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Research Article

A HyFlex-Flipped Class in Action Learning: A Connectivist MOOC for Creative Problem-Solving

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ABSTRACT

This design research aims to propose a HyFlex strategy for students and participants in the workplace using massive open online course (MOOC) flipped between the two settings, an active in-classroom to an action learning in the workplace. The research methods were designed into two major parts, where the first part was a design stage which included the review and design process, while the second part involved case studies. The learning design is analogous to an origami paper folding system that processes the diversified questioning of real-world problems and recursively reflects the thought, action, and solutions to the problems. The case studies showed a statistically significant increase in participants' creative problem-solving at the 0.5 level.

Keywords: MOOC, connectivist MOOC, flipped learning, action learning, creative problem-solving

INTRODUCTION

At the turn of the third decade of the 21st century, educational entities continually converse on human development skills. Once the digital environment evolves, so shall the working resources within it. The most critical "21st century skills" are categorized as foundational literacies, competencies, and character qualities. Under competencies, skills addressed learners' approaches to complex challenges via problem-solving, creativity, communication, and collaboration. Similarly, UNESCO's E2030: Education and skills for the 21st century highlights not only the foundation skills of literacy and calculations but also transferable skills such as problem-solving, communication, creativity, leadership, and entrepreneurship (UNESCO, 2016; World Economic Forum, 2020).

Problem-solving abilities in some research are defined as abilities to solve an ill-defined problem, in contrast to a defined one with specific answers to be reached, with no clear goals, and a solution path usually found in social science and humanity disciplines. Solving this type of problem is not one loop of hypothesizing, planning, testing, and evaluating; but questioning, reframing the iterative question, reflecting, and finding alternate ways of possible innovative solutions along with a feasible plan, as known by the definition of creative problem-solving (CPS) (Csillag & Hidegh, 2021; Fauziah et al., 2020; Nonthamand & Songkhla, 2018).

CPS notions introduced in the previous century are cited by several works referred to the contributors as early of the 20th century by Osborn, Parnes, Guildford, De Bono, and Isaken. They presented the idea of creative imagination to solve problems. In the process, creative problem solvers identify problems, gather information, analyze data, form solutions, clarify ideas, synthesize ideas, and evaluate the best outcomes. Employing divergent and convergent thinking, the steps of CPS by Parnes involved finding the objective, data, problem, ideas, solution, and finally, acceptance to arrive at creative thinking. Innovative thinking, problem-

solving, and creativity are brain activities that depend on divergent and convergent thinking. In his five steps, thinkers prepare the skills, information, sensitivity to the problem, and identify the problem. Well-defined processes are essential and renowned concepts, such as thinking outside the box, and the six thinking hats are known to enhance creative thinking. In contemporary practice, creativity is the ability to construct solutions to a problem's gap, defining what is and, with several approaches, arriving at what needs to be (Lim & Han, 2020; Nonthamand & Songkhla, 2018).

Problem-solving in a workplace is commonly known as action learning (AL). AL, the principle of learning from practice, has advocated university courses on creativity and problem-solving since the early 21st century. This kind of learning was initiated in 1998 at the Technical University of Denmark. The knowledge acquisition integrated experiential learning, action research, and project-based learning. The teaching was developed on the grounds that learning occurred when:

1. learning real problems,
2. learning how to create,
3. learning to work in groups,
4. learning about self,
5. facilitating learning within a group, and
6. learning to learn.

The primary element of this learning activity is to create a space for students to explore ideas, and share opinions, while using tools in the process of CPS (Beech et al., 2021; Brook & Pedler, 2020; Conine & Peratoner, 2019; Csillag & Hidegh, 2021; Dolapcioglu, 2020; Olivares et al., 2019; Perusso et al., 2021).

Learning with real-world problems can be empowered by digital and communication technologies, when massive open online courses (MOOCs) are a contemporary practice of openness and flexibility. The peak and decline of MOOCs since 2012, currently almost a thousand universities launched online courses, and some Asian governments announced the policy supporting open platforms, such as India, India, Israel, Thailand, etc. However, statistics show low figures in course completion in MOOCs, even from prestigious universities. Rise during the pandemic situation, around 220 million users signed up for MOOCs with an expectation of quality content in MOOCs to support the missing face-to-face classroom, especially in the new normal after the pandemic.

Some research studies attempted to intervene in the MOOCs classes with strategies such as self-regulation, peer groups, and machine-learning algorithms to optimize the intervention based on the learners' information for the effective implementation of MOOCs. The results remain slightly but not significantly higher than the average completion rate of no additional intervention (Andersen et al., 2018; Duan et al., 2019; Heutte et al., 2021; Wang et al., 2017).

MOOC are generally classified into two categories which include a course structured similarly to an e-learning course with all the contents predefined with activities by the instructor ("xMOOC"). The other type of MOOC refers to course materials with contents derived from interactions with the students during the course ("cMOOC") (Downes, 2016). The initial MOOC is a revolutionary blur of the existing boundary between the institution and the world "outside" it.

By connectivist approach of MOOCs initially takes its place as an open space and learning community where learners voluntarily meet, discuss, and share their knowledge, following the guidelines and goals of the course instructors. The connectivism approach of MOOCs could strengthen hybrid and flexible learning in the active classroom and workplace. Adding up with the flexibility of changeable choices of learning mode, the assigned tasks, and the learning goal keeps individual learners at their own decisions and paces, and together learning group connects. In addition, MOOC and communication technology advancement gives rise to different modes of learning, one of which introduced great flexibility during difficult circumstances due to the pandemic. It disrupted learning, especially in higher education, to operate around individual demands and styles. It made possible for learners and instructors to choose what, where, and when to learn. They can teach and learn with specific, well-defined objectives and have freedom of time (Eradze et al., 2020; Kang et al., 2021).

Such integrations of MOOCs are only made possible through the availability of advanced communication technology. During the pandemic, the learning terminology "HyFlex" was coined and gained popularity as a teaching modality in the COVID-19 planning environments. Some higher education institutions are branching out a "specific term" based on their university's mascot, such as "HawkFlex" at Montclair State University in 2021. Nevertheless, such unique applications of the HyFlex course delivery term signify the infancy of the modality. Eventually, higher education has been attempting to overcome the challenge of this new mode of teaching and learning (Heilporn & Lakhal, 2021; Kang et al., 2021; Keiper et al., 2021; Liu & Rodriguez, 2019; Malczyk, 2019).

A HyFlex learning design is an integration of hybrid and flexible learning, where hybrid learning is when class content offers in both face-to-face and online modes. In contrast, flexibility is offered as an option for learners to select preferred modes, whether to attend online or face-to-face (Eradze et al., 2020). The fundamental principles of HyFlex courses are to

1. provide a choice on how students will attend a given session,
2. offer equivalent learning tasks in all modes,
3. reuse the same learning objects for all students,
4. ensure that students are equipped with the technologies and skills to interact in all modes, and
5. employ authentic assessments (Heilporn & Lakhal, 2021; Keiper et al., 2021; Liu & Rodriguez, 2019; Malczyk, 2019; Miller et al., 2021).

Thailand, one of the Southeast Asia countries, has strived for economic competitiveness. An added emphasis on automation assets and digital integration encompasses social and economic change. Industry 4.0 has become a country framework as announced as a Thailand 4.0 policy that forwards the structure. The government policy enforces a shift in workforce qualifications preparation at all levels that include high skills and real-world readiness demonstrated as a complex work performance to meet a competitive challenge. In the workplace, skilled staff needs to broaden and freshen up ideas based on updated research. Learning naturally occurs when staff expose themselves to a complex problem with a recursive solution and adapt from their experiences. Students in the classroom are trained for real-world cases to prepare them for a new workforce. Formal and non-formal learning can be realized when the class is open to the outside world, inviting non-registered workplace learners to learn with in-class students using available open content (Boshoff & Fernandes, 2020; Buasuwan, 2018; Dolapcioglu, 2020; Lim & Han, 2020).

As a principal entity contributing to nurturing skilled labor in a society, higher education institutions must not only look to instill the demanded skills. Still, they should also create relevance to the labor market early on. Consequently, a mismatch between the demand for skilled labor and the supply will lead to rising inequalities (Beech et al., 2021; Boshoff & Fernandes, 2020; Perusso et al., 2021). Today, higher education learning necessitates a choice to advance towards authenticity. With the fast-paced changing environment owing to technology, real-life and context-based learning becomes a viable option. An opportunity opens an efficient learning pathway to equip scholars with up-to-date knowledge upon graduation.

Likewise, in an actual workplace setting, learning involves personnel solving problems on a daily basis with a team and reflecting on what has been learned from the tasks. To better counter change and enhance learning development, individuals shall question reality and develop new perspectives by learning through action or, in other words, adopt AL based on the principles of activities of continuous questioning and reflections. Learning in a workplace is an action that involves personnel solving everyday problems within a team approach practical and academically reflecting on what has been done and learned (Antonsen et al., 2022; Beech et al., 2021; Filipkowski, 2022; Olivares et al., 2019; Perusso et al., 2021).

Under these circumstances, MOOCs using an open learning environment could bridge learning between in-class students and workplace professionals in the outside world. The study aimed to design the cMOOCs concept in a hybrid mode of face-to-face and online that aligned with the flexibility of schedule to complete the task. Students are exposed to real lectures, content, and materials that are made openly accessible to non-registered learners in the workplace who are invited to connect their real-world cases to the project as open resources. When students plan their schedules to coincide with the specified activity, a continuous project takes on a dynamic nature.

THEORETICAL BACKGROUND

This section highlights four significant points of this research study. They include CPS, connectivism and MOOCs, AL, and the HyFlex design.

Creative Problem-Solving

The book Applied imagination by Osborn in 1957 introduced the idea of problem-solving and creativity using several brainstorming approaches to find innovative way for solutions. Osborn emphasized using creative imagination to solve problems, a crucial aspect of solving problems creatively. Following Osborn and Parnes, a CPS process covers seven steps of activity:

1. Identifying the problem,
2. Preparing and gathering information to solve the problems,
3. Analyzing the data,
4. Forming an alternative and various ways of solving the problem,
5. Using an idea incubator to make the idea clear and illuminated,
6. Synthesizing or packing pieces together, and
7. Evaluating a selection of the most effective answers (Nonthamand & Songkhla, 2018).

A concept defined the CPS as a sensitivity to what was missing and unfolded, then hypothesized and tested. That was the idea of using integrated information to process thinking to find a missing part and create a new product that was different from the original. A trial-and-error approach for creative thinking has taken four stages, as follows:

1. the preparation stage to gather facts, stories, and ideas,
2. the incubation stage to explore the idea,
3. the imagination Insight stage and test the idea, and
4. the verification of the process.

Another well-known concept of lateral thinking includes outside the box and six hats for creative thinking.

In the vision of brain activity, CPS needs approaches in multi-directions of divergent and convergent thinking. The problem-solving in a creative cycle appears in five steps:

1. preparing stages of the four areas in skills, information, sensitivity to the problem, and identifying the problem,
2. gathering ideas, selecting only those relevant,
3. incubating problems matched with data and possible solutions,
4. clarifying the solution idea, and
5. proving the facts and details.

Eventually, the CPS process has clarified the meaning of a solution to a problem and discussed a routine that could bring about reproductive thinking when productive thought occurs when encountering a non-routine (Fauziah et al., 2020; Lim & Han, 2020; Nonthamand & Songkhla, 2018).

Some applied research studies proposed instructional design strategies that allow the integration of an online support system into a university course to enhance CPS. The research proposed three key factors: information on the online support system, authentic task design, and a team-based approach. The information on the support system contributes significantly to real-world problem-solving, while the team's collaborative work creates an optimum solution (Fauziah et al., 2020; Lim & Han, 2020). The researchers found the key factors that could enhance CPS, including information on reflective activities, thinking tools, and supervising. Moreover, psychological aspect of learners' mindsets that one is capable of being creative, so-called creative self-efficacy, is linked to both creative performance and creative mindsets (Royston & Reiter-Palmon, 2019).

Connectivism and MOOCs

Connectivism has challenged constructivist learning psychology in how the learning is connected, adjusted, and formed into new knowledge. Downes (2016) stated that connectivism is the future of learning that is the creation and removal of connections between the entities or the adjustment of the strengths of those connections. Learning in this approach becomes even more individual and dependent on available resources and the ability to connect those knowledge pieces for a particular purpose. The learning design is altered into an instructional strategy that enhances the skill of this new learning path. A problem-based approach becomes a way of how one learns to connect knowledge to align to answers, as well as decide to commit their efforts to a chosen open courseware to master a necessary skill for a specific situation need.

MOOCs are courses that allow anyone to access and interactively communicate for learning. The term MOOC was coined by Dave Cormier during a connectivist approach in a course, "Connectivism and connective knowledge." At that time, a few registered students in a program were joined by thousands of non-students accessing the same course. This course was named connectivist-MOOC (cMOOC), which claimed to be a dynamic way of learning compared to another approach of MOOC that was well structured as an open course that extended from an intended online course, so-called extended-MOOC (xMOOC). The MOOC has promoted a rich dialogued network for learning versus the xMOOC. The availability of a large number of resources has limited meaning without high interactivity among learners in xMOOC. The interaction, which digitally occurs via a computer network, can be very dynamic or may fail, or there may be a loss of control for in-class students. The Times Higher Education critiqued xMOOC based on its nature of content delivery and e-learning structure, stating that this type of learning lacked creativity and active knowledge (Duan et al., 2019; Nazari et al., 2021; Wang et al., 2017).

The connectivist version of MOOC includes an open learning environment of creative, autonomous, and social network learning within a digital context. In this complex digitized world of fluid knowledge, open content can be updated every minute and selected for everyday problem-solving. Learning in a complex digitized world needs no longer be a tedious or immense task at anytime and anywhere but a skill requiring a connection to needed content in a specific timeframe. An open online learning situation that can contribute as an essential part to this new way of learning is individual, self-determined, and voluntary in the form of MOOC. Many of today's classrooms have been flipped from content-oriented to activity-based, where content must be acquired outside the classroom. MOOCs have flipped the classroom where lecturers assign students to learn online, and activities occur in a classroom. An effective instructional design orchestrates both learnings inside and outside the classroom to meet the maximum potential for learning. Through this innovative approach, students are exposed to diverse kinds of learning materials that encourage a higher order of thinking, such as critical thinking and problem-solving, as well as creativity (Wang et al., 2017).

MOOCs emphasized a platform of open licensing content, structure, and learning goals to enhance reuse, revise, remix of resources, and redistribution as being known for supporting the open educational resources movement. A MOOC instructional design mainly aims to connect learners to engage collaboratively with questions and interactive communications. Several MOOCs are not developed with lectures and materials posted in a learning management system (LMS) but using web resources. As a result, MOOCs later became a backbone for existing distance learning, provided by private or non-profit institutions and faculty members. MOOC principles for learning were activities of aggregated relevant resources, remixing with insights, repurposing to match the use, and finally, feeding forward with the new resources (Boltz et al., 2021).

In addition, case studies of connectivist MOOCs in higher education, such as those by Oxford Brookes University, opened classrooms for professional development for audiences moving to teach. The research study on the connectivist characteristics of learners when attending a MOOCs class found results related to perspectives on autonomous learning, learning diversity, learning through openness and interactivity, organizing learning through aggregation, co-creation via remix, revise, and redistribution, and coping with uncertainty identity. The study found learners overwhelmed with online content and later shifted from consumers to producers through their interaction and collaboration. Social construction brought students to negotiated and flavored interaction until gradually, they could work across space boundaries to make a social connection. Students found they built recognition by negotiating the meaning of their experiences across the open distributed network (Andersen et al., 2018; Duan et al., 2019; Otto et al., 2021; Wang et al., 2017).

Action Learning

AL has been employed extensively as a workplace learning and to effectively solve problems in real situations. An earlier AL was associated with Revan's model in 1982, which argued against a large size of ineffective training but emphasized a small group sharing of experiences through questioning. The framework of AL is based on problem and question: L=P+Q (Revans, 1982). Reflection is an essential component of AL and was later formulated and known as "action reflection learning" (ARL). ARL expanded its emphasis team project rather than individual effort, together with the learning coach role and experiential learning. Another model of AL incorporates challenge, reflective inquiry, action and strategies development, individual and group learning, as well as learning coaches. Learning coaches function to promote learning by questioning and encouraging members to be involved with a problem-solving process and reflection. The type of learning was later implemented worldwide in business education, where personnel learning occurred while attempting to solve a complex working problem and to reflect based on the power of questions from one's own practices (Beech et al., 2021; Boshoff & Fernandes, 2020; Brook & Pedler, 2020; Dolapcioglu, 2020; Filipkowski, 2022; Perusso et al., 2021)

The overlapping of learning and work became a consideration known as work-based learning for students as preparation of readiness, attitudes, and behaviors by linking classroom learning and work-learning content. Researchers proposed the idea of learners as interns in the workplace where the dimension of socio-cognition was enhanced by challenges, less control in accessing knowledge in the workplace, teamwork, and collaboration. Case studies demonstrate how AL was integrated into an internship for university students regarding its cooperation between a business organization and institution that became part of social responsibility for sustainability and maturity of the prospected working force. Case studies based on professional students learning and curriculum claimed that students' acquisitions of related working skills were improved using AL in the professional setting. The research noted a valuable preparation of irregular working environments as having students actively involved and adjusting to the working atmosphere. Furthermore, some comments on the AL internship as a challenge for human resources development in promising students and linking students' classrooms with an authentic performance challenge. This is an essential contribution to an organization for realizing students' professional development (Antonsen et al., 2022; Brook & Pedler, 2020; Perusso et al., 2021).

AL is described by a psychological learning theory that the learning process is a creative way of thinking caused by reflection on how the action can be used for improvement. The method of learning and unlearning in the AL process is underlined by the concept of learning how to learn, a technique of how people know and what works for them from those that do not. Through this method of learning from what worked with group members, AL integrates an appreciative inquiry, where group members dream and aim at the bright sight of solving the problem from past positive experiences (Csillag & Hidegh, 2021; Dolapcioglu, 2020; Robertson & Heckroodt, 2022).

AL, a constructivist learning methodology, has been effectively applied to a classroom primarily for an outdoor experience or action research. AL was initially identified as part of workplace learning and advocated university coursework on creativity and problem-solving in the workplace. The purpose of this type of learning activity is to extend a space for students to share their opinions, discuss and experiment with the creative process, and explore innovative solutions while working with real-world problem-solving. The basis of this type of coursework was the combination of experiential learning, AL, action research, and project-based learning. With an increasing demand for skilled graduates who can integrate and apply theoretical knowledge in a real-world context, universities tend to design a skills-centered curriculum with a partnership between academic institutions and companies (Boshoff & Fernandes, 2020).

In addition, AL approach is a creative way of thinking that the learning process is a never-ending process. Members use AL to struggle out from a predominated idea and reframe the choices, even with recent decisions of their own. The AL process becomes a peer learning process to reach an innovative and creative solution for a complex problem in a workplace. The digital environment and using information and communication technology came into the context of AL advocated university because of its cost-effective solutions for members who were not in the exact location while promoting a total learning environment with an organization (Perusso et al., 2021).

HyFlex and Flipped Learning

Several strategies and technology integration have been used to transform learning into being more engaging and active. The term hybrid or blended learning alone regularly refers to the concept of substitutes for traditional face-to-face meetings with online sessions. The difference blended learning is a broad term that signifies the incorporation of variations and modalities of instruction. "Blended learning" defines blended learning as a system that combines face-to-face and computer-mediated instruction. Blended learning is a thoughtful integration of classroom face-to-face learning experiences with online learning experiences. Some studies describe "blended learning" as using technology to creatively manage activities, distribute content, and assess across all delivery modes, not just face-to-face (Beatty, 2019; Heilporn & Lakhal, 2021).

Some studies define the HyFlex learning model as an integration of hybrid and flexible learning, where hybrid learning is when class content is offered in both face-to-face and online modes while flexibility is offered as an option for learners to select preferred modes, whether to attend online or face-to-face. The HyFlex learning model is an approach that allows students to determine what blended learning they prefer to meet their unique needs. The primary HyFlex difference from the previous blended synchronous model is the need to

1. set up the classroom presentation by either the instructor or learning assistant, and
2. simultaneously stream the session live (Beatty, 2019).

In the context of course management, HyFlex requires additional instructional design as it may be challenging to preplan learning activities without prior knowledge of the number of learners in each modality (Padilla Rodriguez, 2022).

Depended on technologies through hybrid learning, the HyFlex practice gives learners more flexibility and freedom of choice on the learning modality (Wong et al., 2022; Wut et al., 2022). The key principles of HyFlex courses are to

1. provide a choice on how students will attend a given session,
2. offer equivalent learning tasks in all modes,
3. reuse the same learning objects for all students,
4. ensure that students are equipped with the technologies and skills to interact in all modes, and
5. employ authentic assessments.

Some studies found students who participate in a HyFlex course may feel satisfied and have higher learning engagement. The HyFlex model's apparent benefit is that it can provide social distancing while meeting student learning preferences. As some students gather in the classroom while others connect remotely, so do instructors who could be in the classroom or remote (Chan et al., 2022).

In terms of learner attitude towards the HyFlex class, during the pandemic, a few research were conducted, and that found a challenge (Padilla Rodriguez, 2022). Studies reviewed productive tools utilized in HyFlex learning, for example, video-conferencing software and digital noticeboards. Towards the end, the studies reported that some participants were motivated to attend a HyFlex course due to the flexibility that matched their demands. Nevertheless, participants felt that the HyFlex modality was not the optimal mode for learning. When addressing class interaction, learners reported communication problems among students from different modes. Learners express that the online learning mode was tedious, partly because the HyFlex mode required more self-regulation to complete assignments and collaborate with classmates (Beatty, 2019; Keiper et al., 2021).

Some research introduced practical tips for HyFlex teaching for undergraduates during COVID-19, stating that it is different from the regular HyFlex teaching model in that the students did not have the freedom to choose their mode of learning for each day. Also, it is mentioned that some universities that adopted the HyFlex model during the pandemic did not have the proper infrastructure to provide an equitable learning experience. However, in their study, such deficiency offered a promising class engagement. The research provided a lesson learned that helped group work engagement, such as grouping different modality students together, pre-assigning tasks, encouraging presentations, allowing to self-select teammates, assigning concise

deliverables, providing informal communication options, and recording group discussions for further reference as opposed to the main class conversations (Miller et al., 2021).

Flipped learning comes into account when it is another method that transforms the use of traditional teaching strategy to the use of digital or online learning materials. Similar to a blended learning approach, it is designed to maximize the features of online learning for students learning flexibility while using a face-to-face classroom to augment what they have studied online (Aidinopoulou & Sampson, 2017; Kostaris et al., 2017). This teaching method has been positively viewed as an effective instructional method used to help teachers moderate their teaching practice to maximize the class benefits and improve student learning outcomes. Not simply off-online teaching, a flipped classroom is an individual learning experience where a student needs to complete an assigned learning objective at their own pace before participating at another outcome level during the classroom activity. In the classroom, small group activity demonstrates how each individual needs to be knowledgeable about what they have studied before coming to class and then leverage that into complex learning issues such as a problem-solving activity (Chen et al., 2019; Cheng et al., 2019; Li et al., 2021).

METHODOLOGY

A design research methodology was applied, a qualitative approach of a systematic review and experts' opinions supported by collected, quantified data to demonstrate the effects of the learning design system researched by the study.

The First Phase of Learning Design

A systematic review of patterns in the flipped classroom, teaching research, and practices from 2015-2019, both in basic and higher education programs focusing on issues of teaching methodology, strategy, media design, and evaluation. The review included tracking the learning features of a major open LMS. A draft of the flipped classroom system design was reviewed by experts.

The Second Phase of Learning Design

A multi-case study approach was taken to explore the research data. The University Research Ethics Committee granted approval, and participants were informed about the authors' research intention and consented to participate in the research.

Two study cases of graduate and undergraduate students were deployed. The research criteria were met by studying the social science studies programs and the course that focused on a problem-based approach with expected creative learning outcomes. The elements of CPS, CPS process 6.0 (components of CPS (v6.0), included: understanding the problem, generating ideas, planning process, and planning for action based on Isaksen et al.'s (2010) framework. For assessment, the instructors and personnel in the workplace assessed students' work. Archives of the project and semi-structured face-to-face and email interviews were analyzed for evidence of how participants learned. Finally, the result of the two cases was analyzed, and the system was re-designed for a proposed HyFlex-flipped classroom with AL model via cMOOC.

PHASE I DESIGN RESULTS

Systematic Review of HyFlex-Flipped Classroom Studies

The main focus of the part 1 review is to determine how a HyFlex-flipped classroom is designed in terms of teaching/learning strategies and activities. Teaching methods considered for this research study are based on AL, project and problem-based learning, and experiential learning. A self-directed learning strategy is also an essential foundation in this type of classroom arrangement. Previous research found that the most used media was a video lecture of 7-15 minutes, accompanied by questions.

The Framework of the HyFlex-Flipped Classroom System

The learning system design presents a metaphor for the Japanese origami paper folding art (Yoshizawa-Randlett system). Each fold represents concepts, the initial folding that marks the vertical point refers to the

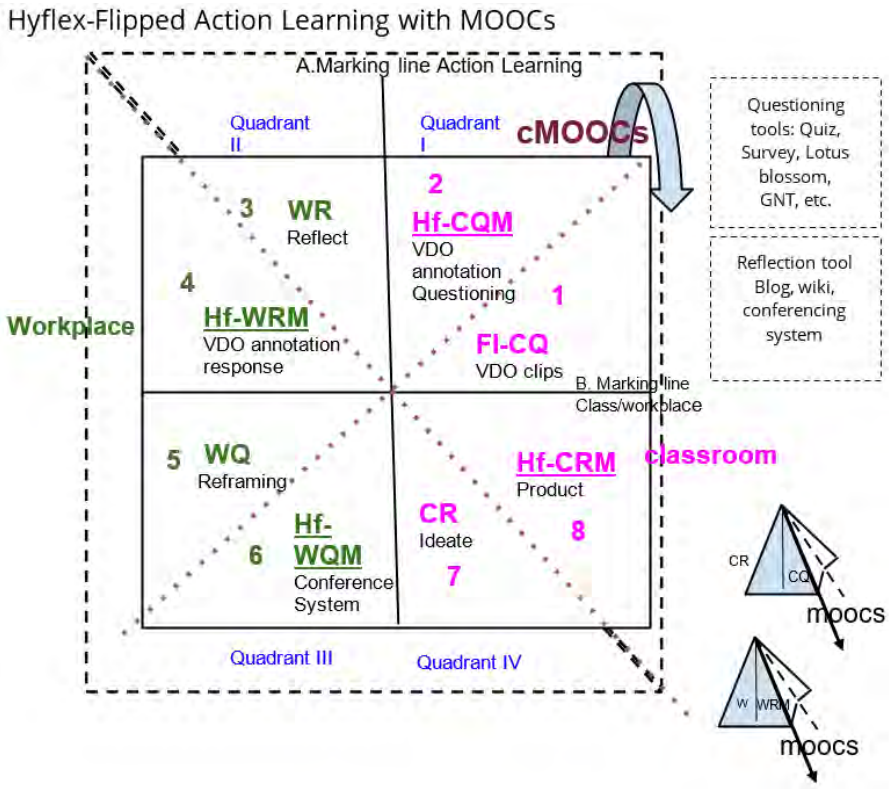

Figure 1. The design of HyFlex-flipped (Original diagram by authors)

classroom and the workplace. At the same time, the horizontal line reveals that questioning and reflection complement the flipping between the two sites of classroom and workplace. To continue the analogy of a folding paper system of an origami base, the final folding of the square base (preliminary fold or square base) is then refolded to be a triangular shape.

The concept of AL in a workplace: learning from real work/practice, questioning, and reflection. To continue the analogy of a folding paper system of an origami base, the initial folding is a square (preliminary fold or square base), which is then refolded to be a triangular shape (Yoshizawa-Randlett system). When flipping from the two marking points, this base system folding, vertically and horizontally (questioning vs. reflecting), will yield the inside and outside of the classroom.

When folded diagonally with the addition of a MOOC, the end of the diagonal represents the two principles occurring when using technologies found within MOOC (**Figure 1**). MOOC technologies include items such as video, e-books, media articles, etc., that needs to be designed to facilitate learning interaction, stimulate with questions, and automatically feedback, and a set of communication tools to facilitate interaction among learners is needed to support reflection and collaborative thinking.

The Designed System

The design of HyFlex-flipped applies AL principles, which include learning in the workplace context, based upon questioning and reflection methods and learning by learner reflecting on the problem-solving iterative process in the working environment. Numbers of solutions from this kind of problem-solving turned out to be immense. The HyFlex-flipped system offers people the ability to connect to up-to-date knowledge as well as communicate over time and space. The origami paper folder system is used as an analogy for a process of A, B as a marking point, then diagonal line (flipped by cMOOC) as shown in **Figure 1**.

Detailed Explanation of the Designed System

Owing to the flexible HyFlex-flipped design, it is not definite as to which setting begins first and in which sequence. However, the system will show a systematic way of flipping the classroom to the workplace.

Table 1. Teaching and learning system

	Questioning practice	Management tools questioning	Reflection action	Reflection tools
Classroom	Flipped classroom-questioning: 1. Fl-CQ	HyFlex-classroom-questioning managing: 2. Hf-CQM	Action at work reflection: 3. WR	HyFlex-work reflection managing: 4. Hf-WRM
Workplace	Workplace questioning: 5. WQ	HyFlex-workplace-questioning managing: 6. Hf-WQM	Classroom reflection: 7. CR	HyFlex-classroom reflection managing: 8. Hf-CRM

Quadrant I. Classroom questioning and managing

1. Fl-CQ--Flipped classroom questioning: In a flipped classroom setting, students, and questioning (Fl-CQ, 1) students based on the instruction and theories view the VDO lecture that shared with participants in a workplace.
2. Hf-CQM--HyFlex-classroom questioning management: HyFlex classroom provides students with in-class and online interactively annotate questions via classroom questioning management (VoiceThread).

Quadrant II. Workplace reflection and managing (Quadrant II)

3. WR--Workplace reflection: Participants in the workplace reflect on their works based on the lecture and questions posed in the VDO clip.
4. Hf-WRM--HyFlex-work reflection managing: HyFlex learning environment provides participants in the workplace interactively annotate reflection and response via the VDO annotation system (VoiceThread).

Quadrant III. Workplace reflection and managing

5. WQ--Workplace questioning: Participants in the workplace propose re-framing questions among themselves based on the thread of MOOCs VDO conversation.
6. Hf-WQM--HyFlex-workplace questioning managing: HyFlex workplace provides an opportunity for students to meet participants in the workplace or online to discuss the issues in real time via a VDO conferencing system to reframe questions/problems.

Quadrant IV. Classroom reflection and managing

7. Hf-CR--Classroom reflection: Students have their choices in coming to class face-to-face or via an online synchronous conferencing system to generate their idea based on the questioning and reflection on the problems. The discussion is recorded.
8. Hf-CRM--HyFlex-classroom reflection managing: The presentation of the final product is recorded, and the creative common license is applied to invite further questions and reflections if it may happen in the future.

Table 1 summarizes the teaching and learning system. Before phase II, the researcher presented the synthesis of phase I to a focus group of nine experts in educational technology. Then a second round of the group's consensus on the proposed learning design system was at the highest level with a mean of 4.7 and a standard deviation 0.27. This was a high enough determination to continue to phase II.

PHASE II THE CASE STUDIES

This section presents the results of the sampling groups' CPS in a flipped classroom using AL with a MOOC. Lesson plans were designed using Flipped classroom and AL with MOOC, and two sampling classes were selected from the classes that expected students' learning outcomes at the level of creation (Bloom's taxonomy) in the second semester of the year 2021. One sampling course was undergraduate level "computer teaching methodology"; the class was a senior class of the pre-service teacher program. Another sampling course was a graduate course, "management and technology education center." Class materials under creative commons license forged copyright that owners provided a specific condition for the public to use their works; for undergraduate students, there were 11 units consisting of 44 learning objects, while 13 units

were prepared for graduate students. 11 undergraduate students and fifteen graduates were in the sampling group, enrolled in a designed open LMS, namely open learning system. Undergraduate students were less likely to access the materials; the highest number of accesses to the assigned video and reading materials was 30 times, compared to 177 times of graduate students.

A self-assessment CPS instrument was constructed based on four key components, accordingly:

1. understanding and identifying issues,
2. finding ideas to solve the problems,
3. preparing to practice, and
4. planning practice.

The reliability of CPS was measured by using Cronbach's alpha ranged from 0.95 to 0.97.

The CPS instruments were administered to the sampling group before and after 16 weeks of the flipped class. The sampling group of 26 students, 15 graduates (57.69%) and 11 undergraduate students (42.31%), average scores were analyzed in an overall and by groups.

The total of 26 samplings had an average CPS ability 3.39, classified by indicators in descending, as follows:

1. planning before action 3.54,
2. understanding and identifying issues 3.38,
3. finding ideas to solve the problems 3.36, and
4. average in CPS 3.30.

The post-test, CPS ability was 3.92 classified by indicators in descending, as follows:

1. planning before action 4.02,
2. understanding and identifying issues 3.92,
3. finding ideas to solve the problems 3.85, and
4. average in CPS 3.84.

The samples were 11 undergraduates who had an average CPS ability in pre-posttest 3.42, reported by its indicators in descending, as follows:

1. planning before action 3.59,
2. understanding and identifying issues 3.39, and
3. finding ideas to solve the problems 3.39.

The post-test scores were an average of 3.92 reported by categories in descending, as follows:

1. planning before action 4.05,
2. understanding and identifying issues 3.92,
3. finding ideas to solve the problems 3.88, and
4. planning before practices was 3.80.

The 15 graduate samples had an average pre-test reported in descending, as follows:

1. planning before action 3.5,
2. understanding and identifying issues 3.44,
3. finding ideas to solve the problems 3.33, and
4. planning before practices was 3.23.

The post-test was an average of 3.9; reporting its components in descending, as follows:

1. planning before action 3.99,
2. understanding and identifying issues 3.92,
3. finding ideas to solve the problems 3.87, and
4. planning before practices was 3.8.

Table 2. Pre-post tests for measuring creative problem-solving abilities

Total samples (n=26)		Minimum	Maximum	Average	SD
Understand and identify issues	Before	2.88	4.19	3.36	0.37
	After	3.12	4.81	3.92	0.44
Finding ideas to solve problems	Before	2.64	4.50	3.30	0.45
	After	2.86	4.93	3.84	0.54
Preparing to practice	Before	3.00	4.82	3.54	0.51
	After	3.27	4.91	4.02	0.51
Planning practice	Before	3.00	4.56	3.38	0.42
	After	3.00	4.89	3.85	0.47
Ability for creative problem-solving	Before	3.02	4.26	3.39	0.36
	After	3.09	4.75	3.91	0.45
Undergraduate (n=11)					
Understand and identify issues	Before	2.88	4.19	3.39	0.39
	After	3.12	4.81	3.92	0.49
Finding ideas to solve problems	Before	2.71	4.21	3.39	0.44
	After	2.86	4.93	3.88	0.56
Preparing to practice	Before	3.00	4.82	3.59	0.55
	After	3.27	4.91	4.05	0.62
Planning practice	Before	3.00	4.17	3.30	0.41
	After	3.00	4.89	3.82	0.58
Ability for creative problem-solving	Before	3.04	4.26	3.42	0.40
	After	3.09	4.75	3.92	0.52
Graduate students (n=15)					
Understand and identify issues	Before	2.88	4.00	3.33	0.36
	After	3.38	4.81	3.92	0.41
Finding ideas to solve problems	Before	2.64	4.50	3.23	0.46
	After	3.14	4.93	3.80	0.55
Preparing to practice	Before	3.00	4.55	3.50	0.50
	After	3.36	4.73	3.99	0.44
Planning practice	Before	3.00	4.56	3.44	0.42
	After	3.22	4.89	3.87	0.38
Ability for creative problem-solving	Before	3.02	4.09	3.38	0.35
	After	3.43	4.75	3.90	0.41

Note. SD: Standard deviation

Table 2 summarizes the pre-post tests for measuring creative problem-solving abilities. Although the sampling group learned and perceived themselves as a way of solving problems creatively, as the data found their post-test score was higher than the pre-test, at the .05. Students' products were also assessed by instructors and personnel in the workplace.

The correlation analysis between the score of product and students' CPS ability found no significance in each indicator but a negative correlation overall; the correlation coefficient was -0.404 * Pearson, -0.362, -0.314, -0.367, and -0.348, respectively. **Table 3** depicts the Pearson correlation analysis between the product score and students' creative problem-solving skills while **Table 4** shows the results of Levene's test.

DISCUSSION

The metaphor origami folding system of the classroom flipped the inside and outside the classroom with AL, using the approach of practice and learning, questioning, and reflection. When applying the MOOC and AL into the flipped system, the LMS supports the flexibility of learning to be blended either online, onsite, or on demand, providing essential learning resources, and integrated thinking tools, that are ready to open classrooms for people at work and students to meet in an actual complex world situation. As in a related study by Boshoff and Fernandes (2012), the learning system offers a supportive environment for problem-

Table 3. Pearson correlation analysis between the product score and students' creative problem-solving skills

	Pearson correlation	
	CPS vs product	p-value
Understanding and identifying issues	-0.362	0.069
Finding ideas	-0.314	0.119
Preparing to practice	-0.367	0.065
Planning practice	-0.348	0.082
Overall	-0.404	0.040*

Table 4. The results of Levene's test

Compare	Average		Levene's test		t	p-value
	PS. Donna	Bachelor	F	p-value		
Understand and identify issues	21.11	21.40	3.515	0.073	-0.21 1	0.834
Find ideas to solve problems	20.97	20.26	14.081	0.001	0.432	0.672
Prepare to practice	22.08	21.02	12.896	0.001	0.666	0.515
The plans follow the expected way	19.72	17.05	2.249	0.147	1.606	0.121
Total score	83.89	79.73	23.111	0.000	0.711	0.488

solving in a diverse and dynamic interaction of people and processes. This CPS method connects the graduate classroom to apply what has been learned and enhances theoretical knowledge in a real-world context (Beech et al., 2021; Boshoff & Fernandes, 2020; Duan et al., 2019; Hsia et al., 2021; Robertson & Heckroodt, 2022).

The results show that students at both the graduate and undergraduate level have increased scores comparing to the beginning of the class. Each step in the learning process exposes students to quest and reverse what they reviewed from various source of materials before flipping between workplace and class. Flipping the class and investigating a real-world problem, students actively reflected on what had been a quest and reframed to initiate problem-solving. A must of the final process was the creation of the solution resulting from a group nomination technique that digital tool helps students to turn in the solution within the time frame of the deadline. In addition, either an in-house video lecture, some selected instructional video online materials available in MOOC could be reused as a source of materials for students and learners outside the classroom (Cheng et al., 2019; Fuchs, 2021; Li et al., 2021).

As mentioned in the work of Fauziah et al. (2020), CPS came for an active social context and authentic problem-solving. With the need to coordinate good practices and case studies, this study presents a metaphor of an origami HyFlex-flipped learning model to nurture an open learning environment that exposes in-class students to real-world questions, diverge and converges thinking to turn into a creative solution to a problem (Beatty, 2019; Chan et al., 2022; Chen, 2022; Lim & Han, 2020). Web-based online support system provides essential information, online open online content courseware of VDO lectures, reading assignments to download, and embedded online collaborative tools for idea generations, reflection, and contribution to others. The learning environment in the HyFlex offers in-class to flipped to outside in the workplace to remotely follow an exact problem in the workplace within their questioning and reflection activities in asynchronous mode. Recent research emphasizes that the creative problem-solving process is effective when the two thinking activities are harmonized rather than done separately. Continuous monitoring and feedback from the instructor are required regardless of several thinking tools in the online support system (Wut et al., 2022).

Students' Creative Problem-Solving Products

A correlation exists between CPS and students' products. Interestingly, students perceived their CPS high in the post-test, yet still did not achieve high scores on their products. It might be a case that students found after the flipped class method that there were choices and alternatives to choose from which they never thought of before having the class. When they had completed the flipped classroom process, however, they found diverse solutions to answers. The self-assessment indicates that students perceived their progress in improving their ability to solve the problem creatively. On the contrary, students who assessed themselves with low scores at the end of the flipped classroom obtained high scores in the product. The students found

alternative ways of solving problems than before having the flipped classroom. Their attempts to put solutions to the problems seemed to be even more though they had completed the product. This is quite reasonable that in a natural complex working environment, students could not simply solve a complex issue in a real-world situation, and AL in the never-ended process (Perusso et al., 2021; Royston & Reiter-Palmon, 2019).

It could be noticed that among the components of CPS, finding ideas, preparing practice, and planning practice, consecutively have less negative correlation than understanding and identifying issues. The greater the students' perceptions of understanding and identifying problems, the lower the score received from the product assessment. On the other hand, the less perception on understanding and identifying issues, the higher the scores of the products. The data shows students perceived themselves as low in CPS ability; they tended to spend harder efforts to come up with innovative solutions, which is evident in the assessment of the product. This finding coincides with several attempts of work in CPS that the process of questions is needed to be reframed and to be an iterative cycle of working on CPS. Once the process of the learning system is completed, the work of learners should then be published in open access so that the compiled knowledge of the problem solution could be a case for others. Similar findings of CPS on self-efficacy, students with open mindsets are capable of being creative, or creative self-efficacy, the better creative performance, and creative mindsets (Royston & Reiter-Palmon, 2019).

CONCLUSIONS AND RECOMMENDATIONS

A design of HyFlex-flipped AL with powerful tools of connecting MOOCs. By using an outside learning environment, students benefit from a connection between the classroom and an open course while letting students interactively learn with professionals in a workplace environment. A systematic instructional design based on a HyFlex-flipped classroom where learning activities exist between the inside and outside classroom creates an opportunity for students to learn in an authentic working environment. This type of learning design encourages students to inquire, reflect, and solve problems in a real context by using innovative solutions. Nevertheless, learning outside the classroom needs guidelines and a semi-structured instructor approach to alter the traditional lectures and support creative learning activities. This learning type of classroom has disrupted a conventional lecture-based format and attempts to flip a class and incubate a future innovator in a workforce as found in recent research (Beatty, 2019; Heilporn & Lakhal, 2021; Liu & Rodriguez, 2019; Malczyk, 2019; Miller et al., 2021).

Although the result shows a significant improvement in students' CPS resulting from the HyFlex-flipped classroom, in a real-world situation, there would be a need to keep the process in an iterative process of seeing problems differently and alternate solutions creative over time. There are issues of recommendation and key success factors in implementing the flipped classroom in AL, which is the involvement of the workplace. A guideline to attain the desired level of this practical learning, the workplace could be a key stakeholder partner in this type of learning program (Heilporn & Lakhal, 2021).

Further research study shall be conducted focusing on the effect of the HyFlex open classroom on the transferable theoretical knowledge and individual ongoing professional development in the workplace. An in-depth exploration of psychological learning factors and how students react to the HyFlex learning to take benefit of state-of-the-art technologies to customize individual learning over specific schedules and physical spaces in a regular classroom.

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