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Nurturing Numeracy Literacy Via Online Learning: A Case Study on the Effectiveness of the Online Forum Discussion

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Abstract

Numeracy skills is one of the required skills in the Malaysian Qualification Framework (MQF) for tertiary education in Malaysia. Numeracy skills is recognised as one of the must-have daily skills because it develops logical thinking and reasoning strategies in one's daily activities. Numeracy skills is a quantitative skill and living skill needed to solve problems and make sense of numbers, time, patterns, and shapes for daily activities. Having an adequate level of numeracy can improve many aspects of our life, including social life, education, and employment opportunities. Nevertheless, numeracy courses are also one of the most difficult courses and hence, it is vital to instill this skill for graduates. It will pose a greater challenge to adult learners in the open distance learning (ODL) environment. This study is carried out to explore the effectiveness of online forum discussion for Numeracy topic in Learning Skills for 21st century course (OUMH1603) using three essential elements in the online learning process – teaching presence, social presence, and cognitive presence. The outcome of this study will be useful to facilitate effective and quality teaching and learning processes for this topic.

Keywords: *Numeracy Skills, Community of Inquiry, Open and Distance Learning, Online Learning*

Introduction

Open and distance learning (ODL) is a learning process that takes place regardless of the distance between the facilitators and the learners. Open University Malaysia is the first open university in the country that has adopted a blended learning approach since its inception. This approach is commonly used by open and distance learning higher education institutions and according to Melton et al. (2009), it has been found to be helpful in increasing retention rates. OUM's mission is to widen access to quality education and to provide lifelong learning opportunities by leveraging technology, adopting flexible modes of learning, and providing a conducive and engaging learning environment at a competitive and affordable cost. Prior to the wide-spread COVID-19 pandemic in 2019, online learning became one of the prevalent modes of continuing and furthering education, particularly for

working adults. Tutors' support in online learning is essential for learners to successfully engage in the learning outcomes as tutors are the ones who interact directly with their learners.

Starting from year 2019, a compulsory university course OUMH1603 Learning Skills for the 21st Century is offered to all OUM undergraduate learners during their first semester of study. According to Ester van Laar et al. (2020), there are certain skills needed for education and the workplace in the current economy. The 21st century skills comprise skills, abilities, and qualities to be successful in 21st century society and workplaces. Most of these skills are associated with higher order thinking skills, which are based on analytic reasoning, complex problem solving, and teamwork. These skills are useful in mastering the knowledge in learners' academic content. There are four dominant categories of 21st century skills as shown in Figure 1. These categories are learning and innovation, digital literacy, career and life skills, and metacognitive skills.

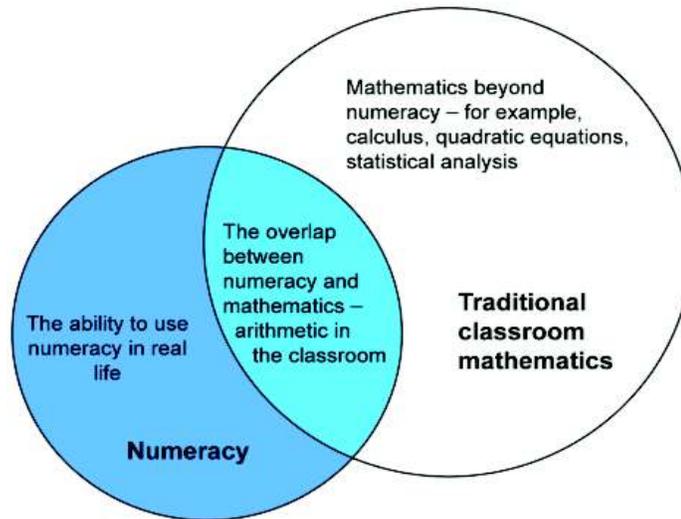
Figure 1

Dominant Categories of 21st Century Skills



The third topic of the course introduces learners to numeracy skills which is categorised under the career and life skills. The aim of the topic is to provide quality numeracy instruction and help them achieve the mathematical knowledge and skills that enable them to adjust to the growing demands of society. Numeracy is considered a fundamental mathematical skill which includes the ability to understand and analyse numerical information, express ideas based on numerical information, and to make the right conclusions and decisions. Fundamental arithmetic including addition, subtraction, multiplication, and division are considered as basic skills in numeracy. The important aspects of numeracy also include numbers and operations, computation, measurement, geometry, statistics, and probability.

The concept of numeracy and its relation with mathematics is depicted in Figure 2. Mathematics is formally taught in formal education institutions and considered as one of the core subjects. Mathematics is beyond numeracy and arithmetic, geometry and algebra, and maybe even statistics or calculus. Numeracy does overlap significantly with a subsection of what is taught in schools. Learners are indirectly introduced to numeracy such as shapes, numbers, time, and patterns in daily classroom mathematics activities especially when applying mathematical problems to real-life situations.

**Figure 2***Concepts of Numeracy*

Numeracy is one of the most needed skills in life as it is a set of skills that enable one to read, count, and analyse numbers that are used in one's daily activities. These days as the world is evolving, numeracy skills is important for one to make predictions and estimation in various matters in life, business, governmental policies, etc. Numeracy courses hold a unique and significant position in the education curriculum. Numeracy also plays a vital role in transforming one into a socially engaged citizen. Numeracy related courses have been introduced since the early education in one's life such as in preschool centres, etc. Although numeracy courses have been introduced at such an early stage, the interest of related programmes at the tertiary level is still relatively low among learners. Hence, teaching and learning numeracy related courses can pose a challenge to the learners at all levels of education.

There are a range of difficulty levels on numeracy skills with the ability to understand and analyse numerical information, expressing ideas based on numerical information, to making the right conclusions and decisions. The numeracy topic involves quantitative skills which apply mathematical courses including algebra, calculus, and statistics in real-life situations. There are various levels of difficulties for such courses. Nevertheless, the need to engage the interest among learners for such courses to equip them with numeracy skills is needed, regardless of its difficulty levels. Learners perceive numeracy courses as difficult and tend to have lower interest in such courses. Quantitative courses could pose a challenge to tutors to teach online.

Therefore, there is a need for a study to explore the effectiveness of online forum discussion for the Numeracy Skills topic in the OUMH1603 course using the Community of Inquiry (CoI) model. Within the Community of Inquiry theoretical framework (Garrison et al., 2000), a successful higher education experience is held to be supported by the presence and interaction of the elements of cognitive, social, and teaching presences. The framework has been extensively used, from a constructivist perspective, to examine the quality of online discussion forums.



Research Objectives

The research objectives are:

- To examine the level of social, teaching and cognitive presence of the OUMH1603 course for January 2021 semester; and
- To recommend steps to be taken by OUM to improve the effectiveness and quality on the numeracy topic based on the findings of the study.

Literature Review

Numeracy seems to reflect the way in which learners approach their mathematics, valuing the confidence in and understanding mathematics. Thus, teaching and learning, especially online, can pose a challenge to educators and learners for quantitative courses such as Mathematics, Accounting, Finance, and Economics due to the nature of the courses. These courses are not easy to teach and learn in a conventional classroom setting; hence, it would be even more challenging to teach them in a virtual classroom setting (Abu Zarin et al., 2008). In a conventional setting, learning occurs during classroom activities in which learners engage in live practice, and trial and error; and receive immediate feedback from their teachers throughout the course. Distant learners, on the other hand, struggle through these courses primarily in isolation. It is also difficult for educators to create teaching and learning activities that meet the needs of these isolated learners. They should ensure that learners are engaged, motivated, and focused throughout the course, in addition to encouraging independent learning. Considering the course's difficulty, it is not surprising that these learners typically perform below-average.

ODL learners mostly are working adults who need to balance life between work and family, apart from pursuing their studies on a part-time basis. Time management can pose a great challenge to these learners as they need to manage their time for work, family as well as studies. Hence, the time allocated for studies would most likely be lesser than full-time learners. Working adults are mostly equipped with rich working experience instead of book-knowledge, and it can pose an even bigger challenge when they do not use much of the higher-level numeracy skills in their life as an adult. Apart from that, handling a rather "challenging" course such as numbers-related can definitely be difficult for them when they have left school life for a long time. According to K. Abdul Gafoor & Abidha Kurukkan (2015), the factors that make Mathematics a difficult course for learners to study are accelerated forgetting of previously learned material and conceptual confusion. Learners who struggle with Mathematics claim to be lacking in learning strategies. Furthermore, these learners lack self-efficacy and struggle to learn Mathematics. Mathematics seems to be neglected more easily by learners who find it challenging. On the other hand, learners who believe Mathematics is a simple course, claimed their educators taught them well and easily grasped the concepts. Therefore, learners who believe mathematics is incredibly difficult are more likely than learners who believe the subject is easy to abandon the task with little effort.

The facilitators who are passing the knowledge and skills to the learners are also a factor in engaging learners with certain courses. Facilitators need to be able to share the knowledge with the learners in an understandable, fun and logical manner. Educators should then connect what learners learn in school and what they see in the real world, hence incorporating numeracy skills into the curriculum is very critical. An explicit focus on using different mathematical processes (such as communication, modelling, devising strategies, representation, and reasoning); an explicit focus on all stages of mathematical modelling (formulating, employing, and interpreting/evaluating) and how to see and excavate the

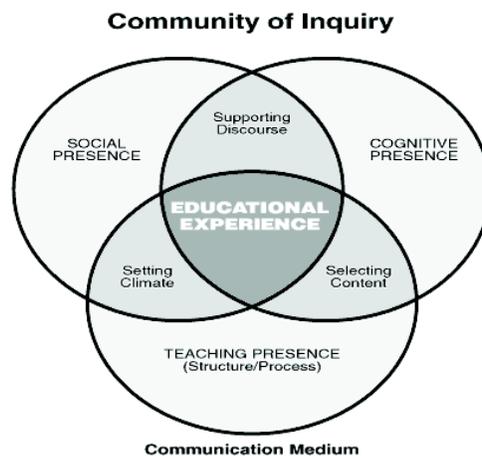


mathematics out of context are all requirements for engaging learners (Victoria State Government, 2020). Educators must teach learners how to "read" and interpret the sense in which mathematics is embedded, which is often in the form of a tangible object, either in a written or digital format. Furthermore, when teaching numeracy, educators must specifically cover a variety of cognitive processes and mathematical content areas, as well as the skills necessary to reason, contend, reflect, and assess, and also convey the results.

The term 'community of inquiry' or Col was originally used by Lipman (1991) where it refers to a learning community which is facilitated by a teacher; where "students will listen to others with respect and then ideas are built based on one another's idea followed with asking justifications for unsupported views and lastly, they will help each other in building inferences from what has been transpired, and seek to identify one another's assumptions" (Garrison and Anderson, 2003). Knowledge building is a contextualised social process that is based on the critical learning community concept, where there are students, teachers and the constructivist learning assumptions, which can be seen in the Col model as in Figure 3. The Col model comprises three mutually interacting and reinforcing elements of cognitive, social, and teaching presences supported in online instructional environments.

Figure 3

Community of Inquiry Model (Garrison et al., 2000)



Cognitive presence is defined as the extent to which participants in any particular configuration of a community of inquiry are able to construct meaning through sustained communication (Garrison et al., 2000). The construct was also used to refer to the intellectual environment that supports sustained critical discourse and higher-order knowledge acquisition and application (Garrison & Anderson, 2003).

Social presence, a term first coined by Short, Williams, and Christie (1976), is used in this model to refer to the ability of participants to identify with the community (e.g., course of study), communicate purposefully in a trusting environment, and develop interpersonal relationships by way of projecting their individual personalities (Garrison, 2009).

Teaching presence is the design, facilitation, and direction of cognitive and social processes for the purpose of realising personally meaningful and educationally worthwhile learning outcomes (Anderson et al., 2001).

Research Method

For the purpose of this study, an instrument of 34 questions rated on a five (5) Likert scale developed by Swan et al., (2008) was used to evaluate and measure the teaching, social, and cognitive presence in the online forum. Thorough observation was made for each forum searching for social, teaching, and cognitive presence and 34 questions were rated accordingly. The questions in the instrument consist of 13 questions for teaching presence, 9 questions for social presence and 12 questions for cognitive presence. The interactions and discussion in the forum were observed and analysed for each tutor for the January 2021 semester. The same will be conducted by another researcher to ensure consistency. Finally, the researchers discussed their analysis and observations, and made their recommendations.

The subject (OUMH1603) Chapter 3 is chosen based on the following criteria:

- i. The subject was offered in January 2021 with a total number of 2608 learners and 100 total postings made by learners;
- ii. In total, there were 19 instructors assigned to teach this subject via online teaching and online forum with a total posting of 336;
- iii. It is a foundation subject and one of the core subjects for those taking any programmes in OUM; and
- iv. The subject is a first semester subject for new learners.

Findings and Discussion

A total of 19 forums for the numeracy topic in Learning Skills for the 21st Century (OUMH1603) course was observed and rated based on Col's three elements: teaching presence, social presence, and cognitive presence. The overall results are as shown in Table 1.

Table 1

The Mean Score for Each Col Element

	Characteristics	Score
Teaching presence	Design & Organisation	3.342
	Facilitation	3.324
	Direct Instruction	3.561
	Mean	3.409
Social presence	Affective Expression	3.614
	Open Communication	3.649
	Group Cohesion	3.263
	Mean	3.508
Cognitive presence	Triggering Event	3.280
	Exploration	3.228
	Integration	3.192
	Resolution	3.368
	Mean	3.267
	Overall mean	3.394



It is observed that the score obtained for social presence was the highest with a mean score of 3.508 for the Numeracy topic. It indicates learners are comfortable interacting with their peers via online forums. Learners were often observed to assist their peer learners in answering questions that were posted and in helping other learners to understand the concepts of Numeracy. This finding is in line with what was emphasised by Herranen et al., (2018) that is, collaborative learning is student-centred rather than facilitator-centred since learners decide what is interesting and useful for them, and the facilitator creates learning environments, which enable and stimulate learners to learn and act for sustainability. This result also indicates that learners preferred peer interactions compared to their facilitators as found in a study conducted by Rourke and Anderson (2002).

It is also worth mentioning that the score of affective expression and open communication are higher than the group cohesion. This result coincides with the study of O'Regan (2003) who stated that learners express their emotions in relation to the various aspects of an online course such as design and organisational issues (i.e., a lack of clear instructions), cognitive issues (i.e., learning materials, success), social issues (during communicating), time management, or technology. The higher level of peer interaction could be due to many factors such as an improved and stable myINSPIRE platform, more affordable computer peripherals, higher computer skills and literacy among learners, faster Internet access (wireless and broadband), an increase in accessibility to information, and learners are more familiar with online communication.

Meanwhile, cognitive presence scored a mean of 3.267 which is close to the neutral score of 3, indicating a balanced agreement and disagreement of the existence of triggering events, exploration, integration and resolution characteristics in the online forum. This study revealed an insubstantial level of cognitive presence due to lack of learning and reflection activities in the numeracy discussion forum which may help learners to understand the fundamental concepts of numeracy and hence construct the explanations and solutions through cognitive presence is an important component in the teaching and learning process.

The mean score of 3.409 obtained for teaching presence indicated that all the e-tutors for OUMH1603 played their roles adequately. It is noted that all the appointed e-tutors have more than 5 years of teaching experience and completed the e-tutor training by the tutor management and development unit of OUM. Another contributing factor is the design and organisation of the forum discussion with the inclusion of e-lesson for the topic. E-lesson is developed as one of the supporting learning materials and activities for learning. Several OER-linked videos are shared, and two sets of online quizzes (pre and post) were prepared for learners to do self-checks. In an online learning environment, teaching presence is vital as it can make a significant difference in the engagement of learners and the facilitation of learning. This is because adult learners need clear guidance, feedback, and motivation from their instructors in order to manage their self-learning effectively.

Table 2

Forum Postings in Numeracy Topic

Role	Number of Postings
E-tutors	336
Learners	100
Total	436



Table 2 represents the total number of postings for the Numeracy topic in the semester of January 2021. It is noted that the e-tutors made more postings than the learners and it corresponds to the teaching presence mean score as shown in Table 1. On the other hand, with a total of 100 postings made amongst the 2608 learners, it is shown that the online engagement of learners is rather low compared to the total postings by the e-tutors. This may be considered a hindrance to effective online learning. Nevertheless, the postings by the learners are rather engaging with the e-tutors as shown in Table 1 with a higher than mean of 3.0 for all the Col components. The quality of the postings is considered as an indicator of an effective teaching and learning of the numeracy skills for the course.

Conclusion and Recommendations to Improve Online Interactions

Online forum is an essential platform in teaching and learning for learners in OUM because learners can communicate with e-tutors here apart from e-tutorials that were conducted. This is because asynchronous discussions are frequently used in online courses to allow learners to openly communicate and build shared understanding, while instructors skilfully facilitate the process (deNoyelles et al., 2014). The participants must perceive interrelated presences; social, cognitive, and teaching; in order to have a successful educational experience. Forum is a teaching and learning tool that plays a vital role in assessing the learning process to learners as well as it covers all the Col components. Educators need to employ discussion strategies such as providing prompt but modest feedback, peer facilitation, protocol discussion prompts, and providing audio feedback that integrates all three presences to support an effective online Col (deNoyelles et al., 2014).

Several measures that could be taken in OUM to enhance the effectiveness of online forum discussions for the numeracy topic especially to improve the cognitive presence and to increase the number of posting by learners. Since the Learning Skills for 21st Century course is offered to all registered undergraduate learners during their first semester, OUM is suggested to prepare them for the online learning experience. Learners who are used to learning in a classroom may have trouble adjusting to the online learning experience. Although all the learners are provided with an introduction session during their orientation session by the respective learning centres, they must be guided by a video tour through myINSPIRE, pointing out the different features and functionality, including the online community. They must be taught how to find materials, assignments, and assessments, and how to communicate with their instructor and fellow learners. A “spark” and engaging discussion questions can be posted by the e-tutors to encourage learners to have engaging discussions with e-tutors on the forum. There are discussions that took place outside the forum among the peers as well as with the e-tutors. Therefore, e-tutors can encourage the learners to post questions in the forum instead of other platforms such as emails, calls, and WhatsApp messages among peers and with e-tutors.

Another recommendation is to get learners to take action on what they have learned. These actions could include participating in an online forum discussion, providing examples or scenarios, solving a problem, and reviewing what they have learned in reflective notes or reports. Learners should be awarded marks according to their submission and this will contribute to their final grade at the end of the semester. This recommendation is supported by a study done by Wells (1999) who stated that reflection is essential to deep learning and problem solving. From a socio-cultural perspective, reflection is developed through social interaction and semiotic mediation.



Further Research

We propose to further this research by evaluating the score of the pre-test and post-test of the topic. Such a study could further explain how online learning occurs through the effective interaction between teaching presence, social presence, and cognitive presence. Besides that, other learning materials such as lesson plan, e-tutorial class recording, etc can be observed as well because discussions among the e-tutors and learners may also take place in a more engaging manner. Apart from that, feedback from learners may also be collected and analysed on the Numeracy topic for this course on the effectiveness of learning numeracy skills from the course.

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