributed among lecturers through public distribution lists and social networks. A total of 128 respondents completed the questionnaire. It was found that the lecturers' use of the various communication channels available to them was conservative, i.e., the leading channels in use were formal communication (e-mail, face-to-face meetings, and course websites). The lecturers made very little use of personal communication channels and rarely used social media. It was also found that organizational climate, personality characteristics, and the perception of the lecturers' role were related to the use of personal and social communication channels.

**KEYWORDS**

Faculty-Students Communication, Out of Class Communication, Communication Channels, Social Networks, Course Site

## 1. INTRODUCTION

Over the past few years, there has been a significant increase in the use of digital media for communication purposes. This change challenges the student-faculty communication channels outside the classroom and raises questions about the boundaries, availability and students' access to faculty members. The purpose of this study is to examine the considerations guiding faculty members in choosing the communication channels they offer their students and the connection between the communication channel chosen and personal and organizational characteristics.

## 2. FACULTY-STUDENT OUT OF CLASS INTERACTION

In the past, informal interactions between students and lecturers took place primarily in the hallways of the academic institution and in face-to-face communications. In recent years, we have witnessed a significant expansion of the communication channels available to lecturers and students. These channels include e-mail, LMS communication tools such as forums, organizational communication systems, instant messaging, and social networks (Hoffman, 2014). Most of the research has focused on the importance of interpersonal and informal teacher-student communication for students and their impact on the learning experience, perseverance in studies, and even scholastic achievements (Lundberg & Schreiner, 2004). As for the lecturers, they rarely initiate informal communication with their students (Cox et al., 2009; Einarson and Clarkberg, 2004).

Most of the applications made to lecturers by mail deal with the request to postpone assignments and questions about the learning content. In addition, there were differences between the organizations investigated in terms of the use of e-mail for lecturer-student communication.

With the increasing use of social networks among students and lecturers, these channels began to serve as an additional platform for lecturer-student communication. Many faculty members are reluctant to establish informal Facebook communication with their students. This is mainly due to the fact that the information in this media is not compartmentalized and they are reluctant to expose the students to their personal lives (Abel, 2005, Hewitt & Forte, 2006; Mendez et al., 2009). Nevertheless, exposing the teachers' private lives to their students through Facebook, and increased exposure of the lecturer to Facebook contributed to the student's perception of the lecturer as credible and human (Mazer et al., 2009; Sarapin, & Morris, 2015).

In recent years, instant individual and group messaging, such as WhatsApp, which is widely used around the world, have become another popular tool of communication (Bouchnik & Deshen, 2014). Using WhatsApp in academic courses has proven to contribute to student achievement and satisfaction (Davidovitch & Yavich, 2016). Nevertheless, there are also challenges and problems using this channel for communication with students. WhatsApp is perceived as a channel of immediate response and so students have high expectations of lecturers' availability and response time. Conversely, lecturers are apt to be stressed and annoyed when receiving messages via this channel (Bouchnik & Deshen, 2014).

In light of the changes in digital media channels in recent years, it is necessary to re-examine the attitudes that lecturers develop regarding the use of various media channels for informal communication outside class and the considerations that guide them in choosing the right media channel in different contexts and for different needs.

# 3. METHODOLOGY

## 3.1 Research Questions and Research Tools

The study was conducted using a quantitative, survey based methodology. A three-part questionnaire was distributed among lecturers and teaching staff in Israel. The questions relating to the demographic details of the respondents, their communication habits with their students, and the organizational climate were composed especially for this research. The questionnaire was first submitted to a small group of experts for validation and then distributed through a public mailing list of academics in Israel (SocSci-IL) and on social networks such as the Facebook page of Israeli academia (Academia-IL-Network)

The research questions are:

1. To what extent do lecturers use various online communication channels to communicate with students?
2. Is there a correlation between the extent to which the lecturers use various channels of communication and their perception of the *role of lecturer*?
3. Is there a correlation between the extent to which teachers use different media channels and their perceptions of the *organizational climate* and policy of the institution in which they work?

## 3.2 The Sample

The questionnaire was distributed through a mailing list of Social Sciences academics (SocSci-IL) and was published on the Facebook group of the Academia-IL Network. A total of 128 respondents completed the questionnaire: 61% female and 39% male. Average age- 46, average seniority-12 years, 66% were senior lecturers, 28% adjunct lecturer , 5% assistants and 1% Doctoral students.

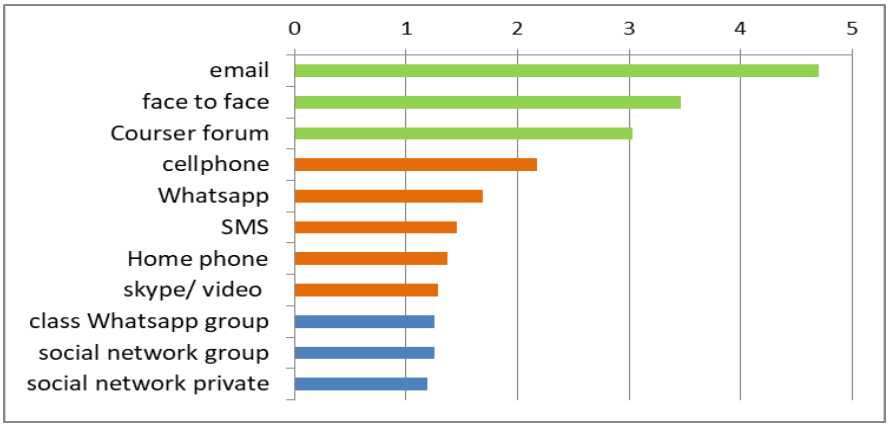
# 4. FINDINGS

## 4.1 Use of Communication Channels

The lecturers were asked to rank their level of use of communication channels with students on a 1-5 Likert scale. Table 1 shows the amount of use of each communication channel divided into three groups.

Table 1 shows that the use of communication channels can be divided into three groups: formal communication (green), personal communication (orange), and social communication (blue). The ranking between the three groups is very clear, so that the formal channels were used most, the personal channels were used less and the least used was social media.

Table 1. Use of Diverse Communication Channels




Formal communication: Formal communication was the main type used by faculty, leading with e-mail (m = 4.70, SD = 0.60) followed by face-to-face communication (m = 3.46, SD = 1). The use of the course forum as a means of formal communication was the lowest in the formal communication group (m = 3.03, SD = 1.34). An examination of the reliability of the formal media revealed that the three channels of communication cannot be considered as measuring the same variable. The Alpha Cronbach reliability value obtained was very low. Therefore, the analyses that follow relate to each formal channel as independent.

*Personal communication:* Personal communication was of low use only. The main use in this category was the personal mobile phone (m = 2.17, SD = 1.13) followed by the private WhatsApp (m = 1.69, SD = 1.04). All five private channels were merged in to a new calculated variable of "personal communication" with an Alpha Cronbach reliability of 0.686.

*Social communication:* Social media was the least and most rarely used by lecturers. All three private channels were merged in to a new calculated variable of "social communication" with an Alpha Cronbach reliability of 0.747.

## 4.2 The Correlation between the Perceptions of the Lecturer's Role and the Use of Communication Channels

In order to examine the relationship between the perception of the lecturer's role and the degree of use of the various communication channels, the lecturers were asked to rate their agreement with a series of statements on a 1-5 Likert scale, some of which represent a perception of the lecturer's role as focusing on academic expertise and some on student service orientation (Table 2).

Table 2. Lecturers' Perception of the Their Role

| *Role Perception* | *M* | *SD* |
|---|---|---|
| **Academic expertise centered, α=0.665** | | |
| Be a role model for academic thinking | 4.75 | .47 |
| Provide information in my field of expertise | 4.66 | .55 |
| Guarantee a high level of academic learning | 4.66 | .54 |
| Motivate students to learning and research | 4.54 | .59 |
| Training quality professionals | 4.29 | .91 |
| Training future researchers | 4.03 | .94 |
| **Average** | **4.49** | **0.42** |

| *Role Perception* | *M* | *SD* |
|---|---|---|
| **Student serving centered , α=0.767** | | |
| Support students with learning difficulties | 4.13 | .83 |
| Enable students to succeed in their studies | 4.11 | .84 |
| Give students the best service | 3.60 | 1.04 |
| Emotionally and intellectually support the students | 3.35 | .99 |
| Satisfy the students | 2.66 | 1.00 |
| **Average** | **3.57** | **0.69** |

Table 2 shows that the lecturers perceived their role as more focused on academic expertise (m = 4. 49, SD = 0.42) than on serving students (m = 3.57 SD = 0.69). To examine the significance of the difference, a t-test for paired variables was performed, and a significant difference was found between the two roles [t (125) = 15.21 p <0.001].

In addition, a significant correlation was also found between the level of "role of serving the student" and the use of personal communication (r = 0.277 p <0.005) and also for use in social communication (r = 0.203 p <0.05). The more the lecturers perceived their role as focused on serving students, the more they enabled students to communicate with them through personal and social channels. No correlation was found between the perception of the role as an academic expert and the use of any communication channels.

## 4.3 Correlation between Organizational Climate and Use of Communication Channels

In order to examine the relationship between the level of use of different communication channels and the organizational climate, respondents were asked to rate their agreement with statements measuring organization atmosphere (for example: The atmosphere between lecturers and students is open and pleasant, the institution encourages informal communication with students) on a 1-5 Likert scale.

A significant correlation was found between the degree of use of personal communication and organizational climate (r = 0.224 p <0.05), so that the more the organizational climate encourages personal connections between lecturers and students, the higher the level the use of personal communication channels. There was no correlation between organizational climate and other communication channels. E-mail was preferred in bi-directional and private communications.

# 5. DISCUSSION

As stated by Hoffman (2014), the benefits available to students as a result of their engagement with faculty outside class have been thoroughly examined, but missing from the literature is the faculty perspective on the use of different communication channels in various contexts (Hagenauer & Volet, 2014). This study contributed to filling these lacunae. This study examined the communication channels lecturers use to communicate with students outside class. The lecturers' use of the various communication channels available to them was found to be conservative, i.e., the leading channels in use are formal communication (e-mail, face-to-face meetings, and course websites). E-mail leads as a preferred channel of communication, even more than face-to-face meetings. It is the leading preference for both bi-directional and private communications. The forum on the course website is only in third place and, as such, is used primarily for one-way and group communication but not for bi-directional interaction and personal communication. This finding raises questions about the success of academic institutions in assimilating the use of course forums.

Moreover, the lecturers make very little use of personal communication channels and rarely use social media. Despite studies showing that personal and social communication between teachers and students is beneficial to both parties (Lundberg & Schreiner, 2004, Lambert, 2012), the lecturers communicate with

students mainly through formal channels and the new media channels haven't yet fully penetrated the academic setting.

This study reveals two factors that are related to the lecturers' use of such communication: 1.Perception of the lecturer's role - the lecturer's perception of his/her role as focused on providing service to the student is also correlated positively with the extent to which personal communication is used. 2. The organizational climate – It seems that the more the organizational climate encourages personal communication, the more the lecturers employ this type of communication. Future research will have to keep tracking the changes in communication channels used by lecturers with their students.

## 6. CONCLUSION

The changes in communication channels available to faculty and students outside the classroom complicates the decision about which channel to use very complicated This study shows that the lecturers are still very conservative in choosing the channels of communication with students and prefer formal communication over personal or social communication. Nevertheless, the diffusion of personal and social communication to this form of communication has begun and future studies will have to keep monitoring these changes.

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# INVESTIGATING TEACHERS' PEDAGOGICAL PRACTICES AND BELIEFS REGARDING DEVELOPING CREATIVE THINKING IN ELEMENTARY SCHOOL STUDENTS

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**ABSTRACT**

Teachers' pedagogical practices and beliefs as they pertain to learning through robotics is becoming increasingly important in education. However, these topics have received little scholarly attention. This study aimed to investigate teachers' pedagogical practices and beliefs regarding developing elementary-school students' creative thinking through robotics. Eleven elementary school teachers participated in this study. We used semi-structured interviews to collect data. A qualitative analysis of teacher interviews revealed that many teachers viewed themselves as facilitators in their class, prioritized the development of students' higher-level abilities, and placed their own emphasis on learning outcomes. This study has implications for teachers and researchers interested in helping students develop their higher-order competencies.

**KEYWORDS**

Robotics Education, Creative Thinking, Pedagogical Practices, Teacher Beliefs

## 1. INTRODUCTION

The development of students' higher-order thinking skills, particularly creative thinking, is one of the goals of current educational practices. Many educators and policy-makers have called for schools to help students think creatively and produce creative outcomes.

Robotics education, a new form of learning and an emerging research subject, has great potential in terms of helping students develop creative thinking and creative design skills. This subject represents a multi-disciplinary form of education that incorporates computer science and integrates mechanical, electrical and electronic engineering (Nemire, Jill, Larriva, Ceser, Jawaharlal & Mariappan, 2017). Guided by teachers, students can develop their creative thinking by generating original solutions to solve authentic problems. Alimisis (2013) pointed out that robotics education can create an engaging, attractive, and interactive learning environment that facilitates interesting activities and hands-on experiences. Students can develop competencies such as creativity, teamwork and problem solving in the face of the challenging tasks (Gerecke & Wagner, 2007).

To embrace this new form of learning, the Chinese government has recently promoted various policies and projects. However, as robotics education in China is still at the initial stage, there is an urgent shortage of experienced and professional teachers, and little is known about the teachers' practicing in this area. Teachers' pedagogical practices and their beliefs about learning through robotics influence how students develop their creative thinking (e.g., Brickhouse, 1990; Clark & Peterson, 1986; Hashweh, 1996; Nespor, 1987). Moreover, understanding teachers' pedagogical practices and beliefs regarding robotics education is necessary for improving teaching practices and providing teacher training. This study focused on analyzing teachers' pedagogical practices and beliefs in terms of developing elementary-school students' creative thinking through robotics. Specifically, this study aimed to investigate the following two research questions:

(1) Is creative thinking an intended learning outcome in robotics education?

(2) Which pedagogical practices and beliefs are visible among elementary school teachers, and are they designed to help students develop creative thinking?

# 2. METHOD

## 2.1 Research Context and Subjects

This study was conducted in two districts of Wuhan, Hubei Province, China. Eleven elementary school teachers from 11 different elementary schools participated in the study. Table 1 details the participants' information.

Table 1. Background information of 11 teachers interviewed. ✓ means teacher graduated from key university. ✗ means not from key university. **N/A** means it is unclear.

| | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 | T11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Gender | Male | Male | Female | Male | Male | Male | Female | Female | Female | Male | Male |
| Years of teaching | 0.5 year | 1.5 years | 0.75 year | 2.5 years | 3 years | 0.4 years | 5 years | 5.5 years | 6.5 years | 6.5 years | 11 years |
| Key university | ✗ | ✓ | ✗ | ✗ | ✓ | ✗ | ✓ | ✗ | ✗ | ✗ | ✗ |
| Degree | Master | Master | Associate | Bachelor | Bachelor | Bachelor | Master | Bachelor | Associate | Bachelor | Bachelor |
| Major | Material Science | N/A | Information Technology | Mathematics | Business Administration | English | Educational technology | Educational technology | Computer Education | Science Education | Computer Education |

## 2.2 Data Collection and Analysis

Semi-structured interviews were used to examine teachers' pedagogical practices and beliefs regarding robotics education. The interviews were conducted either face-to-face or by telephone, and each interview lasted approximately 1 hour. All of teachers were asked the questions according to a pre-designed outline consisting of four parts. Part one was primarily about the teaching content of robotics classes. Part two concerned the teachers' basic information and their understanding of the essence of robotics education. In part three, the teachers were asked to describe their teaching process and methods. Part four addressed their perceptions regarding creativity in robotics education. The interviews were audio recorded and transcribed verbatim. After a preliminary analysis of the interview data in the first round, we conducted supplementary interviews with some teachers to obtain missing information.

We adopted and refined the themes developed by Sawyer (2017, 2018) to analyze the interview data. The teachers' responses in each section of the interview were classified according to these categories: pedagogical practices, learning outcomes, and practices and beliefs regarding creativity. We first conducted a thorough analysis of each interview, followed by a comparison between all of the teachers.

# 3. FINDINGS: EMERGENT THEMES

Six themes emerged from the interviews and were grouped into three clusters: pedagogical practices (3 themes), Learning outcomes (1 theme), and beliefs and practices related to creativity (2 themes). Table 2 presents a detailed analysis of each interviewed teacher in all six aspects.

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Table 2. Each Teacher's Practices and/or beliefs associated with themes. ✓ means matched. ✗ means unmatched. **N/A** means it is unclear

| Description of the themes | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 | T11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Many classes are structured and its contents are predefined | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 2. The teacher facilitates and guides students. | N/A | ✓ | ✓ | ✓ | ✓ | N/A | ✓ | ✓ | N/A | ✓ | ✗ |
| 3. The teacher focuses on summative assessments. | ✗ | N/A | ✓ | N/A | ✓ | ✓ | ✓ | N/A | ✓ | ✓ | N/A |
| 4. The teacher believes that robotics education leads to higher-level abilities. | N/A | N/A | ✓ | N/A | ✓ | N/A | ✓ | ✓ | ✓ | ✓ | ✓ |
| 5. The teacher believes that student creativity is primarily constrained by traditional school pedagogy or influenced by family. | N/A | N/A | ✓ | ✓ | ✗ | N/A | ✗ | N/A | N/A | ✓ | ✓ |
| 6. The teacher fosters student creativity by encouraging their own ideas. | N/A | N/A | ✓ | ✓ | ✓ | ✗ | ✓ | ✗ | ✓ | ✓ | ✓ |

## 3.1 Pedagogical Practices

*Many classes are structured and its contents are predefined (Theme 1).* In most of the robotics classes under consideration, learning was structured and based on the textbook and syllabus. For example, one teacher commented, "The content is based on the textbook" (T5). At the beginning of the class, teachers often opened with questions such as: "What shall we do in this class?" "What's the assignment today?" "Which sensor shall we learn?" and "What's the function of this?" (T3). There were also some classes in which learning activities were prepared for specific contests. For example, as one teacher mentioned, "We mainly refer to the tasks of the contests. It's all about fulfilling the task within the rules, and we train according to those" (T2).

*Most teachers serve as facilitators (Theme 2).* In most cases, the teachers encouraged the students to first try by themselves. The teachers only offered help when the students encountered difficulty. Some teachers also helped to "figure out what was wrong" (T3). Others occasionally provided "some tips" (T10) or "appropriate guidance" (T7). One of the teachers emphasized giving general directions about how to reach the goal and then let the students elaborate on those" (T2).

Some teachers realized that the students could help one another. Some teachers informally encouraged students to help their classmates surmount problems and "help them out," while other teachers directed certain students "who perform better to help them" (T8). One of the teachers explained that "the way we used to think when we were young is different than the way students think today. Furthermore, we can no longer understand how we thought back then. So other students might help them understand better" (T5). Only one teacher mentioned that she preferred to instruct the students on how to finish a task "step by step" (T11).

*Most teachers primarily use summative assessments (Theme 3).* In our interviews, the majority of teachers preferred to assess their students with "the completed level of the artefact" (T3; T5) and "the performance for the assignment" (T9). The former compared the classroom robots with the design manual or with similar criteria and stated that "the more complete, the better" (T1). "For instance, if we are going to make a robot sweeper, you have to know that you should use the touch sensor" (T9). These statements suggest that teachers often evaluate performance with task criteria: "Just take the robot car as an example. It will be expected to make a 90-degree turn when it hits an obstacle. If you perform this task well, you can get 3 or 4 points. If you don't, let's say you can't make your robot turn enough degrees or your robot just hits the obstacle and can't turn at all, then your program is wrong, and you only get 1 point" (T3).

## 3.2 Learning Outcomes

*Most teachers believe that robotics education leads to higher-level abilities (Theme 4).* When talking about the meaning of robotics education, many teachers took for granted that it can improve students' abilities in terms of logical thinking, practices, problem solving, and collaboration. For example, one of the teachers mentioned that robotics education, which calls upon programming skills, can improve students' "logical thinking" (T9). Another said the following: "I think that cultivating the problem-solving capacity is the most significant part of teaching robotics" (T3). Simultaneously, he emphasized cooperation: "In my class, there are only 10 robot suits, so a group may probably have two or three children. They have to resolve the problem together, and in this case how they cooperate and collaborate is extremely important. In my opinion, only in robotics education can students face these problems and improvise." The teacher continued with this explanation: "If you provide an open and error-free environment, the students can develop their creativity".

## 3.3 Beliefs about Creativity

*The teachers believe that student creativity is primarily constrained by traditional school pedagogy or influenced by the family (Theme 5).* Some teachers commented on the traditional pedagogy: "Children basically just follow the teachers' instruction" (T3), "there aren't really any good strategies for cultivating creativity" (T4), and "school constrains students' creativity" (T11). Some teachers believed that the family restricts students' creativity, and made statements such as the following: "Most of the family focuses on examinations, instead of letting the children create more." However, the teachers also recognized that some families "intentionally cultivate children's creativity" and "broaden their horizons."

*The teachers foster student creativity by encouraging their own ideas (Theme 6).* Some teachers mentioned the importance of "letting students to come up with their own solutions according to the tasks, rather than giving them the standard program" (T10) and they believed that teachers "shouldn't provide directions to students or interfere in how they fulfill tasks" (T9). Still other teachers emphasized to students that "they shouldn't refer to the book all the time, they should make something different" (T5).

# 4. CONCLUSION

In this study we found that teachers' beliefs and practices in the area of robotics education were reasonable and positive. Many teachers viewed themselves as facilitators in their class (Theme 2), emphasizing the development of students' higher-level abilities, particularly logical thinking and practical skills (Theme 4). However, this study noted some deficiencies, especially in the area of fostering of creativity. For example, only two of the eleven teachers identified creativity as being a significant learning outcome (Theme 4), which suggested that many of the participating teachers did not realize the essential goal of robotics education. This may relevant to their belief that the primary influence on student creativity comes from traditional school pedagogy or the family (Theme 5), and such influence is difficult to counter. This study, which used interviews to examine teachers' practices and beliefs, provides a foundation for our continuing research into how robotics education can foster students' creative thinking.

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# LEARNING A LANGUAGE THROUGH GAMING: A MINECRAFT GAME DESIGN FOR NEGOTIATION OF MEANING AND CO-CONSTRUCTION OF KNOWLEDGE

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**ABSTRACT**

The purpose of this study is to design a Minecraft game where players can learn a language by negotiating meanings and constructing knowledge together with other players. In order to achieve this purpose, related theories are explored and an instructional design theory was adopted to provide a background for a game building. After the game was designed, it was implemented to test its feasibility. A further suggestion for re-design of the game as a next step was made.

**KEYWORDS**

Minecraft, Learning Language through Games, Negotiation of Meaning, Knowledge Construction

## 1. INTRODUCTION

This study aims to design a Minecraft game where players can communicate to play, negotiate meanings during play, and construct knowledge together with other players. In order to achieve the goal of the study, learning theories related with role playing and research on Minecraft use in the classrooms are explored. In addition, the instructional design theory of Gagné is reviewed as a basis for building the game. After the game is designed, it was implemented to test its feasibility.

## 2. LEARNING BY PLAYING ROLES AND MINECRAFT

### 2.1 Learning by Playing Roles and Minecraft

Even though role playing has been actively utilized in language learning class, the application of massively multiplayer online role-playing games (MMORPGs) is still controversial since many people many people doubt how influential these games are on learning. Role playing in language learning basically has learners taking a role of a particular person or character and acting out as if they are the real person or character. Liu and Ding (2009) insist the positive effects of role-play by arguing that the technique can animate the learning atmosphere, provoke interests to learn and make the language acquisition impressive. According to Dorathy and Mahalakshmi (2011), there are a variety of reasons that role-paying should be implemented in language classes. Not only does role-play help learners deal with real-life situations and daily expressions, but also it encourages learners to work together in order to understand each other. In addition, role-play can be reorganized based on student' interest or need, which enhances learner' responsibility in learning and motivation. Through MMORPGs, which contain all the features of role-play, learners are expected to participate in language learning in a meaningful way. Moreover, when considering the requirements of successful completion of MMORPGs, we can easily find their similarity with the conditions of successful

language learning. Peterson (2010) suggests features of MMORPGs and their potential advantages to second language learning.

The use of Minecraft in classroom environments has been explored in a variety of studies. Researchers have suggested ways to integrate the game into curriculums, offered insight into some benefits and drawbacks of doing so, and proposed possible paths of further application (Callaghan, 2016; Kuhn, 2017; Mail, 2015; Petrov, 2014; Steinbeiß, 2017) The majority of this research lends evidence to the theory that Minecraft is a highly beneficial tool for education. Thus, in this study, the researchers aim to design a Minecraft game to help and facilitate players learning a language through negotiating meanings and co-constructing knowledge.

## 2.2 Minecraft in the Classrooms and Teachers' Role

Some teachers have used Minecraft in a variety of subjects and areas of education already. Players were instructed to create in Minecraft and keep journals of math and writing (Petrov, 2014). Other teachers observed social skill development, and one teacher used Minecraft to help players make real-life objects with 3D printing (Petrov, 2014). Educators who have integrated Minecraft in their lessons have found superb results. Teachers noticed that students were more motivated to do work and developed their communicative and social skills (Petrov, 2014). Another key point to mention about Minecraft is that students were engaged in unexpected ways. Aside from increased rates of assignment completion, for example, students who normally did not actively take leading roles in class were able to act as leaders within the game (Hulstrand, 2015). One main factor in ensuring the helpfulness of Minecraft is peer-to-peer collaboration, as more experienced gamers can use their skills to enable a smoother integration of the game with all students (Hewett, 2016). However, the varying levels of student experience—which, understandably, may be a point of concern—did not detract from learning. Players who are beginners at the game, with some instruction, could follow along with the lesson relatively well (Callaghan, 2016).

Not only are teachers paramount in enabling an effective use of the game in learning, they are also crucial in getting such a program started in their classrooms. For maximum success, teachers should be fully supportive of the idea, and their teaching styles should be compatible with a student-centered approach (Petrov, 2014). Teachers should also be familiar with the game and with knowledge of how social interactions and spaces within the game function. However, many teachers are reluctant to use Minecraft in their curriculum, and part of this may stem from the gap between students' and teachers' video game literacies (Kuhn, 2017).

Minecraft is seen to be an effective tool in varying circumstances for learning. It upholds principles crucial to effective learning by providing motivation, improving social and communication skills, and encouraging critical and creative thinking. Further research on how Minecraft benefits players, as well as on how to make it more suitable to teachers as well as learners, is thus promising.

# 3. DESIGN REFLECTED BY AN INSTRUCTIONAL THEORY

How the activities of gaming in Minecraft could be arranged for language learning is a question of identifying, selecting, arranging, and sequencing the learning experience for players. Gagné, Briggs, and Wager (1992) provide a good framework for designing learning. They developed a framework of nine general events that should take place during learning. This process is called Gagné's Nine Events of Instruction.

# 4. DESIGNED VILLAGE FOR LANGUAGE LEARNING

Based on the reviews on theories related to language learning and design of educational games, a Minecraft game was designed as below presented.

## 4.1 Getting Started with Landmarks

In the Landmarks, players are expected to learn the information regarding some landmarks in the world. While playing the games, they will visit several famous landmarks in the world. By looking around the landmarks, they will read and collect some pieces of information related to each landmark. In the perspectives of language learning, players should be able to negotiate the meanings of unfamiliar words they encounter and construct new knowledge in groups.

In the game, the negotiation of meaning and co-construction of knowledge occurs as follows: While looking around the Eiffel Tower and playing the game, players are asked to keep in mind the information related to the Eiffel Tower for the quizzes later. Then, players will delegate who memorizes which information. This encourages players to communicate and interact with each other more actively, and by having a role, players will be more responsible to the task or the game.

Although each student has their own role to memorize a piece of information, players will help each other when they find some challenging expressions such as ‘be named after’ and ’81-storey building’ because they need to collaborate to complete the whole game. To understand the meaning of difficult words, players will take a guess and share their ideas with other players. By doing so, players understand the meaning of the challenging words, and they naturally co-construct the knowledge regarding the Eiffel Tower. While negotiating the meaning of incomprehensible words such as ‘emperor’ and ‘plunder’, players will use their own background knowledge or take a guess. If they cannot figure out the meaning, they can ask for help to a teacher or a teacher’s avatar in the game. In this case, the teacher decides whether the challenging words are key words students must understand. If so, the teacher gives hints so that players can figure out the meaning of the words by themselves. By doing so, players can figure out the words’ meaning, which is the result of negotiation of meaning and co-construction of knowledge.

## 4.2 Having Fun in the Amusement Park

In the Amusement Park, players are expected to complete the given quests in an amusement park and zoo. While playing the game, players will experience some typical situations they are likely to have when they visit a real amusement park or a zoo. Players in the beginning of the game will buy tickets for the ride. Also, they will order food in a cafeteria, and look around the zoo for certain animals. Since all these situations are related to their actual lives, players will be more motivated to play the games and learn new expressions in English.

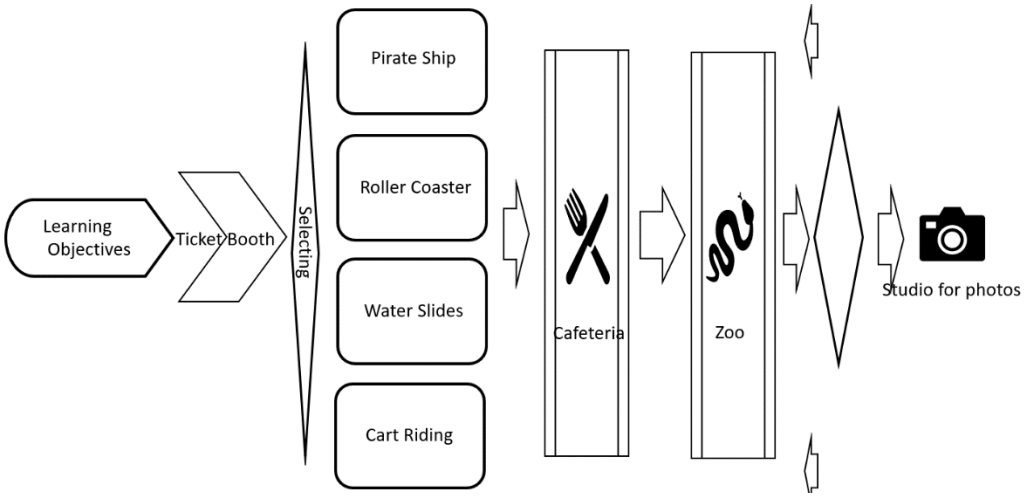


Figure 1. Activity Flow in Amusement Park

Players will be able to negotiate meanings and co-construct new knowledge in groups. In the game, players will experience a variety of meaning negotiation and knowledge co-construction situations. For instance, players will discuss with others to choose a ride. They also have chances to read the safety instruction before going on rides, so when they do not understand some difficult words, they will negotiate the meaning by sharing each other’s background knowledge. Through the process of complete quests, players

will come to learn which expressions to use in each situation resulting in co-construction of knowledge about the related situations and the appropriate expressions in English.

In the theme, numerous events are implemented for players to have meaning negotiation and knowledge co-construction. Specifically, after being told about today's game goals, players move to a ticket box to buy the tickets for rides. In the ticket booth, players will have a conversation with an NPC or a teacher's avatar regarding 'buying tickets.' The conversation will be about the cost, discount, coupon, and so on. When players find some unfamiliar words or expressions, they negotiate the meaning of the incomprehensible words with other players or the teacher's avatar. Through this, players come to understand the situation and learn new expressions related the situation. This leads to co-construction of knowledge related to 'buying tickets in the public places' such as amusement park and museums. At a cafeteria for lunch, players will discuss what to eat after reading the menu. Discussing the menu, players will learn some new words related to food and they will have active communication. While ordering food, players are asked to talk about detail preference regarding the food, such as 'What kinds of sauce do you like for your French fries?" When players need more explanation about the food, they can ask to the clerk, and this naturally provokes negotiation of meaning. Through this series of activities, players will be aware of what to say in English when ordering food, which indicates construction of knowledge regarding 'ordering food in a restaurant.'

## 4.3 Attending a Party at a Friend's house

In the Amusement Park, players should be able to complete the quests required to visit a friend's house. In the beginning of the game, players are invited to a house party hosted by a friend. On the way to the friend's house, players stop by a DVD shop and supermarket. To complete the requests, players need to use appropriate game strategies and have conversations in English with other characters.

In this game, players are exposed to various situations which have them negotiate meaning and co-construct knowledge. For instance, once players enter the supermarket, they walk around to find the items they need to buy. Some of the ingredients such as 'beetroot' and 'salmon' are unfamiliar for them. To figure out the meaning of the words, they negotiate the meaning with each other or they can get help from pictures. In addition, players can choose one item they want to buy for the party. To determine the item, players share their ideas, and this leads active interaction and authentic communication. Through this whole process, players will negotiate meaning of incomprehensible words and co-construct of knowledge regarding 'the name of some ingredient' or 'expressions related to grocery shopping'.

## 4.4 Designing a Share House

As the activities in 'Designing a Share House' mostly depend on players' preference and creativity, they provide a variety of chances for negotiation of meanings and co-construction of knowledge. In detail, players in the beginning enter a basement room to figure out what materials they can use to decorate the house. There, players will help each other understand what each item is and how they can be used to decorate the house. During this process, players naturally have conversations regarding the items and when a student does not understand the exact usage of the item, other players can explain more simply by repeating the key words or using easier words. After figuring out the items to use, players move to the living room. Then players share their ideas on how to decorate the house. For example, players assign which part each student will decorate and what type of items or materials they will use for the decoration. Players might have some misunderstanding due to some player's lack of language competency. In this case, players will help each other to solve the misunderstanding or miscommunication by giving feedback or using simpler vocabularies, all of which includes negotiation of meaning. Since players come to learn the name of items and how to use them for house decoration in addition to new English expressions, they will co-construct the knowledge relating to the given topic.

# 5. IMPLEMENTATION AS A PILOT TEST

After the game was designed, two technology teachers at elementary schools played the game. They were told about the game in advance and introduced how it was developed. After review, they reported that the intended features could be easily found in the designed Minecraft games.

Above all, players in the games are encouraged to interact with each other through chat rooms for a variety of purposes. In the theme 'Designing a Share House', players could have discussion time regarding how to decorate their shared house. In the discussion, players could assign a role to each other to decorate the whole house and talk about how to achieve the given quests, such as which material they are using and what furniture they have chosen. This interaction provides learners not only with a chance to communicate in the target language but also the opportunity for exchanging linguistic feedback or negotiating meanings when they do not understand each other. Moreover, every theme of the Minecraft games has clear goals for players to complete. In the case of 'The Landmarks in the World', players are asked to look around some landmarks in the world such as Machu Picchu and the Sphinx, and take quizzes related to the landmarks. As the level of quizzes is slightly difficult for one player to handle alone, players are naturally led to collaborate with each other by assigning a role and helping others to understand unfamiliar words or phrases in games. Lastly, like typical RPGs, players in Minecraft also could have their own avatars. When playing with avatars, learners are less afraid of making mistakes since the avatar is not identified to their actual ego in reality (Chin, Oppezzo, & Schwartz, 2009). Consequently, this reduced inhibition makes players participate in the learning process more actively, leading to the development of their language skills. Two technology teachers also reported that the game should have more conditionals and loops so that players can repeat their game at any place and time.

## 6. CONCLUSIONS AND NEXT STEPS

The designed game is expected to be a useful tool for learning languages by negotiating meanings and co-constructing knowledge while playing the game. However, as the pilot test shows it has several recommendations to revise towards a more beneficial tool for language learning. Researchers will start to get more data when more students play the game. In addition, the game will be applied for students to learn a language to see if it is effective and what has to be done in terms of its design in order to enhance players' language learning.

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# DEVELOPING 21ST CENTURY INTERCULTURAL AND COLLABORATIVE COMPETENCIES THROUGH TRANSFORMATIVE INTERNATIONALISATION PROJECTS: A POST NEO-COLONIALISM APPROACH

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**ABSTRACT**

There is widespread agreement that collaboration, teamwork and intercultural competence, among others, are essential 21st century skills. Higher education teaching and learning initiatives tend to have a significant focus on developing these skills through assessments and other in-class activities, and yet often do not take advantage of opportunities to collaborate with other institutions located in different countries to give their students an authentic, globalised learning experience. Previous transnational education projects have tended to encourage cross-institutional collaboration through engagement with host institution subjects/courses that are delivered at off-shore locations. Although these initiatives are valuable, they tend to impose a 'neo-colonialism' approach and therefore may not develop 'transformative' international perspectives.
This paper will present an initiative that was developed between two institutions located in Australia and Hong Kong, where their students collaborated on an assessment *for* learning task that involved developing a real-life solution for not-for-profit organisations, often located in a third country. The ideas discussed in this paper will be useful for anyone who is trying to create a more immersive, authentic learning experience for their students. These initiatives developed in our students a heightened sense of belonging to a truly globalised world we live in and instilled a shared responsibility of care. Ideas discussed in the presentation will also be useful for policy makers about how to go about creating more supportive policy and governance frameworks to encourage greater collaborations with off-shore institutions in a truly respectful arrangement.

**KEYWORDS**

Assessments, Internationalisation, Trans-National, Collaboration, Communication, Social-Responsibility

## 1. INTRODUCTION

A number of universities in Australia and elsewhere are keen to forge their presence overseas. This has been reflected in the establishment of numerous off-shore campuses and collaborative arrangements by many institutions in various countries around the world, particularly in Asia due to the rapidly increasing education sectors and demand for higher education services in these countries.

These relationships provide institutions with strategic opportunities to deliver their courses off-shore and ultimately provide increased 'pipeline' of students to other on-shore (and off-shore) courses. As the number and types of these transnational education and alliances increase, so does the research into transnational alliances (Melano, Walker and Maureen, 2014) often focused on quality and compliance, rather than educational outcomes.

In Australia, most of these transnational initiatives tend to focus on appropriate ways to deliver Australian courses at off-shore institutions, and therefore, even with the best of intentions, tend to 'impose' an 'Australian way of doing things' on the off-shore campuses, often to the detriment of promoting true collaborative partnerships in developing and providing internationalised learning experiences for students in Australia and off-shore locations (Ling, Mazzolini and Giridharan, 2014, Clifford and Montgomery, 2017).

Developing collaborative assessments that enables students from Australia and off-shore locations to work on activities while enrolled in their respective campuses, in their own courses can provide more enriching learning experience in a truly respectable, understanding environment, without imposing off-shore institutions to change their local 'styles' of teaching and learning and other inherent educational practices (Barker, 2011).

An innovative, collaborative assessment has been designed between an Australian higher education institution and a similar higher education institution in Hong Kong, where small groups of students from each institution collaborate with each other to develop and implement a social media strategy for a 'real', not-for-profit organisation located in a third developing country.

Based on our experience and research implementing this initiative, now with two different institutions, from different countries (Anand and Latt, 2015), we feel that there is scope to expand this initiative as a generic assessment that can be 'plugged' into most courses at different institutions, giving students a truly internationalised learning experience, while acquiring essential 21st century skills.

## 2. EMBEDDDING TRANSFORMATIVE INTERNATIONALISATION INTO THE LEARNING ACTIVITIES

This project involves small groups of students from Australia and Hong Kong working together to identify a real not-for-profit organisations in developing countries to develop and implement a social media strategy for them. This project runs for about 6 to 8 weeks and during this time the students have to be able to organise themselves, develop project plans and tasks the needs to be completed, identify and contact the not-for-profit organisations, identify their social media needs, develop and implement the strategy using one of the social media platforms, develop appropriate training materials and then deliver all this back to the organisation.

This process involves significant collaboration between the students, dealing and negotiating between the cultural and language differences, and yet be able to deliver a service that is expected from their chosen organisation. This project is significant as the students engage with the project and their chosen organisation emotionally which is difficult to replicate in other types of assessments. More specifically the project fulfils the following aims:

a. **Develop the skills, knowledge and attitudes for 21st century learning and collaborative learning:** Shultz and Adams (2007) suggests that education, and indeed global education, that aims to develop 21st Century skills needs to be transformative "where citizens have and understanding of a common humanity, as shared planet and a shared future". Students need to develop appropriate skills, and attitudes to engage in collaborative activities within complex cultural and social domains.

b. **Develop a digital and social media mindset through appropriate digital and technology based teaching and learning:** Students engage in this project using digital communications platforms. They also have to adapt to use appropriate platforms, in some cases platforms that they may have not used previously. Not only do the students use and learn about social media, they have to very quickly become competent enough to be able to advise an external organisation about using social media effectively (Chigona, 2018).

*c.* **Develop appropriate systems and ideas to enhance teaching and learning across multiple-locations:** Although various approaches to internationalisation can be demonstrated by other initiatives, this project is different as it develops students' internationalisation skills through transformative approaches, while ensuring true collaborative partnership between Australia and the off-shore institutions, not imposing 'Australian' way on other cultures, therefore benefiting both groups of students (and teachers) equally (Keevers, Bell, Ganesharatnam, K.P. Dawood Sultan, Lim, Loh, Lefoe, Hall and Scholz, 2014).

## 3. RESULTS

This initiative is still in its early days, and has not been thoroughly evaluated about its impact on students academic outcomes, not just for the course and subject involved, but also in the long term to develop students attitudes and ability to cope with the challenges of higher education studies, and beyond.

However, anecdotal observations from teachers indicate that students are a lot more motivated in class, and a number of negative classroom behavioral issues have disappeared. Feedback from students also indicates that they feel a lot more engaged with the subject and find the assessments relevant and challenging. Students also had the chance to learn another's cultural backgrounds and gave them the opportunity to gain knowledge about another part of the world.

This assessment was designed to instill a sense of purpose in the students, where they could feel that they have contributed in some way for the betterment of society. The following feedback from students suggests that this initiative has been a success.

*"Very different to any other assessment, will help improve communication and cooperation skills." Student's anonymous feedback after being introduced to the assessment for the first time, October 2018*

*"This is a very useful lesson, whether it's learning and living." Student feedback*

*"While the task seemed challenging to me it could also be more interesting than a lot of other assessments as the work I'm doing could have a positive impact on someone other than myself providing a greater sense of accomplishment when completed. One of the things a lot of people used to say about classes when I was in high school was 'when am I ever going to use this', what this task provided me with is a clear example of how we can use the knowledge learnt in the classroom in the real world. Working with students in another country was another big challenge for me as we had to work around language barriers, time zone differences and amount of work done so far. But it was also helpful to me to have the input and ideas from other people to help complete the task. Overall this task was a uniquely fun and challenging experience for me". - Australian student*

*I am hereby writing this e-mail to give feedback on one of our teammates, student1 who is a Japanese. Frankly speaking, I think she is really helpful and she contributed her effort and time in this project. For example, she gave us lots of ideas or advice. She was even willing to listen to us and follow our instructions. In the future, I am looking forward to doing the project with such hard-working groupmate. - Hong Kong student*

*It is pleasure for us to work with an overseas student. He (student2) help us a lot in doing our project The most interesting thing is that he can already share his work related to the NGO with us and we include his work on our report as well. His work is quite effective and useful for us which shows that our group member is hardworking and responsible student. We are very thankful to him for helping us a lot. - Hong Kong student*

Similarly, the NGOs that the students helped seemed pleased with their contributions. Even though the organisations were not required to give any feedback, some, off their own back gave positive feedback, and for some groups of students, some organisations even provided them with an acknowledgement in the form of a certificate of appreciation. (Figures 1 and 2 below)

There were however some significant challenges that needed to be addressed by the subject coordinators and teachers. These were:

1. Students were unfamiliar with these types of assessments. Significant amount of time had to be devoted to helping students understand the requirements of the assessments.
2. Students did not feel comfortable or confident contacting the not-for-profit organisations. Lots of modelling and examples were provided during class and students were encouraged to role play telephone conversations before they contacted their chosen organisations.
3. Students needed to explore a method to communicate with other students from different countries and needed to overcome the time differences with different time zone. For sometimes email is not an effective means of communication, especially there is a time zone different.

A thorough evaluation is planned through student surveys, analysing samples of students work, and conducting focus groups in Hong Kong and Australia. The Kirkpatrick model of evaluating interaction for learning framework (Paull, Whitsed and Girardi, 2016) and the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich, Smith, Garcia and McKeachie, 1991) will be used to guide this evaluation exercise, and results will be used to improve the approach, and also to inform the wider academic sector about effective internationalisation of the learning experience.

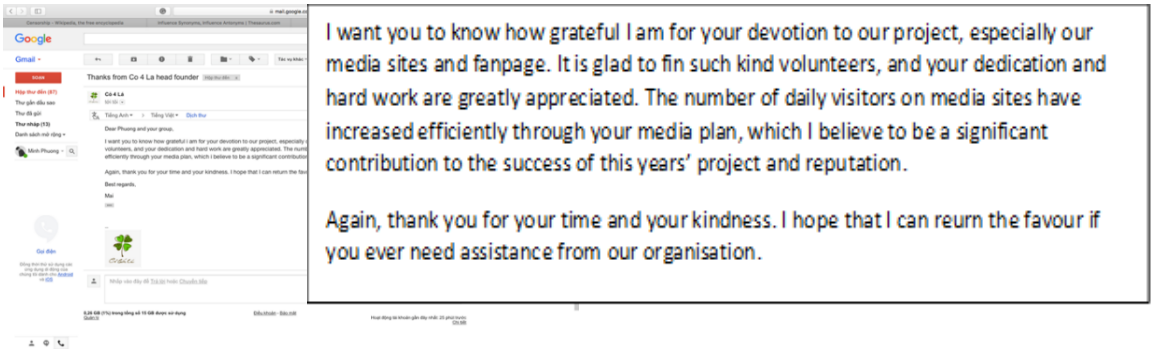


Figure 1. Feedback from NGO

Figure 2. Certifications of Appreciation from NGO

## 4. CONCLUSION

This initiative is still in its early stages of implementation. Although we have now implemented it for two sessions, a thorough evaluation has not yet been conducted to see how the students were able to develop to the stated objectives of developing 21st century collaborative skills and attitudes, apply appropriate current and emerging digital technologies and deal with teaching and learning activities across different geographical locations.

Early indications are however very positive and encouraging, and provides confidence for the academics in Hong Kong and Australia to continue to use this approach.

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# STUDY OF A VISUALIZATION SYSTEM OF THE CONCENTRATION DEGREE BY BIOLOGICAL SIGNALS -CASE OF ACTIVE LEARNING-

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**ABSTRACT**

Recently, Active Learning (AL) has been focused as the educational method. AL is different from traditional method of the class which is teacher-centric class, namely only teacher speak and students have the class passively [Ministry of Education, Culture, Sports, Science and Technology, 2012] [中部圏 23 大学 東海Ａチーム 7 校（NUCB Undergraduate School.）, 2014]. AL is the style which students become active and they progress the class themselves actively. However, it is difficult to assess the students which have the AL, and it becomes hard about progressing the evolution of this style. The method of assesss this two perspectives. One is that teachers have been able to have the class well? The other one is that students quorily (knowledge and skill) has been able to progress well? Generally, assessment of class is questioneir-centric after closing the class at the end of semester. So we cannot feedback to our students that questionair's opinions. Moreover, generally the questionnaire to the students has included the issue that it is difficult to assess we want because subjectivity has strengthen. So we have advanced the investigation which can measure the degree of concentration against the class students have, using biological information as the assessment method we can measure it objectively. Using these results, we assess the degree of concentration against class of students while they are having the class of AL. This method makes us the situation which we can realize the visualization of the degree of actively while we realize the monitoring the situation of students in which they are having the class of AL. We use GSR, blinking, motion of the head as assessment indexes. We have selected the biological informations we measure mentioned above and equipment we will use in order to reduce the strain of students by wearing the equipment, although we can select and use a variety of biological informations and equipments to measure the situation of students. We can progress the class while visualizing the degree of concentration of students by using our system. As a result, we can reduce the class of AL which is imitative that is being a mere refrection of AL technique. Furthermore, we can apply our result to traditional teaching method because we can inform the situation which the students are becoming activated while the teachers are using a variety of skills which they drive the class well.

**KEYWORDS**

Active Learning, Eye Blinking, GSR, Evaluating System, Biological-Information

## 1. INTRODUCTION

Recently, measurement of electroencephalogram (EEG) and heart rate variability (HRA) are most general method as the assessment of biological information in the research of biopsychology. In addition, the index of biochemical substance is also used, for example, electro dermal activity (EDA), the temperature of skin surface, amount of hormonal secretion, and so on. Such indexes are called hemodynamic parameter; the assessment of these parameters has been advanced on the physiological research field. Although same research has been advanced on the field of e-learning and general education, they didn’t have consensus because they have the different of the type physiological responses of students, and the different of the robustness. So it is the stage which researchers have been accumulated individualized approach each other so far.

In the fiscal year of 2009, we studied a research of the physiological estimation using hemodynamic parameter as the physiology for educational material on the e-learning. In that research, we associated hemodynamic parameters with active coping against stress (pattern 1) and passive coping (pattern 2) behaviorally, as the typical patterns against psychological stress designed by experimental psychology. Pattern 1 appears by in literally active coping which they cope with a stress, that they can control it, themselves. Inversely, we can think that pattern 2 appears by passive coping which they wait out the stress while standing up the situation they have, for example, the noise is the situation that we don't have the method of efficient coping.

We prepared two different e-learning contents, and carried out the comparison experiment by measuring biological information based on hemodynamic parameter while students have the class with active learning. Two contents were as follows: one is that is dialog type content which is that lecture explains with video and students answer several simple questions while having a class, and the others is that is the non-dialog type content which has only explanations and that result with text. We measured the high frequency component (HF) as biological information, and measured systolic blood pressure (SBP), diastolic blood pressure (DBP), mean blood pressure (MBP), heart rate (HR), cardiac output (CO), stoke volume (SV) and total peripheral resistance (TPR) as hemodynamic parameter. As the result of this experiment, we obtained the findings that a change of hemodynamic parameter evoked pattern 1, that is active coping against stress, while having the class with dialog-type content, and it also evoked pattern 2, that is passive coping, while having the class with non-dialog type content. Measurement result had the individual different on the studying time and the power of concentration by the influence of the degree of understanding about content, answer of questions, physical condition of student on the day they learned, and the time period of measurement. However, this result reported that we can identify the condition of having the class whether it is active or passive from student's blood current and the temperature of fingertip.

In the fiscal year of 2010, we focused on TPR which is a type of hemodynamic parameter. This is the result that measured a change of blood pressure on peripheral blood vessel of fingertip. As a result of this experiment, we observed the situation that blood pressure of students while having the class with contents changed with a cycle of from seven to eight minutes. Therefore, we collected the change of blood pressure of peripheral blood vessel by measuring the temperature of fingertip of students on real-time. As a result, they reported that body temperature decrease by decreasing of the power of concentration.

In the fiscal year of 2011, we measured the biological information using BIOPAC and Finometor, and researched causal relationship the power of concentration and biological information. we examined the result of previous research which we measured a variety of biological information, and decided to measure the degree of concentration of students by measuring the GSR, body temperature, and the pulse wave.

In the fiscal year of 2012, we carried out the measurement of effect of e-learning contents using biological information. The class advanced regardless of the degree of understanding of students on the e-learning, these contents of class is structuredness, it is difficult to keep the motivation of learning, and we can only assess situation of students using analysis after the class. So we developed the system which can assess the degree of concentration of student observing electrical skin resistance from forehead with real-time. The cause of emotional sweating is that is the sweating while exciting, and it evokes the decreasing of electrical skin resistance. As the result of that we measured the electrical skin resistance while on the concentration and non-concentration using measurement equipment we developed, we observed that GSR had low level by sweating while exiting, and reversely, electrical skin resistance had high level while cooling. This result suggested that we can identify the degree of concentration.

In the fiscal year of 2013, we suggested to assess by measuring GSR, body temperature, and beat in order to assess the degree of concentration of student while having an active learning class. We attempted increasing the accuracy of the identification of the degree of concentration by measuring additionally beat and body temperature in order to analysis the power of concentration while having the active learning class. We obtained the future task that need to be smaller of measurement system, and redesigned a part of measurement and redeveloped the system, because the students moved their body more on active learning class than while having the e-learning. We carried out the experiment using small measurement system we developed. Figure 1 and 2 has shown the experimental results. The result has shown the measurement on 20 minutes. We measured biological information with the cycle of five minutes. And students practiced the task for five minutes and had the rest for five minutes one after the other. As a result, GSR was changed in proportion to the degree of concentration while having active learning, and body temperature and beat had no change which we can identify to have the significant change. Clearly explain the nature of the problem, previous work, purpose, and contribution of the paper.

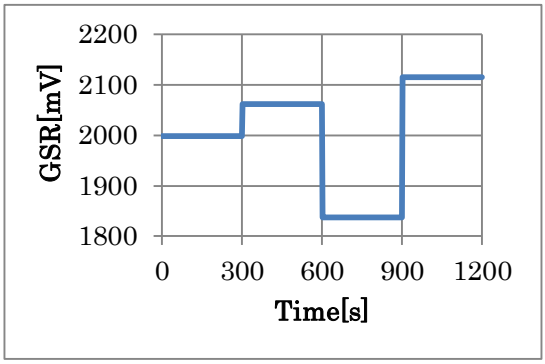


Figure 1. Average Value of GSR

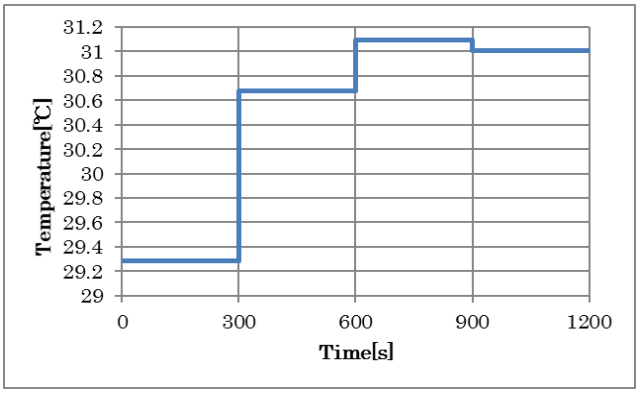


Figure 2. Average Value of Temperature

## 2. EXPERIMENT

The biological information is various information (for example, electrocardiogram, heart sound, X-ray absorption rate, etc.) emitted from the living body. In recent years, technology that utilizes such information has been applied in various fields such as medical care, nursing care, education. As an application example, there is also an approach called biofeedback that improves concentration by feeding back biological information to the visual and auditory sense.

Along with changes in human mental activity and state of consciousness, brain waves show different patterns. The brain wave at the time of awakening is an electroencephalogram that appears when consciousness concentration or stress is felt in a state of arousal, and it is called beta wave (13 to 20 Hz). The brain wave at rest is an electroencephalogram that appears in a relaxed state or a resting closed eye state and is called an alpha wave (8 to 13 Hz).

### 2.1 Measuring Degree of Concentration by Eye Blinks

People generally blink 15 to 20 times per minute. It is said that 3 to 4 physical blinks for moisturizing are enough and everything else is considered a psychoneurotic blink. Frequency of blinking of eyes decreases, such as when you are crazy, and tends to increase as the arousal level decreases. Frequency of blinking is greatly different between individuals and it is difficult to evaluate with absolute numbers, but mutations from normal times, relative numbers can be compared. Blinking can also be measured by changes in myoelectric potential [8]. For that reason, we adopt blinking as biometric information to use.

### 2.2 Measuring Equipments

In recent years, JIN CO., LTD., which develop the glasses brand “JINS”, announce the glasses “JINS MEME” which is able to measure the fatigue degree of eye at work, the drowsiness during driving and the amount of activity. It has three types of sensors, three-point electrooculography sensors, three-axis accelerometer sensors and three-axis gyroscope sensors. Communication mode is Bluetooth Low Energy. JINS MEME can be obtain the data by connecting smartphone applications. We will verify the validity of relationship between concentration and biological-information by using the results, which are measured by the simple mearing instrument and a commercial wearable appliance such as JINS MEME.

In addition, in this research, in order to compare the change in the number of blinks and the brain wave, we use MindWave Mobile, a headset type electroencephalogram sensor developed independently by NeuroSky. JINS MEME has released SDK (Software Development Kit). SDK is provided for iOS and android, and in this research we developed using SDK for Android. SDK provides only real-time mode that can acquire data at about 20 Hz. In order to carry out experiments, it is necessary to hold data, mainly to change the program of the output part so that outputted data can be output to CSR format on Android

terminal's internal storage. Also added a method to output the timestamp at the same time as the acquired data. In addition, MindWave Mobile also provides SDK, and developed using that SDK. MindWave Mobile can acquire data obtained by removing noise from the acquired brain wave signal and converting it to a digital signal and data analyzed by the algorithm. MindWave mobile is able to output acquired data in CSV format to internal storage like JINS MEME.

Figure 3. Measuring Devices

## 3. RESULT

Assuming actual AL, we conducted a discussion with three students. During the experiment, JINS MEME and Mindwave Mobile were worn by three of the students. Furthermore, in order to record the student's movements during the experiment, I recorded the situation of the experiment. As a content of the experiment, given a theme, three people talked about the subject. After that, after taking a break, we changed the person who wears the device again and carried out the experiment.

Experimental results of three subjects are shown in Figures 4-6. In addition, in order to investigate the relationship between the brain waves of individuals and the number of blinks, Table 1 shows correlation coefficients of each subject. Looking at the items related to blinks in the individual correlation, only the subject2 has low correlation, but it turns out that there is almost no correlation between the other two persons. The reason for this result is that there are differences in time between brain waves and blinks depending on the degree of concentration and outliers in the number of blinks, and they do not consider it Can be considered. Therefore, we think that it is necessary to identify outliers and reexamine analysis methods.

Table 1. A Correlation Coefficient

| Test subject① | Alpha | Beta | Amonut of blinks |
|---|---|---|---|
| Alpha | 1 | | |
| Beta | 0.309708234 | 1 | |
| Amonut of blinks | -0.184307091 | -0.177033061 | 1 |
| | | | |
| Test subject② | Alpha | Beta | Amount of blinks |
| Alpha | 1 | | |
| Beta | 0.114314208 | 1 | |
| Amount of blinks | -0.048206323 | 0.28841719 | 1 |
| | | | |
| Test subject③ | Alpha | Beta | Amount of blinks |
| Alpha | 1 | | |
| Beta | 0.357878084 | 1 | |
| Amount of blinks | 0.105023702 | 0.078766294 | 1 |

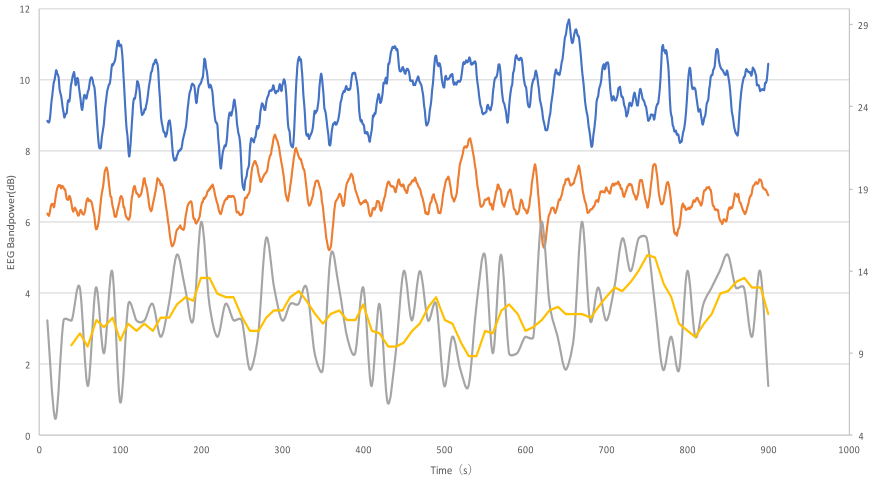


Figure 4. Results of Test Subjects 1

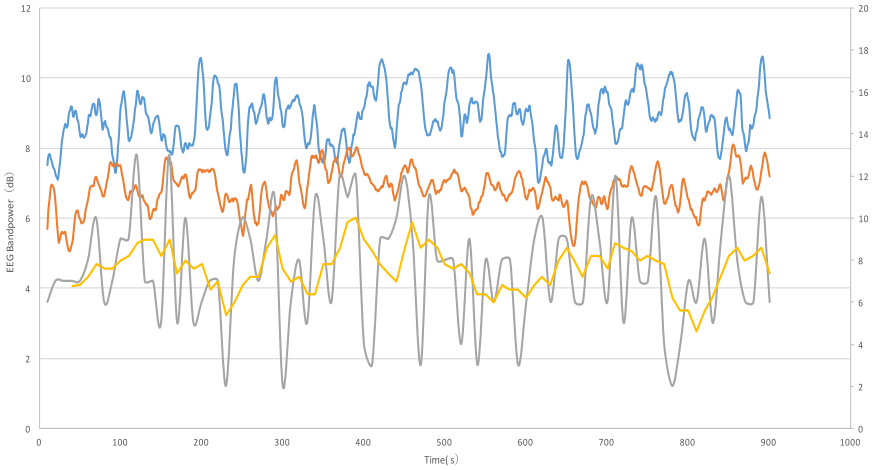


Figure 5. Results of Test Subjects 2

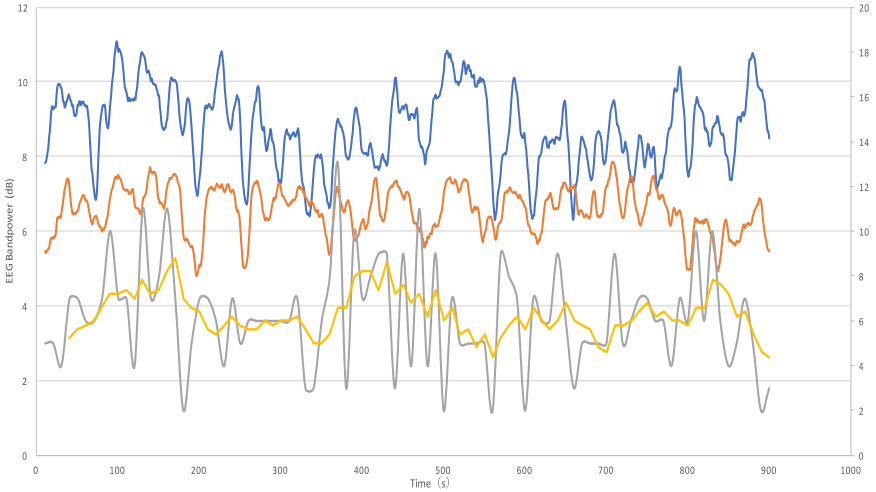


Figure 6. Results of Test Subjects 3

## 4. CONCLUSION

In this paper, the power spectra of the alpha and beta waves of the students at the time of discussion and the number of blinks were compared and analyzed. As a result of the experiment, almost no correlation was found between blinking and brain waves. However, since each person has different characteristics in the brain wave information and the state of blinking, it is impossible to definitely declare significance with significance only by this result. In the future, in order to verify the significance of the data of this research, it is necessary to conduct additional experiments with an increased number of subjects and to reexamine the experimental method including the method of data analysis.

## ACKNOWLEDGEMENT

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# INVESTIGATION OF WHETHER UNDERGRADUATES CAN TAKE COLLECTIVE COGNITIVE RESPONSIBILITY IN THE KNOWLEDGE BUILDING PROCESS

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**ABSTRACT**

This study investigates whether undergraduates were able to take collective responsibility to gradually improve community knowledge. The participants were 30 undergraduates from 24 majors in a key normal university. The analysis of their online Knowledge Forum writing indicated that the undergraduates were aware of peers' contributions, made complementary contributions, and showed distributed engagement, and thus they could take collective cognitive responsibility. The results also showed that students gradually improved community ideas. This study has implications for teachers who aim to design technology-enhanced learning environments to engage students.

**KEYWORDS**

Collective Cognitive Responsibility, Knowledge Building, Engagement

## 1. INTRODUCTION

Collaborative inquiry, a major research strand in education, can help students develop higher-level competencies such as inquiry, collaboration, knowledge creation, agency and metacognition. Productive collaborative inquiry requires participants to collectively take cognitive responsibility (Zhang, Scardamalia, Reeve, & Messina, 2009). However, facilitating students to collectively and sustainably take this responsibility and thus advance collective ideas instead of solely completing tasks is challenging. Collective cognitive responsibility includes the three dimensions of awareness of contributions, complementary contributions, and distributed engagement (Zhang et al., 2009).

Knowledge building is a collaborative-inquiry model, and considers the process of knowledge creation to be a social process (Scardamalia & Bereiter, 2006). It refers to "collective cognitive responsibility for idea improvement" (Scardamalia & Bereiter, 2006). In most knowledge-building implementations, the Knowledge Forum is used to promote and sustain the knowledge-building discourse. Research has suggested that students tend to sharing rather than create knowledge, which can be due to low-level collective cognitive knowledge resulting from a lack of an appropriate knowledge-building environment.

By recognizing the challenges and the requirements, a knowledge-building environment to help students take collective cognitive responsibility was designed in this study. The study aims to examine whether undergraduates were capable of taking collective responsibility to improve their knowledge-building discourse. This study is part of a larger project that focused on developing students higher-order competencies through knowledge-building environment augmented by learning analytics. The study aimed to answer the following two research questions.

(1) What are the characteristics of undergraduates' collective cognitive responsibility in the knowledge-building process?

(2) To what extent do undergraduates gradually take collective cognitive responsibility to advance community knowledge?

# 2. METHODS

## 2.1 Research Context and Participants

The participants were 30 undergraduates from 24 disciplines in a key university that focused on preparing primary and secondary school teachers. They participated in the study for 4 months while taking a core course of literal education for 1.5 hours each week. The course is aimed at helping undergraduates deploy and develop skills in the process of inquiry and creating knowledge. Most students had low levels of motivation and limited skills of collaboration and inquiry in the initial stage, and they took this course to gain academic points for graduation. The course teacher had one year of teaching experience, had received her doctoral degree in information technology studies, and had expertise in knowledge-building pedagogy.

## 2.2 Pedagogical Design

The teacher used a three-phase knowledge-building model to help undergraduates familiarize themselves with knowledge building and to gradually take collective cognitive responsibility for idea improvement. The phases were to develop an awareness of their contributions and their skills of inquiry and collaboration through small-group design activities (e.g., making bridges using newspapers and posters) (Phase 1); to provide complementary contributions through question-oriented, idea-centered inquiry discourse on the Knowledge Forum (Phase 2); and to promote collective responsibility through reflecting on data indicating their participation, collaboration, and contributions (Phase 3).

# 3. DATA ANALYSIS AND RESULTS

Knowledge Forum writing was the primary data source. Our argument was that if students gradually assumed a higher level of collective responsibility they could generate productive Knowledge Forum discourse. The online discourse was pre-processed based on thematic analysis and then organized into inquiry threads. An inquiry thread is a sequence of notes that aim to address one principal problem (Zhang, Scardamalia, Lamon, Messina, & Reeve, 2007). The goal of analyzing the inquiry threads was to obtain a holistic understanding of the students' ideas and provide a context for the subsequent analysis of the characteristics of cognitive collective responsibility. In total, 38 inquiry threads including 612 notes were developed.

Next, we conducted content analysis to analyze and characterize undergraduates' collective responsibility using the inquiry thread as the unit of analysis. We used the coding framework that was adapted from our previous research (Yang, van Aalst, Chan, & Tian, 2016) to code the notes in each inquiry thread. Two raters independently coded the notes from three inquiry threads in the experimental class (n = 190, 30%). The inter-rater reliability was .78 for awareness of contributions, .79 for complementary contributions, and .78 for the wide-ranging complexity of questions and ideas (Cohen's kappas).

## 3.1 Characterization of Collective Cognitive Responsibility

We selected 14 large inquiry threads for content analysis, which were defined as threads that included more than 15 notes. The coding results are given in Table 1.

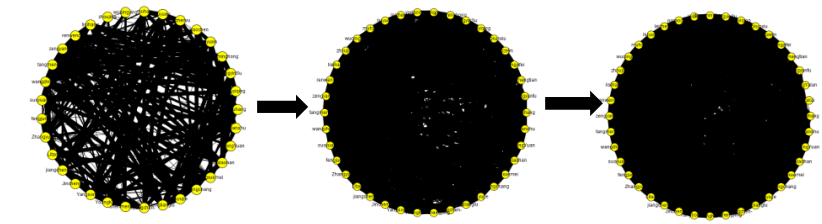
*Awareness of contribution and complementary contributions*. Table 1 shows that students contributed a considerable number of notes to create shared understanding (70) and to negotiating a fit (119). The results suggest that undergraduate became aware of the emergent issues and others' ideas by reading notes on shared understanding and further negotiating a fit, and therefore were aware of peers' contributions. Table 1 also shows that students made complementary contributions through participating in problem-centered discourse (62 notes), regulating their inquiry (22), and synthesizing community ideas to attain a higher level (38).

*Distributed engagement*. To reveal students' distributed engagement, we used the Knowledge Building Discourse Explorer (KBDex, Oshima, Oshima, & Matsuzawa, 2012), a socio-semantic network analysis tool. KBDex was developed to analyze knowledge-building discourse, and can support metrics of the three networks of degree centrality, betweeness centrality, and closeness centrality. Thus it can facilitate a visual

inspection of the semantic relationships, an analysis of pivotal points and phases, and trend analysis. We selected 10 keywords that were highly relevant to students' inquiry topics from their online discourse for analysis. We argue that the keywords can represent the discourse content, so the closeness of keyword links and the number of keyword instances represent the density and diversity of discourse content, respectively.

Table 1. Number of Different Categories of Contributions and Epidemic Complexity in Inquiry Threads

| | | Awareness of contributions | | Complementary contributions | | |
|---|---|---|---|---|---|---|
| | | Creating shared understanding (medium) | Negotiating a fit (high) | Problem-centered idea uptake (medium) | Regulating inquiry (medium) | Synthesizing notes (high) |
| Total | 318 | 70 | 119 | 62 | 22 | 38 |
| Mean | 22.71 | 5 | 8.5 | 4.23 | 1.57 | 2.71 |
| SD | 6.59 | 2.48 | 2.56 | 2.65 | 1.55 | 1.81 |
| 1# | 20 | 7 | 4 | 3 | 3 | 1 |
| 2# | 18 | 3 | 8 | 5 | 2 | 0 |
| 3# | 37 | 10 | 10 | 12 | 1 | 3 |
| 4# | 35 | 6 | 14 | 7 | 3 | 5 |
| 5# | 20 | 7 | 6 | 4 | 0 | 1 |
| 6# | 21 | 4 | 12 | 2 | 0 | 3 |
| 7# | 20 | 3 | 8 | 3 | 4 | 2 |
| 8# | 16 | 3 | 8 | 2 | 1 | 2 |
| 9# | 29 | 7 | 8 | 6 | 0 | 7 |
| 10# | 23 | 6 | 8 | 4 | 0 | 4 |
| 11# | 23 | 7 | 8 | 4 | 0 | 4 |
| 12# | 16 | 1 | 8 | 2 | 3 | 2 |
| 13# | 23 | 3 | 11 | 3 | 4 | 2 |
| 14# | 17 | 3 | 6 | 5 | 1 | 2 |



The first 200 notes The first 400 notes All the 600 notes

Figure 1. Snapshots of the Network of Students Over Time

## 3.2 Changes of Collective Cognitive Responsibility and Idea Improvement

To measure the extent of changes in collective cognitive responsibility and idea improvement, we first sequenced the notes in each of the 14 large inquiry threads, based on the time of the last modification, and then divided the notes into two phases, each with an approximately equivalent number of notes. Table 2 shows that the frequency distributions for Phases 1 and 2 differed greatly. Generally, undergraduates in Phase 2 engaged in more high-level discourse moves than those in Phase 1. For example, they engaged more in synthesizing notes that were critical for knowledge creation in Phase 2 than in Phase 1.

Table 2 also shows that students in Phase 2 engaged more in discourse with higher explanatory power and quality, and in inquiry- and explanation-oriented discourse. For example, they produced many more "rise-above" notes than those in Phase 1. These results indicate that the undergraduates gradually advanced their community ideas.

# 4. CONCLUSIONS

In this study we investigated whether undergraduates were capable of take collective cognitive responsibility in the knowledge-building process. We found that they were able to progressively take collective responsibility to develop a knowledge-building discourse. However, a deliberate design that encourages their development is required to achieve these outcomes. The design of the knowledge-building environment involved three components: (1) the creation of an error-free collaborative environment; (2) periodic tasks to promote the development of collective cognitive development; and (3) knowledge-building talks to prompt collaborative reflection and the thoughtful use of the assessment data. This study demonstrates the potential of a knowledge-building environment that engages undergraduates in an examination-centered culture. The study had implications for teachers and researchers who aim to design technology-supported learning environments that can engage students who are generally unmotivated and disengaged.

Table 2. Changes of Collective Responsibility and Community Ideas over Time

| | | Phase 1 | | Phase 2 | |
|---|---|---|---|---|---|
| Total notes | | 162 | | 156 | |
| | | f | % | F | % |
| Awareness of contributions | Creating shared understanding (medium) | 50 | 30.86 | 20 | 12.18 |
| | Negotiating a fit (high) | 52 | 32.10 | 67 | 42.95 |
| Complementary contributions | Problem-centered idea uptake (high) | 30 | 18.52 | 30 | 19.23 |
| | Regulating inquiry (high) | 13 | 8.02 | 9 | 5.77 |
| | Synthesizing notes (high) | 14 | 8.64 | 29 | 18.47 |
| Quality of questions and ideas | Fact-seeking | 3 | 1.85 | 0 | 0 |
| | Explanation-seeking | 13 | 8.03 | 7 | 4.32 |
| | Simple claim | 9 | 5.56 | 5 | 3.18 |
| | Elaboration | 49 | 30.25 | 36 | 23.08 |
| | Explanation | 72 | 44.44 | 77 | 49.36 |
| | Rise-above | 16 | 9.88 | 32 | 20.51 |

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# COMMUNICATIVE TEACHING IN THE TERTIARY LEVEL

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**ABSTRACT**

This paper developed a module for college English teachers. Communicative language teaching was the utilized strategy. The teacher-respondents were trained using the learning segments which were revised and finalized after a five-day try out.

Explicitly, the research determined: (1) the stages in the development of the training module and (2) the contents of the learning segments as research output.

The module composed of segments produced in this study ensured that teachers will incorporate tasks involving communication in the classroom. This involved requiring students to do something in the lesson, with the language, or with each other. Developing students' oral and written communication skills is one of the most important goals in language teaching. These skills were considered essential in the training module which was developed in the study.

Research findings showed that the English professors of Capitol University and San Isidro College need to training with the current trends in language teaching. Further, the said training was deemed necessary to better achieve the goal of language teaching; that of developing students' oral and written communication skills.

Moreover, part of the modules produced by the researchers led these professors to reconstruct their own syllabuses to provide for a communicative class.

**KEYWORDS**

Communicative Teaching, Module, Learning Segment

## 1. INTRODUCTION

Teaching English as a second language is very challenging in the Philippines. Hence, English teachers should look for varied ways to respond to this challenge. To do this, college English teachers have to be prepared by updating themselves with the current trends in language teaching. Being well-informed with the latest developments in language teaching is a must for them. As posited by Long (2005), teachers' mastery of teaching the English language gives their students the skills needed to compete in the global marketplace.

Moreover, Cottrell (2003) states that teacher competence is an essential factor for achieving educational excellence. Truly, quality teaching leads students to learn better. Ellet, Loup, Culross, McMullen & Rugutt (2002), who conducted a study at Louisiana State University on "learning environments", found that student's self - reports of their learning and of their learning efficiency were significantly related to their personal perceptions of the learning environment. Student learning is enhanced in higher education settings that address students' personal learning environment needs and in which Quality Teaching thrives.

Students have different abilities when learning a second language. Some grasp concepts easily while others struggle and have difficulties leading to demotivation and lack of interest. Hence, to teach students successfully, teachers do not only educate, but also create a suitable environment for learners. Therefore it is necessary to perform many different roles in the classroom to fully achieve the best learning development (Keller, 2011). Teachers may do both of these: monitor students' language use; and facilitating communication.

A study of poor English language performance among student teachers in National University of Laos reveals that the cause of the poor performance is attributed to factors (Souriyavongsa et al., 2013) inclusive of the *lack of well-trained teachers, students' lack of English background knowledge* and *students' limited opportunity to use English with native English speakers*.

In a country like the Philippines, which aims to participate meaningfully in international affairs, English has a special place. And so has the English teacher who is called upon to define the role of the English language in national development.

However, it has long been known that teaching does not necessarily equal learning - that what a teacher does in the classroom to teach may not match what the learner perceives the lesson to be about. Crowe (2008) asserts that each lesson is a different lesson for every learner. The effect of what learners learn in every learning episode may vary, depending on how well they are motivated and how ready they are. Hence, teachers have a very important role to play in ensuring that students get the desired motivation scheme to achieve the goal of communicative teaching.

Davis (2003) states that the key to teaching students to think lies in how the teaching process is conducted. Teachers have the command to raise the level of students' thinking even to the extent of analysis and appreciation. Since students do not think this way naturally, interaction is necessary. High quality class interaction contributes significantly to a student's progress in developing his communication and verbal skills. This in turn will lead him to develop his thinking skills.

## 2. LITERATURE/ THEORETICAL UNDERPINNING

Strayhorn (2012) posits that teacher competence is essential for achieving educational excellence. To ensure that teachers are knowledgeable about the subject they teach, emphasis is placed on professional training. Teachers, as the key component of an educational system, need professional training to assure efficiency of students' learning. Thus, educational systems should be driven by the need to achieve efficiency, effectiveness and equity. This highlights the importance of training on-the-job teachers.

For a teacher to develop competence, the primacy of the classroom is indeed high. In a learning environment, they become principal agents of change. It is where experience is based and where growth takes effect (Fraser, 2012). Considering the importance of the classroom in a teaching-learning process, this research focused on observing students in their English classes to find out how teachers develop their communicative competence. Developing students' communication skills is vital for them to become professionals, Danao (2002) says. She explains in her book, *Confluence: Journeys* that students need to learn the body of material for the profession they are preparing for. This body of material in the different disciplines is in English. Most importantly, students need to know how to communicate in English since it is an international language, and one of the official languages of the Philippines and of Philippine education. Thus, the English subjects in college must equip students to become the professionals they want to be, Danao concludes.

English teachers then must try to hold on against the rapid wearing down of the position of English in the Philippines. Eugenio (2009) suggests that the line can best be defended at the level of the teaching of English in college. Many strategies come and go but these are not appreciated because teachers have not redirected their traditional teaching style. For this reason, the researchers developed the training module composed of learning segments; designed for English teachers to maximize learners' communicative potentials. Block (2002) supports the communicative teaching idea for he believes in the active process of learning; a scenario that involves students in classroom communicative tasks, allows learning to be both more personal and more memorable and for these reasons, is more effective. Learners who are engaged by the lesson – by the teacher, the materials, the tasks, and the activities – are more likely to have that learning make an impact on them.

## 3. METHODOLOGY

The Systems Approach to Training was used in this study to gather information from the college English classes of the two try out institutions. The Twenty five professors from Capitol University and Fifteen Instructors from San Isidro College were taken as respondents of this paper. Complete enumeration of samples was then employed. These respondents were intensely involved in the adopted five phases of the systems approach to training as follows; analyze, design, develop, implement, and evaluate.

In the needs analysis stage, baseline data were obtained from the respondents through the use of Focus Group Discussion (FGD) to gather the type of teaching strategies used in college English classes; the questionnaire for identifying the lesson objectives; the classroom observation which looked into the three parts of the lesson; and the analysis of the content of English tests.

Making use of the four extensive needs analysis procedures, the data were then analyzed. These were analyzed individually and entered in a matrix in the form of focus, rating and description. Final evaluation was derived through these three categories. The matrix showed commonality of results through simple frequency counts. The lesson objectives, strategy, content, evaluation, texts, textbooks and work texts as variables for the questionnaire; classroom observation and analysis of tests revealed a non-communicative language approach. The focus group discussion conducted among the forty respondents of the two try out institutes displayed a strong support for communicative language teaching. These results served as basis for the production of the training module's learning segments. Three experts then evaluated the designed training module composed of six learning segments. It was then refined in context with the stated results.

## 4. FINDINGS AND CONCLUSIONS

In gathering the results of the study, relevant points were seen. The analysis phase showed that the research respondents were purely using the traditional lecture method. Classroom observation results further showed very limited chances for student talk. Additionally, the Question and Answer technique was overused.

Furthermore, the needs assessment stage discovered that teachers needed to develop competencies in communicative teaching. The classroom activities they gave did not encourage class interaction. They ranged from the correct usage to rote memorizing of the grammar rules. This therefore, made students more conscious to speak, as they had to think of the correct usage of verbs all the time. Hence, the researchers thought of the necessity to develop the training module.

It is consequently concluded that various opportunities for student-talk should be provided among English classes. This calls for teachers' creativity in designing meaningful and communicative tasks. After all, communication is but the goal of language instruction.

## 5. RECOMMENDATIONS

It is recommended that an experimental research be conducted to test the effectiveness of the developed training module. The existing module may be compared to another design, which can possibly give focus on the grammar approach to teaching English. Finally, more trainings may be tailored for teachers to enhance communicative teaching.

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# CHALLENGES AND SUPPORT FOR THE DEVELOPMENT OF NOVICE TEACHERS' PROFESSIONAL IDENTITIES

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**ABSTRACT**

Teaching profession requires teachers to be prepared with skills and knowledge to overcome challenges related to subject matter, students, colleagues and personal matters. In order to become an outstanding teacher, one has to undergo formal as well as informal professional development experiences. This study aims to explore the challenges faced by novice teachers and the sources they turned to in order to resolve these challenges. The research participants were three novice teachers who are currently in their first two years of teaching experience. The data were mainly collected using semi-structured interviews with each participant. With the assistance of NVivo software, the data were coded using a thematic analysis approach. The findings indicate that novice teachers not only struggle with their own lack of skills, but are also burdened with students' negative attitudes and difficulties in the environment in which they work. The main supportive elements found to be helping these teachers in solving their problems are support from senior colleagues and family, and information available on the Internet.

**KEYWORDS**

Novice Teachers, Professional Development, Professional Identities, Significant Others

## 1. INTRODUCTION

In order to become effective, teachers have to be professionally prepared. Teachers therefore need to experience continuing professional development so as to become more effective (Harris, 2002). For pre-service teachers, teaching practice is one of the key elements in their training (Haigh and Tuck, 1999; Hill and Brodin, 2004). Through pre-service training, student teachers are provided with experience in teaching and learning in and outside the classroom, as well as opportunities to enhance the development of their characters so as to become ethical and professional (Kennedy, 2006). Some past studies have proven that teaching practice helps pre-service teachers to have better discussions with lecturers and mentors, and thus helps pre-service teachers to determine the approaches to use and their implications in teaching (Botha and Reddy, 2011; Agbo, 2003). In addition, teaching practice has been found to help pre-service teachers to enhance those skills related to problem identification, decision making, and the selection of approaches to overcome problems in classroom situations, and has also been found to be incredibly significant in developing pre-service teachers' confidence in themselves (Khalid, 2014). Nevertheless, teachers' professional development is not merely limited to pre-service training. Berliner (1995) views the initial stage of new teachers' professionalism as the critical stage in which novice teachers will face numerous conflicts, responsibilities and tasks. These challenges, according to Seyfarth (2002), may impact the efficiency and commitment of novice teachers. Workplace culture, students' attitudes, teachers' low self-confidence, and subject mastery are among the challenging factors for novice teachers (Nolan & James, 2004). Day et al. (2007) also report that teachers who are within the first three years of the profession show a high commitment towards their profession; however, students' negative attitudes are the main factor impacting on their self-confidence. Novice teachers have also been found to hold back from asking 'too much' of their seniors so as to maintain their self-esteem (Khalid, 2014; Khalid, 2015). Much research has been done into the development of teachers' professional identities; however, for new teachers, the transition from their learning institution to the real context of work has been given a little focus in past research. This paper aims to explore the challenges faced by the novice teachers and the sources they turn to in order to resolve challenges.

## 2. METHODOLOGY

This study employed a case study design that involved three female novice teachers who are in their first phase of professional life, i.e. between one to three years of employment (Day et al., 2007). All three participants major in Islamic and Moral Education. Two of them are married, but none has a child. These teachers were posted in three different secondary schools in rural area in Borneo (Sarawak). The data was collected using a semi-structured one-to-one interview during a school holiday. Research data were trancribed and coded using NVivo following a thematic analysis approach (Braun & Clarke, 2006).

## 3. FINDINGS

This paper aims to explore the challenges faced by the novice teachers and the source they turned to in order to resolve these challenges. Based on the analysis, two main factors were derived: internal factors and external factors. Internal factors covered: (a) teachers' ability to adapt to the new environment, (b) classroom management skills, (c) creative-thinking skills, and (d) family or spouse factors. External factors, on the other hand, covered: (a) students' acceptance, (b) students' motivation, (c) students' performance, and (d) students' different culture. All three participants mentioned their struggle to adapt to the new environment. Seemingly, coming from the Malaysian peninsula and now being in Borneo, where people speak different dialects and live in different tribes, was a challenging new environment for them. For example, one of the participants mentioned:

> *When I was in my first month here, I was struggling to adapt myself with the whole thing! First, since I am teaching in Sarawak, I could not understand their language, but all the students were speaking in their dialect. Then, it was difficult to get myself accepted … at least, that is how I felt. (Sara)*

Another challenge highlighted by the participants is related to their classroom management skills. Azura, for instance, mentioned that she is still having a problem with her classroom management but she has to accept the conditions. It seems that other senior teachers also encountered such problems. In some cases, students ignored their teachers and would only do their work when they were asked personally. However, having a limitation in mastering the dialect the students used has created a gap between Sara and Azura and their students. To engage the students in learning activities, teachers had to be more creative in selecting or planning appropriate activities during the class sessions. Participants in this study did not deny that having to plan creative activities or learning materials to attract their students' motivation wasn't an easy process, and that they sometimes ran out of creative ideas to conduct fun learning experiences for their students. In addition to the above issues, the participants also mentioned the factor of their families. Two of the three participants were married, and both their husbands were working in Peninsular Malaysia. The distance did not allow them to meet often: the only time when they had the chance to see each other was during school holidays, not even at weekends. The teachers reported that being separated from their spouses impacted upon their motivation, which led to lower productivity. Responses from the participants include:

> *It was an emotional disturbance really, to have your husband living far from you. I almost quit my job. But he consoled me not to … we need to be more patient. I really hope to transfer back to the peninsula end of this year. The stress is becoming more when I have problems with the students. (Azura)*

Some external factors were also recognized. The first challenge the teachers faced is students' acceptance. These novice teachers were struggling with this. They described the situation of the students not paying respect to them in class. They reported that some students just ignored the teacher, thus making them feel uneasy and rejected. Having to understand the culture of any context is a crucial part of making someone comfortable and at ease. However, being in a new cultural setting that is different from where they come from put these novice teachers in difficult situation. Students' motivation was also cited as one of the challenges these teachers are facing. This situation directly impacted the teachers' levels of motivation in return. Sara explained:

*Many times … when I was feeling so down. Imagine that I had spent a few days preparing the lesson activities and materials but when I entered the class, the students were not paying attention, they showed less respect to me and sometime they were being rude to me. Then, I couldn't help myself, I preached at them instead! They really ruined the mood! (Sara)*

As much as their low motivation, students' low academic performance also had a negative influence on these teachers. This prevented them from teaching what they were supposed to teach. Some of them were in a dilemma. For example:

*My students are poor in the subject [Islamic Education]. They can't read Arabic letters, or recite the Holy Qur'an. Perhaps having a limitation in those skills made them less attracted to learn the subject. Knowing that it is almost impossible to cover the syllabus as it is supposed to be covered makes me frustrated. Do we have to teach them all the basics again? (Azura)*

## 3.1 Sources of Support

The analysis indicates that there are some sources that significantly contribute to the teachers resolving the challenges they face. These primarily rest on: (a) support from senior teachers, (b) self-awareness, (c) support from family, and (d) technology. All three participants mentioned receiving support from senior teachers. From their seniors, the novice teachers learned about dealing with poor students in an effective way. Among the advice they received was to learn their dialect and use it in the class sessions. According to Sara, students are happier when they head their teachers communicating using their own dialect. Another example of the tips received was not to show their state of demotivation in front of the students. Rather, Damia says that they have to smile and call the names of their students one by one. This approach will make the students believe that their teachers really care about them. Two participants also mentioned how they learned from other teachers about different kinds of activities that suit their students. They also learned that teaching low performing students does not mean following the actual syllabus. The most important thing is to make sure they convey good examples to the students and show their good characters. Apart from support from other teachers, the analysis reveals that these novice teachers also depended on their own selves. All of them mentioned how they made sure to be well-prepared for their lessons. For instance, all three mentioned that they would prepare learning materials such as flash cards, quizzes, or even tokens for their students. They explained how they prepared themselves with more fun stories to be told in their class. Preparation prior to the lesson is important, but reflection after the sessions is also needed. The teachers mentioned the importance of self-reflection. For example, Azura stated:

*Starting from last year [during her first year of the profession], I tried to do self-reflection. I asked myself what are the things that I am happy with in my lesson? What else can I improve? Once I did that, it really helped, at least it helped me to be more systematic. I even have my own notebook to write down any new ideas that suddenly sparked in my mind. Because I do not want to miss a thing. (Azura)* It was undeniable that being in such a situation – having unsupportive students, being in a different culture, and far from family – put these teachers under pressure.

Family is always a source of inspiration and strength. For these teachers, family plays a significant role for them in maintaining their strength and spirits.

*To me, I would say my mum is the one with the most significant support. [Laughs] Well, I am not married yet so … I don't have a husband. So ... my mum will always be there for me. She flew to Sarawak five times already, just to be by my side. When my mum is with me I feel stronger and more motivated. But I wish that within two years from now I will be able to transfer to Selangor or Melaka [states in Peninsular Malaysia]. (Azura)*

Another significant source of support that all these novice teachers cited was the Internet. Access to the Internet was viewed as a necessity for them to get new ideas and examples of different activities that they could adopt in their teaching. Although these teachers were teaching in a rural area, they were lucky to have internet access, particularly using their own mobile data. Two of the teachers also mentioned the use of

instant messaging services such as WhatsApp and Telegram as a medium for them to obtain ideas, and as a creative way to make their lessons more fun and meaningful. Damia, for example, explained how she benefitted from a Telegram group that gathers Islamic Education teachers from different states:

> *I think my involvement in a Telegram group that consists of other Islamic Education teachers from different parts of the country helps me with regards to many aspects, but most importantly, I gained a lot of quizzes and exercise questions from the group. They also share past year questions in the group. So normally I will download the questions and do some modifications before using them for my students. (Damia)*

The use of WhatsApp as a medium for discussion and exchanging ideas was elaborated by Damia and Azura. They used a WhatsApp group for all teachers teaching Islamic Education in the same school. Using the group, information can be disseminated in a short time. Azura highlighted how she was delighted to have the group:

> *My head of subject panel used a WhatsApp group as a medium for us to communicate. He even shared documents in the group. He also encourages us to use the group to seek help. It was helpful. (Azura)*

## 4. DISCUSSSION

This paper aims to explore the challenges faced by novice teachers and the sources they turned to in order to resolve these challenges. For these novice teachers, the challenges do not only come from their own lack of skills related to classroom management, but also result from factors related to their students. Day et al. (2007) explains that it is normal for novice teachers to struggle with their own skills. In this study, novice teachers are also having difficulties with unmotivated students, who show less respect to them. This situation is difficult for novice teachers, and impacts upon their commitment and self-confidence as a teacher. This finding corroborates Day et al.'s (2007) and Beauchamp & Thomas's (2009) findings that students significantly influence teachers' professional identities, either positively or negatively. This study's findings further strengthen the literature showing that teachers' personal lives have an impact on the development of their professional identities. These findings show that novice teachers also struggle with their own lack of skills. However, interestingly, none of the teachers in this study mentioned any difficulty in mastering their subject content; rather, they highlighted having difficulties in planning activities for teaching and learning. This might be due to the fact that these teachers are teaching students who are have moderate or weak academic performance. Thus, there was less pressure on the teachers with regards to their proficiency and knowledge in the subject matter. This is also explained by Khalid (2013), who reports how novice teachers in a fully residential school with high performing groups of students were having difficulties in preparing themselves with information on their subjects due to the demands from their students who would occasionally ask 'tough' questions. This research has also found that novice teachers are faced with an experience where they are in a phase of accustoming themselves to their new surroundings (culture, people, way of life, et cetera). Stansbury and Zimmerman (2002) recommend that a mentoring system as a vital element of teachers' professional development. Novice teachers cited their learning from seniors as an important resource for professional development. This approach is similar to the concept of 'apprenticeship', as discussed by Wenger (1998), who developed the community of practice (CoP) approach. Through a CoP approach, novice teachers may learn tremendously and tacitly from other teachers (Khalid, 2014). The findings of this study indicate who are the 'significant others' for novice teachers in supporting the development of their professionalism: more senior teachers, family, and the Internet are the main three resources cited by these teachers. In the era of technology, it is expected that novice teachers would use the Internet to gather information to help support their teaching activities.

## 5. CONCLUSION

This study promotes an understanding of the struggles faced by novice teachers and how they solve their problems in the teaching and learning processes. Professional development is an ongoing process and should be tacitly experienced by novice teachers in order to build a stronger identity as a teacher. However, it is irrefutable that formal professional development and training are greatly needed. Three main 'significant others' that were found to be supportive factors for novice teachers are colleagues or senior teachers, family, and Internet sources.

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# DEPLOYMENT OF A GENERIC METHOD IN THE DESIGN OF DIGITAL LEARNING ENVIRONMENTS USING A COLLABORATIVE AUTHORING TOOL

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**ABSTRACT**

This paper describes the first stages on the development of a design method of digital trainings using the collaborative authoring tool "ALO". Based on the theory of instrumental conflict (Marquet, 2005), this method highlights the necessity of the design digital trainings under the optimal harmonization for users/learners in didactic, pedagogical and technical terms. By the implementation of an artificial intelligence, we will collect the data acquired from users' experiences to analyse their performances. The result of this analysis will be given to the trainer/designer in order to improve future trainings by predictive learning models increasing cognitive skills and the measurement of the efficiency of a digital training.

**KEYWORDS**

Digital Trainings, Learning Analytics, Instrumental Conflict, Artificial Intelligence, xAPI

## 1. INTRODUCTION

For many of companies, the improvements on employee's expertise demands a financial investment. Some companies choose to adopt digital learning as a solution. They make a call for learning services organisations to guide them through this strategy (Loh, 2013). However, All, A & *al*, (2015) points out the lack of evidence on the effectiveness of digital trainings for learning improvement.

This document describes the first stages of a generic method in the development of digital trainings using the collaborative authoring tool from **My-Serious-Game**, a French company specialized in the design of digital trainings. Marquet (2005) describes the instrumental conflict as a possibility of harmonizing the learner interface with valuable functionalities on the teaching topics. Based on this theory, our method contributes then to define the appropriate learning elements to a suitable scenario with the correct/adapted learner interface.

Our main objective is to obtain users' experience data through the implementation of an artificial intelligence allowing us to:

1. Apply the generic method through the implementation about cognitive activities (Instrumental Conflict Influence).
2. Collect user's performances data by the implementation of tracking supporting tools (xAPI, Learning Analytics).
3. The analyse the results of the users' performance will provide us a verification or not about our generic method. On this stage we will identify the main aspects generating an instrumental conflict.
4. With the data generated and the results of performances, we will define a new path of cognitive activities and the effectiveness of trainings in terms of learning outcomes.

First, we will detail the context in which this approach is based, following on the conceptual framework and methodology to identify the design aspects of training and the application of artificial intelligence. At the moment of the depot of our document, no results have been analysed yet. However, the matrix of Learning Analytics and path performances have been stablished to predict the first tendency of our method.

## 2. RESEARCH CONTEXT

The last couple of decades, specifically after the inclusion of learning technologies among the academic institutions, educational engineering and digital learning design have been mobilized to identify the required improvement where technology contributes to learning processes (Linard, 2002; Henry, 2007; Baron, 2001). Paquet (2014) describes educational engineering as a method allowing models and charts organizing learning activities, the selection of the technological display with the teachers' role and resources, including digital environments.

According to the industry, the choice of the corresponding training to improve employees' skills is one of the main concerns for stakeholders (Loh, 2013). An optimal solution detected to hold back this concern comes with the hybridization of those trainings meaning the mix between digital and classroom learning environments (Peraya, 2010). This hybrid environment guides the learner through the adaptation for the use of technologies for learning improvement (Lebrun, 2006). This hybridization could also facilitate the role of the trainer/designer due to the analysis generated to the most stablished and relevant elements to perform during the training.

The evolution of the design process for those hybrid trainings develops more technological learning devices. According to our work, the authoring tool it's a trademark product of **My-Serious-Game**. A French company leader in the development of digital trainings. Supported by this authoring tool, designers/trainers will be guided to customize trainings with a large set of possibilities (plug-in). The use of artificial intelligence and the xAPI technology contributes with the identification of more details related to learners' performances.

This occurs during the training with the corresponding path and behaviour analysis (Bennane, 2012). The addition of A.I. (Artificial Intelligence) to this tool relies on the importance of the access to previously complex information about the learning process. The data obtained from those performances would be modified allowing trainers to analyse the elements that contribute or deteriorate the learning process (Cleveland, M., Olimpo, J, DeChenne-Peters, S. 2018).

The measurement about those trainings in terms of efficiency and improvement on cognitive skills will be hold by the design of an architecture with the interpretation and predictions of the training design assessment with an exploratory analysis (Mirroahi & al., 2016).

## 3. THEORETICAL FRAMEWORK

Humans through history have always been elaborated tools to help them resolve some particular issues (Leroi-Gourhan, 1967). Those tools have been designed under the anthropological concept of "artefact" for their attachment to a social structure. Artefacts then become "instruments" as soon as they contribute with a practical solution to a problem, applied to a concrete reality of the world (Latour, 1987). In terms of learning, when an artefact becomes appropriated for a learning/teaching situation, it is necessary to divide into "didactic artefact" and "pedagogical artefact". The first one refers to all the disciplinary knowledge or professional behaviour needed to be learned to become an instrument. The second one refers to the appropriate representation of the scenario needed for its teaching (Marquet et Coulibaly, 2007).

However, the inclusion of technologies for learning, has created another obstruction on the development of trainings. This technology could interfere on the balance between the didactic and educational artefact, with the knowledge to be acquired, or the skill to be developed, associated with its teaching scenario, could be relevant with the potential inappropriate use of ICT (Marquet, 2012).

One example of instrumental conflict occurs when a technical system dedicated to a family of disciplinary objects is used inappropriately by the learner/user or teacher/trainer. In this type of situation, neither the learning contents, nor the functionalities of the system are involved. As an example, teachers can prevent students from accessing the properties of some specific subject manipulated objects that the software exploits, since these same properties are not highlighted when a figure could be done by hand (Denami & Marquet, 2016). In this case, modeling the trainings for the majority of cases where this conflict is not expected to occur, an actual incoherence is shown (Mitgutsch & Alvarado, 2012).

This empirical model on the designing of digital trainings begins by identifying the elements to include on the training (artefacts) in terms of technology (display), pedagogical (game design) and didactical (game play). Once those elements are identified, the formulation of cognitive tasks and exercises takes place through the pedagogical dimension. Once the learner executes the tasks, an amount of data is generated, tracked by the algorithms from an artificial intelligence to be analyzed. The data obtained is divided into several lexical outputs in terms of recognition of semantic unities (xAPI performance).

In this case, modeling the trainings for the majority of cases where this conflict is not expected to occur, an actual incoherence is shown due to the fact that some designers are still not able to difference this aspect through their courses (Mitgutsch & Alvarado, 2012). The collected data describe the performance and results of each action. Knobbout and Van der Stappen (2017) quote an architecture on the analysis of learnings performance by SURF (2016). The strategy on the evaluation of the data collected will be given by the dialogue between the instruments of measurement. Using these elements, a new data of the complexity of the task are released. Rossi (2014) explains that the complexity of the cognitive task could be measured by the alterations of the level of performance of the learner. Those changes show the variation on the cognitive process and introduce, basically, the level of acknowledge of each learner.

With the new analyzed data, we could provide a formative feedback to both participants of the process (Banihashem, S & *al*., 2018). First, the trainer. The data provide the elements of improvement and advice about which artefacts and pedagogical tasks should be reconsidered to include or exclude from the training. Second, the learner, whom could identify through the data the cognitive aspects where they had more difficulties during the training to overcome with (Song, D, 2018).

## 4. PERFORMANCE TRACKING AND METHODOLOGY

**My-Serious-Game** has structured an R&D team to develop the authoring tool. This tool has been conceived to optimize trainings using xAPI technology and artificial intelligence. This is the first digital tool applying A.I. technology to allow companies to create a wide variety of collaborative and interactive training courses.

The objective of this project is to stablish a generic method of digital learning conception. In order to accomplish it, we have organized it in several stages. First, we have done a benchmarking about all the digital trainings produced by our company since 2014. After, we have classified under the instrument conflict theory the artefacts (technology, pedagogical and didactical) of each one of the. With this classification we could identify the empirical own model of conception from **My-Serious-Game**.

On the third stage, we have overviewed the literature on the design methods of digital training. The result allowed us to create a comparative chart between our model and those already applied. This chart would provide us the information related to the main cognitive subjects to consider on the conception process of digital trainings.

Once we have stablished the cognitive subjects, we have applied a framework of predictive behavior on learners and teachers' performances. From the learners, we will consider the learning outcomes with the activities measured by our experimental tool and for the teachers, we will track the path behavior on the design of digital trainings. Our predictive behavior is based after the analysis of our predictive learning model with a *Delta* of measurement and behavior.

At the same time, we have analyzed the tracking tools and the dialogue to communicate that data. First, we have written the syntaxes for the tracking on the learner's activities (xAPI). Also, we have defined the vectors to include in our matrix algorithm of 4 dimensions to identify that behavior.

Related to trainers, they are guided while they host training sessions using our engine advice. The training content is broadcasted from the trainer's digital tool (iPad, tablet, laptop, etc.) proposing to learners a set of cognitive activities. From a pedagogical perspective, the collaborative dimension using technology it's an advantage (Lebrun, 2006). Our product gives to the trainers the control on learners' performances on real time. Data collection such time, interactivity, scores among others, provide the trainer valuable information to optimize the training.

## 5. DISCUSSION

By the time this paper is released, our work relies on the validation of our expert-concept (V1) which means to validate the *Delta* set for the trainings. We consider our method a key tool on the prediction of learning analytics. Besides, it highlights how trainers could improve digital trainings through data collected from user's experiences. Our work seeks to conceive a learning/working environment where instrumental conflict doesn't take place, and, at the same time, it allows to optimize the results obtained.

This conception is stablished by first: conceiving the cognitive activities to develop through digital trainings under the instrumental conflict theory. Then, track them to analyze our predictions and finally, reformulate a new path proposing predictive learning models.

At this stage, we already have conceived the structure of our cognitive tasks, as well as the pedagogical path. This structure contains the *Delta* settings in both measurement tools and learning prediction model. We would like to describe if the use of the authoring tool using an A.I. contributes to optimize the digital trainings under the influence of instrumental conflict. Our main hypothesis is that **the use of the authoring tool contributes to optimize the conception of digital trainings under the influence of instrumental conflict.**

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# Poster

# NEW PROGRAMMING EDUCATION FOCUSING ON PROBLEM SOLVING SKILLS BY "POV-RAY"

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**ABSTRACT**

We developed a new curriculum of programming education for high school students by using "POV-Ray" software. This software is a ray tracing software which draws 3D images. The language of POV-Ray is similar to the C programming language. We think POV-Ray is more suitable for programming education than C language in that the result is outputted as a figure. Then, we designed and practiced nine lectures. At the beginning students could only make simple figures, e.g., spheres, boxes. However, they finally became able to make complicated images oceans, chess board, etc.

**KEYWORDS**

Programming Education, Problem-based Learning, Creativity Skills

## 1. INTRODUCTION

We developed a new curriculum of programming education for high school students by using "POV-Ray" software. Programming education is attracting attention in order to educate Assessment and Teaching of 21st Century Skills (ATC21s) in Japan (Ministry of Internal Affairs and Communications (2017)). ATC21s comprise abilities that have been identified as the requirements of success in 21st century society and workplaces. In particular, problem-solving, cogent reasoning and critical thinking are considered important and strongly related to programming education. Therefore, a better programming education curriculum is required.

POV-Ray is a ray tracing software which draws 3D images from a text-based scene description. For example, this software can create 3D images by combining move, rotate and scale operations with basic objects, e.g., boxes, spheres. The scene description language of POV-Ray is similar to the C programming language. Students are easy to understand a result of POV-Ray program, because POV-Ray can easily generate images and visualize the source code. We think that POV-Ray is better than the C in classroom activities.

## 2. CURRICULUM DESIGN

We adopted John Keller's ARCS Model (Keller (1983)) in instructional design. The ARCS Model is based on the motivational design theories and consists of four categories, Attention, Relevance, Confidence and Satisfaction (ARCS). For example, The Attention can be gained in perceptual arousal. We think that the experience of creating 3D images with simple programming stimulates the interests of students. For the Relevance we use examples that students know well. We think that students can find meaning in the program by making familiar things in their life. They observe what they want to create, and think about ways to realize by program. This leads to the Confidence of them when they were able to create 3D images as they imagined. Since POV-Ray can visualize the program as a 3D image, teachers can easily give feedback depending on their imagination for the Confidence. They will get a sense of Satisfaction by becoming able to make more complicated things with new knowledge.

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Our curriculum has focused on high school second graders (eleventh-grade students) because having the mathematical knowledge (e.g., knowledge of trigonometric functions) might be necessary for them. The curriculum consists of nine lessons. The lesson starts from a simple program that creates a sphere as a basic object (Figure 1), they will become able to create more objects with each attendance to the lessons. Finally, they make their own original 3D image. Also, we use "include files" in the lessons. A include file is specific file that increase work efficiency by creating frequently used functions in separate files. Even if the program of object is complexly, we can teach it according to the student's level by preparing the appropriate include files. Learner analysis is particularly important to prepare include files at the appropriate level.

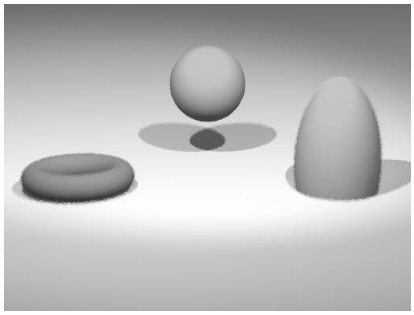

Figure 1. Example of Students' Work in the First Lesson

## 3. CONCLUSION

In our practice the following results were obtained. Creating a 3D image from a program was a new experience for the students. Many of them were interested in this lesson and actively working on it. Finally, they have created 3D images of their interest such as an airplane, oceans, chess, etc (Figure 2). by programming. This seems to train problem-solving ability in the sense that students realized what they imagined by the programming. In this presentation we will discuss more details such as the content of the curriculum and the work of the students. Also, we will introduce 3D images actually created by students.

Figure 2. Example of Students' Work in the Final Lesson

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