

Engaging Secondary School Students in Extended and Open Learning Supported by Online Technologies

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Abstract

This paper investigates the use of online technologies to extend the learning of a group of junior secondary school students after attending a Sun, Science, and Society camp. The students were of mixed ages and came from metropolitan and rural schools. Their teachers described them as students of high ability or students interested in science who required extension work. These students were engaged in online learning for a period of 6 months after the camp. This paper reports on how they engaged with the extended and open learning supported by online technologies. (Keywords: secondary school students, online learning pedagogy, open tasks, engagement, online interaction and collaboration)

INTRODUCTION

We live in a society where an enormous amount of information is readily and cheaply accessible on the Web. Learners can engage with this knowledge anytime and anywhere there is access to the Internet. With the exception of highly specific areas, there are few limits to how much knowledge students can gain in a relevant area. Secondary students seeking extended learning can engage in independent, research-based learning with Web materials. Besides providing the knowledge base for learners on the Web, there are other technologies associated with the Internet (such as e-mailing, Microsoft Network [MSN], and online management systems) that provide the tools for collaborating, exchanging, and sharing that knowledge.

This paper reports on a research study that capitalizes on Internet technologies to extend the learning of a group of 13- to 15-year-old students who attended a 4-day Sun, Science, and Society camp. The objective of this research study was to investigate how online technologies (an online management system, e-mail, and Web-based resources) are able to support additional open learning for these students for 6 months beyond that time by situating them in a virtual community of other students with similar interests and familiar facilitators.

The broad research question for the study was: What is the level of participation demonstrated by secondary students engaging with extended learning that is open and supported by online technologies?

The subquestions were:

- How motivated are the secondary students to discuss and share learning with their online community of peers in a virtual environment managed by Moodle?

- How do the students collaborate and interact in such an environment?
- What is the extent of the learning that students demonstrate when learning within this environment?

LITERATURE REVIEW

Online Learning Programs for Secondary Students

In a meta-analysis of the effects of distance education on K–12 student outcomes, Cavanaugh, Gillan, Kromrey, Hess, and Blomeyer (2004) reported that, as of 2004, an estimated 40,000–50,000 students were participating in online courses in 2,400 U.S. publicly funded cyberbased charter schools and state and district virtual schools. Rice (2006), who conducted a comprehensive review of distance education in the U.S. K–12 context, indicated that K–12 distance education programs range from text-based correspondence programs to online programs that fully use technology-mediated instruction. Citing Watson, Winograd, and Kalmon (2004), Rice stated that there are five basic types of online programs: statewide supplemental programs, district-level supplemental programs, single district cyberschools, multidistrict cyberschools, and cyber-charters. Different models of cyberschools have been evaluated by Stone (2008), who developed a rubric for evaluating these schools. The rubric identified vital “ingredients” for establishing and maintaining successful K–12 cyberschools. Stone identified inadequacies in existing cyberschools as reflecting either “deficit models” or “patchwork models” and proposed a holistic model for blending learning for K–12 cyberschools.

Tertiary institutions also offer online programs¹ in the United States for secondary school students. The online programs these institutions offer usually cater to the general education of K–12 students, but specialised courses are also targeted at groups of students, such as gifted students. The online programs are almost entirely courses where curriculum materials are prepared for students to retrieve and study in their own time and space. They undertake assessments and submit assignments for grading as part of their learning. In the United Kingdom, virtual schools such as www.notschool.net cater to the needs of at-risk students. Although most learning takes place asynchronously in most virtual schools, Briteschool, a British e-school, conducts live (synchronous) instruction over the Internet. Students log in at the start of the day and interact with the teacher online as they would on a “normal” school day. In Australia, the number of K–12 virtual schools is small. In 2002, Stanthorpe State High School became the first virtual school for small and remote schools throughout the State of Queensland and has since expanded in its program delivery to include more than 55 schools around the state.

Most of the research conducted on online learning (commonly called distance education) is in the higher education sectors. Although the number of virtual high schools has increased, particularly in the United States and United Kingdom, little research has been conducted in this area (Rice, 2006). In Cavanaugh et al.’s (2004) meta-analysis, factors contributing to successful distance education at the K–12 levels include:

¹ http://www.learningabledkids.com/college_and_high_school/virtual_high_schools.htm

- scaffolding younger students to assist them with developing skills to be autonomous and self-regulating learners. This is necessary for later learning (e.g., in adulthood), as self-discipline is one of the most important factors contributing to success in online learning (Schrum & Hong, 2002).
- embracing Piaget's stages of cognitive development and constructivist learning to implement appropriate developmental activities that build on students' achievements through the different cognitive stages.
- requiring teachers to have greater presence and to give instructions that are fewer and simpler (unlike older students, whose greater internal locus of control and persistence in learning requires less teacher presence).

Their studies also showed that distance education students can achieve academic success that is similar to their peers in traditional classroom settings.

Theoretical Framework Underlying Online Learning for Secondary Students

The learning theories supporting the online learning framework of this study are based on those underpinning effective computer-supported collaborative learning (for a historical perspective, see Stahl, Koschmann & Suthers, 2006). These learning theories include sociocultural (Vygotsky, 1978), constructivist (Bruner, 1966; Piaget, 1955, 1972), and dialogic (Bakhtin, 1986; Hicks, 1996) theories. Central to knowledge construction in online learning is a socially immersed learning environment where the students create a virtual community involving cognition, peers, and teacher(s), enabling them to construct knowledge in an interactive and iterative manner (Ng & Nicholas, 2007).

Constructivist learning theory (Bruner, 1966; Piaget, 1955, 1972) purports that individuals construct their own representations of knowledge and build upon pre-existing knowledge through active engagement with the learning, either at the operational level of physical manipulations or at the cognitive level of processing information or stimuli (or some combination of both). In an online learning environment, the cognitive aspect of learning requires students to draw on prior knowledge to present opinions in discussion forums and to actively construct new meanings from learning new material either from the Internet and paper-based resources or from contributions by other members of the online community that the student is in. Social constructivism provides a scaffolding dimension to learning through social interactions, as knowledge is constructed through the process of negotiating meanings with others (Vygotsky, 1978). The requirement for a social environment is based on the pedagogical benefits of having access to discussions generated in learning dialogues, such as in developing critical reflections and constructing knowledge (Anderson, 2004; Lipman, 1991; McConnell, 2000; Palloff & Pratt, 1999).

In this study, social presence is important for online learning for secondary students engaged with open tasks and who are from different geographic locations (Ng & Nicholas, 2007). With appropriate preparation, students learning online identify themselves as a "community of learners" (Anderson, 2004) with a common goal. The virtual learning space allows students to visit anytime and anywhere where Internet access is available to ask questions, express opinions, discuss concepts, and seek assistance with planning and completion of tasks.

The importance of social presence in asynchronous discussions in online courses at the tertiary level has been reviewed by Swan (2003), who cites studies by researchers such as Gunawardena and Zittle (1997); Poole (2000); Rourke, Anderson, Garrison, and Archer (2001); and Ruberg, Moore, and Taylor (1996). The studies showed that in an online learning environment, asynchronous discussions were a significant factor in success and learning satisfaction, as students were able to project their own presences and had opportunities to digest their peers' contributions as well as to write their responses and reflect on them before posting. Hoskins and van Hooff (2005) have shown that students' use of bulletin boards was a factor influencing achievement, and that those posting frequent messages on discussion boards outperformed peers who did not post messages or who were passive users. Fung (2004) and Stacey (1999) have found that through discussions that negotiate meanings in collaborative learning environments, students are exposed to different perspectives that help them develop critical thinking and judgment skills that value, support, or oppose the different views. Another benefit of online learning that the students reportedly perceived (Swan, 2003) was that an online learning environment had much less teacher dominance and offered a more democratic atmosphere for learning, where all voices were heard. Nevertheless, the role of the teacher in guiding the students' online learning process by moderating the discourse, acting as a motivating force, and maintaining its continuity is crucial to the success of secondary students' learning (Cavanaugh et.al., 2004; Ng & Nicholas, 2007).

This study sought both to create a network of independent learners (secondary school students) working directly with one another and to support this through adult/teacher involvement by allowing student choice (and hence some degree of ownership) within guided tasks. These tasks provided organisational and intellectual challenges to the students by pushing them to transcend comfortable understandings through both synchronous and asynchronous interactions with others who were already familiar to them and with whom they had established comfortable relationships.

METHOD OF STUDY

This research is exploratory case study research aimed at gathering data that is holistic and in-depth (Feagin, Orum, & Sjoberg, 1991) about the experiences of a small group of secondary school students participating in extension learning within a virtual learning environment supported by the online management system, Moodle. Consistent with Yin's (1994) descriptions of case studies, the purpose is to understand the relationships within what is examined rather than to offer generalisations to other contexts or people. As researchers, we were participant observers and online facilitators.

We developed what might be termed "adult friend" relationships with the participants. We provided some of the seminars and sessions during the camp, but our relationships with the students were more as facilitators, as much of the direction of the camp sessions reflected students' interests and questions. Our joint participation in the camp, in shared social activities surrounding the camp and in having the role of mentor/researcher built into the subsequent online

activities, meant that we became accepted members of the students' learning community. Our close involvement with the participants during all phases of their experience gave us multiple insights into their behaviours, motivations, and experiences. This involvement permitted us to interpret particular actions or comments by relating them to a wider context and our understandings of relationships between particular people and their histories of involvement in various aspects of the project. These considerations made case study method appropriate.

Participants

The participants in this research project were 13- to 15-year-old students who were, with one exception, from different school sectors (government, Catholic, and independent) and different regions of Victoria, Australia. The one exception was Mf, who was homeschooled. The students had applied to come together during summer for a 4-day university-based Sun, Science, and Society camp that took place annually. As the camp was subsidized through sponsorships, camp organizers limited the number of students. Students who applied to attend were selected based on their reasons for attending, their teachers' written references, and the need to ensure a balanced participation of genders and of students from rural and metropolitan schools. Teachers described most of the students applying as very interested in science and/or high-ability students. Within the context of this study, high ability means students who had excelled academically at school and were seeking extended learning opportunities. Of the 52 students who applied, 32 were selected to attend the camp.

Setting Up the Learning Environment

The 4-day camp was advertised as a learning experience for secondary school students consisting of two phases: Phase I was a 4-day residential camp involving activities at the university, and Phase II was a 6-month follow-up online-learning phase.

Phase I: Camp learning environment. During the camp, the students were engaged in workshops that related both directly and indirectly to the sun. The activities at the camp were a joint effort between the Faculty of Education and the Faculty of Science, Technology, and Engineering. The topic of the sun provided a context for learning and was a basis for making connections between varied lectures, workshops, and excursions. As part of their activities, the students constructed a variety of solar-based devices and listened to experts speak on fields such as nanotechnology, the synchrotron, biotechnology, sun science, space science, neuroscience, and robotics. The themes addressed varied from the narrowly technical to larger moral and ethical issues to do with topics such as experimentation and environment.

Phase II: Online learning environment. The online learning space was located in the online management system, Moodle. The learning environment in Moodle was safe, as students were required to log in to the system with individual usernames and passwords. Moodle is an open source e-learning platform that is freely available on the Internet and had been downloaded onto the university's

server. Students were able to access it anywhere Internet access was available. The tools available for learning in this virtual environment were

- discussion forums, which were set up according to topics that individuals or groups nominated; participants had free access to all discussion forums and were encouraged to explore the totality of the experiences their peers had created
- chat rooms that were created for both formal interviews and informal chats
- the resource area, where general information or reading materials were posted (e.g., the group photograph of the students and their names so that the students could put names to faces while working in a virtual environment)
- a facility for private messages that could to be sent to facilitators or individual students.

One feature that only facilitators could access was the tracking of students' activities on Moodle. They could monitor the frequency with which individual students logged into the system and the pages they visited via this feature.

Learning online for these students was open ended. We provided a general guideline about what the students should be doing and the expectations of the learning outcome (see Appendix). However, we did not structure the learning in terms of topic choice, reading materials, groupings, or the format used to demonstrate learning. The choice of topics did not have to follow from things learned at the camp, but all participants were encouraged to investigate societal and ethical issues around any topic proposed. We provided a list of examples of topics and tasks that students could undertake, ranging from extension of topics learned at the camp to novel projects that they could undertake individually or in small groups. The guidelines requested that the students submit a learning outcome resulting from the work on the topic of choice, such as a written essay or report in any format (e.g., a PowerPoint or a Web page) that they believed appropriate. The outcome was, however, not a compulsory condition for participating.

The very open nature of the online learning task for the secondary students in this study constitutes what Maker (1993) and Maker & Schiever (1991) classify as a type V problem—the highest level in a continuum of problem types from I–V. At this level, the problem, the method for solving it, and the solution are unknown to both facilitators and students.

As the learning was open, there was no direct teaching, nor was there provision of “coursework”-type learning materials. The role of the facilitators was to provide an adult presence and maintain continuity and guidance both overall and at critical points where the conceptualizing and constructing of knowledge needed to be highlighted. The facilitators were intended to be a motivating force for the students to persist with the learning and to assist students with seeking expert help (mentors) in areas of uncertainty or lack of knowledge.

Data Gathering and Analysis

The research made use of qualitative methodologies of data collection and analysis. To study how these secondary students engaged with extended learning that was open and supported by online technologies, triangulation of data analysis involved (a) analyzing data recorded in Moodle and (b) focus-group interviews at two stages of the learning to obtain further insights into the students' achievements, or lack thereof. A research assistant conducted the first structured focus-group interview online in Moodle about two months into the project to track motivation and provide a means by which the students could comment on areas where they were experiencing difficulties so that facilitators could intervene to support them. The research assistant had been trained by observing a prior online interview that one of the researchers had conducted with one of the participants (Af1). The research assistant contacted the students by phone and e-mail to arrange times for their online interviews. She provided five online focus-group interview times for the students to select from. The online interviews were automatically transcribed as a consequence of their "chat" format. The thematic analysis of these transcripts focused on comments students made about their participation in the activities they had selected and factors that supported or inhibited participation. We have selected for reporting in this paper aspects that illuminated features of the quantitative participation measures (e.g. number of times logged on).

The researchers conducted a second (face-to-face) focus-group interview that was semi-structured 4 months later, at the end of the 6-month project. The purpose of this final interview was to elicit opinions on the students' learning experience and how the online learning could be improved. We used the same approach to analysing this interview as we did for the earlier online interviews. We sent letters and e-mail messages to invite the students to the second interview, which took place during a vacation period. The interview questions are shown in the Appendix.

We assessed how motivated students were to log in to Moodle and the level of participation each demonstrated in the online discussions based on the number of messages posted. This view treats *motivation* as propensity to act rather than a mental state. *Level of participation* reflects perseverance and commitment to task, and hence the willingness to act (motivation), rather than just statements about desire to act (Kuhl, 1985). The activity record of each student was analysed for the frequencies of logins and postings. To determine how students collaborated and interacted with each other in an online environment, we conducted a thematic analysis (Rice & Ezzy, 1999) of the messages posted in Moodle's discussion forums and chat rooms. Messages were analysed for their content to identify themes that emerged within two categories: (a) messages that are task-focused (e.g., questions asked about a topic, responding to a topic-based question/comment, or sharing what the student know about a specific topic), (b) messages that reveal behaviour, (c) social messages (e.g., reporting on what happened at school or telling a joke), and (d) manner of the behaviour (e.g., whether the messages were polite, aggressive, or helpful).

To determine the extent to which the students had learned by the end of the 6 months, the learning was related to different stages of learning: the topic choice stage, the research stage, the draft stage, or the final submission stage. These different stages were determined based on discussions on Moodle, e-mail messages, and submission of drafts or completed products. For example, students talking about having read about the topic of interest in a book or on a Web site would indicate that they had conducted research.

The teachers who nominated the students for the camp were asked to monitor their progress and provide support where necessary. At the end of the project, one of the teachers who had worked with the Mungo National Park group of students was interviewed over the phone to elicit advantages, issues, and how to improve this type of learning. We chose this teacher because of the pattern of participation of the students she had been working with to obtain a perspective other than that of the researchers on issues influencing the students.

The main reasons provided by the students for applying to attend the camp were a desire to (a) increase knowledge and an interest in the topics advertised; (b) make new friends; (c) learn with peers with similar interests; (d) experience university life; and (e) explore concerns about societal issues such as energy conservation, global warming, and the ethics of science. Of the thirty-two 13- to 15-year-olds who attended the camp, sixteen (6 females and 10 males) expressed interest in undertaking the online learning phase of the program. These students represented 12 schools from both metropolitan and rural areas of Victoria and came from both private and government schools. One of the students was a homeschooler. All the students in this study participated actively in the hands-on component of the camp but differed in their willingness to contribute to discussions or ask questions. Many were articulate and raised intelligent questions with the lecturers. Even though different friendship groups formed, the camp provided an opportunity for the students to get to know all the members of the wider group before the online learning phase.

Fourteen of the 16 students participated in the online interview. They formed five focus groups of different sizes. There were three groups of 2 students, one group of 3 students, and another group of 5 students. Each group met synchronously in the chat room and was interviewed online by the research assistant. The online interviews lasted 1–2 hours. One of the groups interviewed consisted of students from a rural school and the interview took place during a lunchtime, when they used their school's computer to participate in the interview. The other online interviews took place in the evenings, when students logged in from their home computers. Five students (indicated in Table 1) turned up for the face-to-face focus-group interview at the end of the project. The low turnout for the face-to-face interview was due mainly to conflicting vacation commitments.

RESULTS AND DISCUSSIONS

Motivation of Students to Participate in Online Discussions

Motivation in terms of the number of times the students visited Moodle and posted messages is shown in Table 1.

Table 1. Summary of Performance of Students Learning with Online Technologies

Student	Gender	Participation in Moodle	Moodle login frequency	No. of post-ings on Moodle	Topic	Stage of work at end of project
Jf1	Female	Active	39	35	Cloning	Completed
*Am1	Male	Active	75	121	Philosophy: Are we related?	Completed
Bm1	Male	Active	18	10	Cells: Evolution & history	Completed
Lm2	Male	Inactive	3	1	Nanotechnology	Completed
Gf1	Female	Active	23	18	Eugenics	Draft
*Sm2	Male	Active	12	3	Science of sports	Draft
Jm2	Male	Active	20	10	Fuel cell technology	Draft
Af2	Female	Active	69	12	Mungo National Park	Draft
Lm1	Male	Active	48	25	Downfall of man	Researched
Sm1	Male	Active	52	32	Downfall of man	Researched
Am3	Male	Active	18	2	Mungo National Park	Researched
*Jm1	Male	Inactive	3	0	Downfall of man	Started
Am2	Male	Inactive	4	0	Downfall of man	Started
*Mf1	Female	Active	57	26	—	Undecided
Af1	Female	Inactive	8	0	—	Undecided
*Kf1	Female	Inactive	4	0	—	Undecided

Note: These students attended the end-of-project face-to-face focus interview.

As indicated earlier, the use of MSN means that the numbers quoted here are underestimates of the actual levels of participation. An analysis of the records indicates that across all the topics, participation patterns were specific to the different individuals and could be categorized as

- frequent logins to Moodle and frequent postings (student Am1). This student was enthusiastic and contributed in all discussion forums, often posting two to three messages during each visit. He logged into Moodle on average three times a week.
- reasonably frequent logins accompanied by frequent postings relative to the number of visits (students Jf1, Bm1, Gf1, Jm2, Lm1, Sm1, and Mf1). These students logged in one to two times a week and contributed to the discussions during most of their visits.
- frequent logins but infrequent postings (student Af2). This student appeared to read but was somewhat reserved in offering opinions to the discussions. She was the most frequent sender of private messages to the facilitators.
- less frequent logins and few postings (students Lm2, Sm2, Jm3, Jm1, Am2, Af1, and Kf1). Student Lm2 was the first student to complete and send his project (an essay on nanotechnology) to the facilitators. Although he made no contributions to the discussion online (despite encouragement), he used e-mail to communicate with the facilitators about his work.

The existence of these different categories means that the level of motivation varied considerably between the students such that some can be regarded as highly motivated, whereas others appear to need strong additional support. However, as will be discussed below, the raw participation figures do not tell the whole story. Reasons for infrequent logins and whether they directly reflect motivation and commitment are discussed later (see “Extent of the learning demonstrated by the students.”)

Online Collaboration and Interaction

Levels of participation. Table 1 summarises the participation and performance of the students in the online learning project of this study. It shows the level of participation in Moodle for each of the students in terms of login frequencies, the number of messages each had posted, the topics they undertook, and the stage of learning they were at by the end of the project. As the learning was open and mainly self-directed, the broad steps involved in the activity were (a) selection of topic, (b) undertaking research and discussions on Moodle, (c) developing a draft, and (d) submitting a completed product.

Selecting topics. Topics chosen by the students were placed in different forums on Moodle and were open to all so that anyone could contribute to any topic. Students were encouraged to select topics that were not traditional classroom topics. In all, 10 topics were selected by the 16 students. Eight of the topics were undertaken by individuals and two were undertaken by groups. Table 2 shows the spread of topics selected by the students and the extent of engagement with that topic as measured by the number of contributions from the students.

Table 2. Forums Based on Topics Nominated by Students.

Discussion	Started by	Replies	Last post
Cloning	Jf1	51	Facilitator
Introduction and choosing a topic to learn	Facilitator	64	Facilitator
General Notices: Please read this forum and notices above forum titles each time you log in.	Facilitator	33	Facilitator
Philosophy: Are we all related?]	Am1	15	Jf1
Mungo National Park	Af2	33	Am1
Downfall of Man	Lm1	38	Facilitator
Nanotechnology	Lm2	20	Am1
Eugenics	Gf1	32	Bm1
Fuel cell technology discussion	Jm2	15	Facilitator
Science of sports	Sm2	17	Sm2
Total postings over course of online learning		318	

By about the third week after the commencement of the online learning, all but three students knew which area they wished to pursue and with whom they would be working. Most of the students chose to work individually. The topics were wide ranging, including information topics about nanotechnology and eugenics, philosophical topics such as the downfall of man and “Are we all related?” as well as the investigative topic of “What do sports people think about during training?” As the contribution from Sm2 (see below) indicates, this diversity in topics reflects the students’ individual commitments and desire to learn more than they could normally learn in a standard classroom experience or to learn in ways that standard classrooms had not afforded them.

Sm2: I have decided to concentrate on the Psychological side of sports, mostly running and athletics. I am researching by doing a survey on athletes at my athletics club on what they think while they run, as well as before a race and during training ect. I found it is more a researching project then say, finding out how muscles work out of a textbook. (Moodle discussion forum)

The first group topic was negotiated by Lm1, Sm3, Am2, and Jm1, who chose to work as a group on a very open-ended topic, the Downfall of Man. The online focus-group interviews with the students revealed that, despite the provision of the Moodle forum, most of the discussions for this group took place on MSN chats. One consequence of this finding is that the Moodle frequency counts are underestimates of the students’ actual levels of participation. The distribution of the group work for this topic (not the mode of the communication) was captured in this unedited online interview:

20:33 Sm3: I’m doing “Television and Novel Theories on Downfall of Man”

20:34 Am2: ok i have to research other extinct mammals and relate these reasons back to human beings

20:34 Lm1: I'm making biological theories based on previous history

20:34 RA: What about J?

20:34 Sm3: ok Lm1 and Am2 are different

20:35 Jm1: and im researching how different religions have 'predicted' man will fall

20:35 RA: SO ur all doing different topics but then ur gonna put everything together because they're related?

20:35 Sm3: yep i gave him that one

20:35 Lm1: Yep. Each pursuing a different theory

20:35 Jm1: pf u didnt give me that one i sed it n ur like

20:36 Lm1: We'll probably do it as a presentation

20:36 Sm3: powerpoint

20:36 Jm1: mmm hhhhhh i said that loser boy

20:36 Am2: oik

20:36 RA: That's good so do u talk about it often or just do your separate things?

20:36 Lm1: I think Sm3 will be the first human to fall

20:36 Sm3: each do separate presentations and join them together

20:36 Lm1: We talk at random intervals (online interview)

The dialogue provides an indication of the breadth and innovative nature of the tasks associated with the downfall of man with members of the team looking at the religious, scientific, and philosophical aspects of the topic.

The other group topic was Mungo National Park. Af2 and Jm3 worked with four students from the same school who had not participated in the camp to research different aspects of this national park, which is located near their school in a rural township. The students were helped by a teacher who took them on an excursion to the park. This park is notable for its archaeological remains, in

particular the remains of the Mungo Man, the oldest human remains discovered in Australia, and Mungo Lady, the oldest known human to have been ritually cremated. Unfortunately neither of the members of the group from the camp submitted a completed piece of work. The postings on Moodle, however, demonstrated some rich discussions occurring about these topics, indicating that they were conducting research and reading at the individual level. Not all group members contributed equally to the online discussions. An unedited excerpt of the discussion is shown below:

Re: Topics for this online learning project.

That actually sounds really good. It's like Kakadu only without a uranium mine or Cane Toads. What's Mega Fauna? Large animals? I've no idea 🤔 (Lm1, Moodle discussion forum)

I think its like the dinosaurs and the giant plants and animals around then. I not sure what I'm going to do yet but the mega fauna, magnetic poles and the mungo man sounds interesting. (Af2, Moodle discussion forum)

This is a really good one to talk with different teachers about. There is a huge argument at the moment about whether modern human beings started in Africa and then spread to the rest of the world or whether there was more than one place where we started. Some of this is linked to geology and the history of continental drift. Did you know that Australia, Antarctica and South America used to be part of the same continent? (Facilitator 2, Moodle discussion forum)

i read in a book somewhere that if you traced all the continents you should be able to join them into one main landmass. i forget what its called though. (Am2, Moodle discussion forum)

It's called Pangea. It was a huge landmass (all the continents in one), millions of years ago and eventually all continents will again form another Pangea. All the continents are drifting. We move 1cm to the east a year i think (if not correct me). (Sm1, Moodle discussion forum)

o yeah and gondwana and laurasia were the 2 landmasses after it split. i heard that one continent moved 4 cm a year. (Am1, Moodle discussion forum)

Yeh, Australia was in the Gondwana land mass. Thanks for correcting me, looks like we will be crashing into another continent sooner than i thought. (Sm1, Moodle discussion forum)

Nature of online collaboration and interactions. Initially, most of the students' interest and participation in asynchronous discussion in Moodle was frequent. A few students logged on frequently to read rather than post opinions in these forums. As the school term progressed, the frequency of logging into the system and posting dropped off. However, the online interview about two months into the project caused an increase in the number of postings. For the remainder of the project, the login and posting frequencies were inconsistent from week to week. These patterns suggest that, despite the high levels of individual commitment to the topics, there was a need for external support to sustain that interest and convert it into a tangible product.

We elicited the nature of the online interactions between the students by analysing the messages and dialogues in each of the discussion forums. About two thirds of the total messages posted in the forums were social, involving what happened in school, or diverged from the topic under discussion in some other way. The students' online social behaviour was generally polite, and no negative issues were encountered. An important lesson from this is the need for online forums to provide space for conversations that are not directly topic related, as well as means by which those relationship-building conversations can be brought around to a focus on the topic of the task. An example of a humour-injected social talk around the topic of the Downfall of Man is shown below:

Sm3: Maybe.... we should believe that I, Sm3 will become ruler and banish Lm1 to a pool of mud.

Am1: ruler of what? a flea circus ha eh heeh hee (*Moodle* discussion forum)

The other one third of the messages focused on the topics. Students presented their opinions and exchanged facts and information they read in books or heard from teachers.

The number of postings varied considerably among the different discussion topics (see Table 1). The topics on cloning, eugenics, and the downfall of man were most active, as students contributed to the historical, scientific, and ethical issues surrounding these topics. Mungo National Park generated a reasonable number of discussions, as the students asked questions and talked about the history, geology, and archaeological findings surrounding the park.

Students posted three broad kinds of task-focused messages that took the form of

- reporting on the progress of projects, especially when prompted by the facilitators. For example:

Re: Fuel Cell Technology forum.

Contacted Daimler Chrysler yesterday. They emailed me last night and I should be getting some info. Will continue research on internet till it arrives. If others want copies can email electronic files. Contact me at xxxxxx@xxx.com if you want a copy. (Jm2, Moodle discussion forum)

- opinions that were often lengthy and well thought out. For example, student Sm2 had read about the psychological theories of association and disassociation thinking and put forward views related to sports training. He designed a research investigation in which he surveyed the members of his sporting club about what they thought about when they were training. Other opinions were imaginative but also appeared well informed as a result of wide-reading and diverse information-seeking activities. For example, Lm1 commented:

Re: Downfall of Man

The obvious answer is that humans will be their own undoing, it certainly is the notion most widely entertained by those I've asked, but I was looking into other areas. Insofar as Biology is concerned, Eukaryotic cells have out developed Prokaryotic but have never out populated. Perhaps a new cell structure will form, using Eukaryotic cells' diversity with Prokaryotic cells' robust qualities and reproduction rates. The simple truth is that nothing lasts forever. For all we know, humans may develop the transport to abandon the damaged Earth and make for a new paradise, leaving another organism's dominion in their wake. (Lm2, Moodle discussion forum)

- assisting others with resources such as

Re: Nanotechnology

There is a book called 'Prey' by Michael Crichton (the guy that wrote Jurassic Park) about a team of scientist create a swarm of nanobots but they lose control and eventually get killed by them. It's good and i recommend it to Lm2 who is doing nanotechnology. (Sm2, Moodle discussion forum)

An advantage of asynchronous online discussion is the time that students have to reflect and react, as well as to manage discussions that allow them to express deep thinking in writing (Markel, 2001; Poole, 2000; Lim & Tan, 2001). This advantage is demonstrated in the conversations in the forums in this study. However, despite the opportunity to reflect, many of the students did not edit their writing in the forums, and grammatical and spelling errors are found throughout most forums. Many students used mobile phone text-based language in their expressions in these forums and especially in the chat rooms. This reflects their engagement in the tasks using forms of English that were comfortable for them and appropriate for the medium, where the focus was on the exchanging of ideas rather than the rehearsal of the formal presentation. Similar to face-to-face group discussions, this informal language is an essential part of the formulation of ideas, allowing the ideas to be the focus rather than the type of language needed to express more formal propositions. This form of communication also eases the move between social-relationship building and academic exchange.

Extent of the Learning Demonstrated by the Students

Although adequate (and sometimes quite complex and sophisticated) discussions took place in the discussion forums, only eight of the students took their learning to the draft stage or to the final stage of producing a tangible outcome such as an essay or PowerPoint. A draft stage was indicated by a substantial amount of writing that shows organization of ideas but not of language or, alternatively, content that was written down but not yet organized.

The other eight of the online learning group remained at various beginning learning stages of *undecided*, *started*, and *researched* (see Table 1). Students Mf1, Af1, and Kf1 were undecided, as they had not selected a topic. Students Jm1 and Am2 had started by choosing a topic but were inactive in the discussion forums. Students Lm1, Sm1, and Am3 indicated that they had researched their topics. The three female students Mf1, Af1, and Kf1, while still demonstrating interest in the project until its end, did not make a start with their tasks. Despite the frequent logins and postings by Mf1, she was still undecided about what topic to study. Her postings were mostly social in nature and included dialogues about working with another student as a team. Her messages indicate that the process of moving back and forth between the social and academic aspects of online collaboration is not easy to manage.

We obtained the reasons for these students' lack of commitment during the end-of-project focus-group interview, which Mf1 and Kf1 attended. Jm1, who was inactive in the online discussions in Moodle, was also present for this focus-group interview. These students provided reasons for their lack of motivation and commitment to the learning. The contributing factors were related to (a) losing the password to login; (b) computer unreliability such as slow Internet access and frequent computer crashing; (c) competition for time between homework, part-time work, extracurricular activities, and this project; (d) the inconvenience of logging into learning management systems compared with sending text messages or using MSN; (e) the noncompulsory nature of the online learning in terms of attendance and assessment; and (f) general lack of motivation to undertake the online task at home rather than being able to do it at school during class time provided to them specifically for this learning.

The technical and organisational issues with using Moodle and the advantages of using MSN were captured in the end-of-project focus-group interview:

Jm1: Look it's (Moodle) good but it's not enough. We use MSN a lot more than we use Moodle because MSN is a more reliable chat. I find that I don't get kicked out of there compared to Moodle. It's more of a forum type thing, while MSN you'll go on anyway if you've got spare time just to chat to friends and if they're on then you'll talk to them as well. I just find it more efficient than saying "we'll go on at 8:30 on the 21st July on Moodle" MSN is a lot better because you'll go on.

Jm1: Plus it's a lot more reliable. You can have voice conversations and video conversations and you can actually show work and present it easily.

Researcher: But for us, Moodle is good because we can put things on there and have resources you can't do that on MSN

Jm1: That's right, it's more a closed forum, which is a lot better. It keeps track of things. We do our discussions on MSN and then we go back to Moodle and finalise things (end-of-project face-to-face interview)

The focus-group interviews (both online and face to face) indicated that most of the students did not ask for support from their teachers, despite the evidence in Cavanaugh et.al.'s (2004) meta-analysis. Nevertheless, Bm1, Am1, Sm1, Jm2, and Jf1 reported that they had some discussions with their teachers. These students appear to have taken their learning further than the other students. Again, the role of adults in supporting learning was indicated, but being part of the students' communities seems to have been a prerequisite for that involvement to be effective.

In addition to the six shared reasons for lack of commitment, student Af1 provided a seventh reason. She communicated this at the end of the project in an e-mail in which she stated that, apart from competition with schoolwork, the very open and unstructured nature of the learning made it difficult for her to know how to target her research. The open nature of the learning (Maker, 1993) had produced too many topics for a small group of students. Hence the "critical mass" of students for each topic was not there to support each other's in-depth exploration into the topic.

All five students at the end-of-project focus-group interview suggested that one way to improve their learning experiences and to get better results in terms of ensuring that there was more completed work was to blend the online learning with some face-to-face meetings. As the teacher who was interviewed said, "The camp was great, all the students learned a lot from it, and while the [on-line] idea is great, the enormity of it is a bit much for these very young kids." This was particularly true when the learning was in addition to their normal school work. She also commented that the online learning time provided was too long, as "the more time the students were given, the more they dragged the project." It seems reasonable to suggest that, for optimal learning of this type to take place, it is important that schools seeking extended learning for students commit some time within the students' curriculum to pursue the learning.

CONCLUSION AND IMPLICATIONS FOR FURTHER RESEARCH

The online learning as described in this case study is able to provide secondary students seeking extended learning, regardless of geographic location, with an opportunity and a space to communicate and learn from each other about topics that are not normally covered in the classroom. Topics that have social and ethical implications are particularly relevant for online learning, as they require

students to have some understanding of the content of the topic before posting opinions but permit individual stances to be articulated.

The open nature of the online learning (Maker, 1993) can provide challenges to the students to take up tasks that challenge their thinking, their independence in learning in a nontraditional environment, their organisational and management skills such as remembering to log in to read postings, and their ability to plan the content to be researched and to place the knowledge gained in a format that could demonstrate their depth of understanding of the topic. This study has indicated that some students are capable of rising to these challenges, even at this comparatively young age. The variation of learning online can enrich their learning experiences as demonstrated in the richness of thinking in some of the discussions.

The study's findings, however, cannot be generalized due to the relatively small number of students participating in the online learning phase. Another limitation of the study is that the students' views in the online focus-group interviews may not have been captured completely, as they depended on how quickly the students can type. This is especially problematic when the group is large. The chat script of the focus-group interview with five students showed that the conversation was disjointed in several sections, as some students were still responding to questions that had moved on, even though the research assistant made attempts to call out the names of all the students to respond before moving on. A third limitation is the small number of students (five) participating in the face-to-face focus-group interview, which means that the responses may not be representative.

Implications of the Study

The study indicated varying degrees of task completion in the online environment. About half of the students took their learning to the more advanced stages, the draft and completed formats. Students whose learning advanced in a limited way identified multiple reasons for this. Competition with schoolwork was the major reason for their lack of measured commitment. Motivation was also lacking due to the noncompulsory attendance and assessment. An implication is that schools considering extending their students via online learning should take an active part in supporting students' engagement in the learning by allowing class time and access to computers in the school.

Rice (2006), referencing Carr (2000), Roblyer & Elbaum (2000), and Simpson (2004) noted that K–12 virtual programs have quite high dropout and failure rates, similar to adult online learning programs. One of the factors identified is that students need to make connections with their teachers and peers. In the case of the online learning reported in this study, connections with teachers at schools and online facilitators are necessary so that students know that their learning is valued.

An implication for further research is to investigate at least beginning with a less open structure for online learning. For secondary school students whose instruction is still conducted primarily in the traditional way, it is beneficial to ease them gradually into a very different learning environment online. Although this research study did not indicate that the students were apprehensive in any

way about using Moodle, a couple of closed tasks to allow students to explore the new learning environment and become familiar with it might have been useful. Hence it may be more appropriate for the instructional design to have more structure at the beginning, followed by the open nature of the learning that this study has reported. Such a strategy has been reported to be successful for higher education students (Ng, 2008). Restricting the learning topics to a smaller number would also help ensure that the usually small number of students participating in online learning is not spread too thinly and that a substantial number explores each topic and exchanges ideas.

As younger students' internal locus of control is less well developed (Cavanaugh et. al., 2004), motivation to cooperate may not arise spontaneously, so there is a role for facilitators/teachers of online learning in creating that motivation extrinsically. One possible approach uses Papert's (1991, 1993) view of constructionism learning. Constructionism learning theory embraces constructivist learning discussed in the literature review section of this paper but takes the theory further. Papert's studies suggested that children are more engaged in learning when constructing a public artifact that others will see, critique, and use than if they are only required to produce something to be handed in to the teacher. This public artifact can be anything from a work of art to a scientific theory of the universe. In this regard, the secondary students learning online will need a forum through which to display knowledge gained. This could be presentations to an audience of school peers, educators, and parents, in forums such as a peer-for-peer conference or on a Web site. An activity organised by the online learners to show off their learning outcome and to engage other peers in learning and contributing to the solutions of problems identified in the learning outcomes could take the form of an online conference or a one-day student conference in a central location where the learners can get together to present their findings. This approach will incur costs that school communities could contribute to. Alternatively, funds could be sought through sponsorships. A constructionist approach requiring students to construct an artifact for display to the school community or the general public would provide more incentive to online learners to take more creative approaches, such as constructing an animated product using Macromedia Flash, creating a Web site, or producing a digitally recorded and edited drama activity/play.

When considering online learning for adolescents, it is necessary to be aware of the changing culture and expectations of the younger generations who are growing up with computers and computer-associated devices, and who use these devices creatively to communicate and to seek, access, and process information for educational and recreational purposes. One of the students who worked in a group in this study reported difficulty getting everyone in his group to meet online in a Moodle forum at the same time. Moodle takes a special effort to log in to, whereas MSN, SMS (Short Message Service), or e-mail requires less effort and could be more productive because the students were already in communicative relationships based in MSN. Online learning should embrace these choices.

In conclusion, the approach outlined in this paper offers advantages and avoids some of the economic and social/organisational disadvantages of other

possible responses to providing for academically able students or groups of students with similar interests requiring extended learning. These students from within a school or a cluster of schools can be brought together into a “virtual classroom” to pursue a specific area of interest or to work on cross-school projects such as understanding global warming, its impact on the environment, and actions their schools could engage with to help sustain the environment. Ongoing research into the pedagogy of online learning for school-aged students and means of assessing learning conducted online will inform best ways of using the technologies that support this type of learning.

Acknowledgment

This research study was supported by a research grant provided by the Faculty of Education, La Trobe University.

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APPENDIX

Guidelines for Online Learning

There are many interesting possibilities that can be explored with this online learning project. The aim is to make use of information communication technology (ICT) to explore independent academic learning by pursuing an area of interest in depth and to develop social skills.

You will choose a topic of interest. The topic that you wish to learn could be an extension of the lectures or the activities that you were involved in at the camp, or it could be a topic from school that you wish to learn more about. The topic could be an investigative one (we'd like to encourage this) (e.g., try a learning strategy on LOTE [Language Other Than English] learning with your classmates, collect data, and write a report). We will provide guidance on how to go about a (social) investigation such as this. We have attached a list of topics that you may wish to select from.

Individual work is fine, but we would encourage that you to work in groups of two or three on a topic. Once you have chosen the topic, please provide us with an outline of what you wish to study about the topic. If you work in a group, you will discuss which aspects of the topic that each will be looking at. We will set up small group discussion forums on Moodle according to topics. These forums are also accessible to the whole group, but essentially discussions on the topic will be within the forum dedicated to it. Throughout the online learning, you will talk to your peers and to us as facilitators. Where there is a request for specialist mentors, we will attempt to get them.

We would like you to present your learning in any creative form you choose—essay, multimedia and animated (e.g. Flash animation), drama, investigative report, etc. You will search the World Wide Web as the main resource for learning.

You will be reminded once every 3–4 weeks to report or post to us what you have done. The amount of time you wish to put into the learning for this project could vary from week to week, but we would like to encourage 3–4 hours a week on it. Learning online requires a lot of independence, but please ask questions in the discussion forums or privately by sending messages to us.

Online Focus Group Interview Questions

1. Have you gone into the Moodle site before today?
2. If “yes,” how often did you go in and what did you do in there?
3. If “no,” why not?
4. What things about the Sun and Science camp do you remember best?
5. What made them memorable?
6. Who did you work with most at the camp?
7. Are you still in contact with them?
8. What has helped you to stay or in contact with those people?
9. What has made it difficult for you to keep in contact with people from the camp?
10. What are your plans for your research project? Tell me how far you have gotten.

11. Have you chosen a topic yet?
12. Have you decided on a plan to research and learn about the topic that you are interested in? For example, where you will look for information, who you will seek help from, how much time do you plan to spend each week on the project, and how will you present your project at the peer conference?
13. What has helped you get to where you are now?
14. What has made it difficult to get further than that?
15. Have your teachers helped you, and how have they helped you so far?
16. If you are finding it difficult to choose a topic, what would help you to choose something?
17. How else could the facilitators help you work with your project?
18. Who else could help you?

End-of-Project Face-to-Face Interview Questions (Semi-Structured)

1. Tell us about your experiences with this online learning project. How far did you go with the learning?
2. What are the good things about this type of learning?
3. What are the issues you had with the learning?
4. How could the learning be improved?