Mobile Technology in Enhancing Students’ Higher Order Thinking Skill

Mazlina Ahmad1, Noor Rohana Mansor1, Cho Min Sung2, Roswati Abdul Rashid1, Nurul Ain Chua Abdullah1 Rosdi Zakaria1, and Sharipah Nur Mursalina Syed Azmy1

1Centre for Fundamental & Liberal Studies, Universiti Malaysia Terengganu
2Hankuk University of Foreign Studies

mazlinaahmad@umt.edu.my,

Abstract. 21st Century learning requires a lot of skills that students need to have. One of them is the technology literacy skills and High Order Thinking Skill (HOTS). Cognitive skills in technology literacy are based on the use of digital technology to manage information, communication tools or networks to ensure a person’s success and function in society. Many researchers pointed out that mobile technologies in general and mobile phones in particular play a fundamental role in both teaching and learning process. Today, the application of mobile technology is widely promoted in the national education system. Therefore, this paper is a concept paper aimed at discussing the capabilities of mobile technology in improving students’ HOTS based on findings from previous studies. The literature review is based on publications from 2015 to the present. It is hoped this study can be used to benefit the educators while integrating the mobile technology in their teaching and learning, and to improve the HOTS in line with current developments.

Keywords: Higher Order Thinking Skill (HOTS), Mobile Technology, Teaching and Learning

1. Introduction

Thinking skills was introduced since the beginning in teaching and learning. In the context of the Malaysia, thinking skills in public education began in the early 1990s (Zainal, 2011; Rajendran, 2010). According to Bartlett (1958), thinking is considered as an effort to fill in the missing information (i.e., interpolation), to provide further information based on existing information (i.e., extrapolation); and rearranging information in order to create a new interpretations (i.e., reinterpreted). Mayer (1977) perceives thinking as the processing of certain mental operations that take place in one’s mind or cognitive system for the purpose of solving problems. HOTS is defined as the ability to apply knowledge, skills and values in reasoning and reflection to solve problems, making decisions, innovate and the ability to create something. (KPM, 2013). In today’s competitive world, students need to do more than just memorize or restate facts. HOTS elevates thinking skills to a higher level among students than just repeating or restating the facts. They need to be able to understand the facts, to relate them to one another.
In addition to HOTS, 21st century skills become an essential aspect that requires the students to master in its entirety in order to position themselves in the future profession. The 21st century skills are meant to be communication, information, media, and technology. The integration of technology in life has brought about many changes including education and offers many opportunities and advantages in teaching and learning aspects. This aspect is one of the challenges in realizing the application of technology in the learning process. Among the major advantages of technology in today’s education sector are developing high-level thinking among students, enabling lifelong learning, overcoming time and space constraints in the learning environment and more. Looking into these benefits, the components of high order thinking skills (HOTS) and technology have been incorporated into the 21st century learning framework as the combination certainly give impacts on student’s competencies level in the aspects of critical thinking, decision making, teamwork, dynamic management and affective communication. The application of technology in education sector will certainly create a new concept of learning as a combination of both education and entertainment approaches, namely edutainment (education & entertainment) (Jamalludin & Zaidatun, 2015).

Thus, in a more challenging learning environment in the 21st century, each and every student needs to master technology skills in order to enable them to have a good critical thinking regardless of different racial, religious, and cultural backgrounds. To achieve the goal of mastering high order thinking, integrating technology into the curriculum is an approach that enables students to experience more meaningful, effective and interactive learning processes besides enhancing their understanding. (Hasnah et al, 2014).

Today, mobile technology skills have been embraced in almost every corner of society as it becomes an important element in the quest for bringing more creativity and innovation. The features of learning by using mobile technology helped to improve understanding of basic concepts in learning (Alessi & Trollip, 2001; Parker, 2008). In addition, the application of technology also able to create an attractive and interactive learning environment and as well as able to enhance the learning interest and curiosity of a student. Therefore, in facing many challenges of the 21st century, students need to be emphasized to apply or use mobile technology in the learning process. In addition, the use of mobile technology has the potential to create knowledgeable individuals who are capable of using the best of their minds to meet the various challenges of resolving issues that require HOTS.

According to Trexler (2007), mobile technology tools are consist of smartphone, personal data assistant (PDA), and tablet that are small in size and portable to bring to anyplace. The specifications of this mobile technology tool are designed to be a facility for students to integrate technology through their learning as well as gain the many skills needed in the current industry, including HOTS. According to Bernie & Charles (2009), in order to produce students with HOTS characteristics, they need to have some skills, such as skills in critical thinking and problem solving, creativity and innovation, collaboration and leadership, and also in communication, information skills, media and technology. This statement clearly shows the significance in relationship between technology and HOTS. Therefore, recognizing the importance of application of technology as one of the key tools in shaping students’ high level thinking, this study will focus and summarize the findings from previous studies as evidence to strengthen the aforementioned statement.

2. Literature Review

2.1 Mobile Technology and HOTS

Mobile technology education is often used for online teaching in universities around the world (Jimoyiannis et al., 2013). Applying high-level thinking in teaching requires the ability to reduce confusion and increase student’s interest in the assigned tasks. Support from teachers in encouraging
students to think widely and openly to give ideas in solving problems also able to help students to improve their high order thinking skills (FJ King, 1998). In this regard, the application of mobile technology becomes an important tool in educating today’s generation. One of the challenges that educators will face in the contemporary era is that today’s generation are becoming more digital. Of course this is due to the way they learn is different as the current environment are influenced by the presence of technology. However, mobile technology needs to be applied in conjunction with appropriate learning methods in generating HOTS students (Scott, 2015).

The development of HOTS using technology medium has produced several theories. Among them is the Multimedia Cognitive Theory pioneered by Mayer (2002), involving the use of multimedia technology in the process of delivering information. This theory is a continuation of the cognitive load/burden theory that has two different channels in processing information, namely audio and visual channels. These two channels are collected through the senses of the eyes and ears before being filtered by memory during working (Abdullah et al. 2007; Ashfahani et al. 2015; Ibrahim 2013). Both mediums have capacity limitation at a point of time while receiving information. An active learning process occurs when information reaches working memory and when it involves the process of filtering, selecting, organizing and integrating information. In addition, the implementation or application of multimedia cognitive theory facilitates the cognitive functioning of individuals to filter important information only. Important information will be integrated into a permanent form of knowledge under the long-term memory (Abdullah et al. 2007; Ibrahim 2013).

Furthermore, a study conducted by Martin and Ertberger (2013) clarified that learning using this technology has the advantage in enhancing informal learning by students indirectly through learning sessions using the mobile technology. This is in line with the mobile features introduced by Ozdamli and Cavus (2011), as one of the features is a blended mobile technology. A study by Hussin et al (2012) explained that mobile technology contributes positive effects to personal readiness of a student. In addition, a study conducted by Chokri (2015) on two student groups at Taibah University, Saudi Arabia clearly showed that a group of students exposed to additional learning through the WhatsApp app (70% face-to-face + 30% discussion via WhatsApp) had higher grade scores and have a more positive attitude towards exploring information, sharing information and finding learning-related solutions than groups of students who only follow face-to-face conventional learning. This clearly demonstrates the ability of students to explore information using the medium of technology as a contributing factor to their success.

Nowadays, the phenomenon of learning using game technology is seen as an increasing trend in the world of learning not only in the higher education, but also in schools. Studies showed that game-based learning has positive effects compared to traditional learning (Ismail & Mohammad, 2017). According to Premanand (2014) game-based learning can be widely used in education sector and can enhance the enjoyment and interest in learning. Mc. Gonigal (2011) also agreed that game-based learning is also seen to have a positive effect and enhance imagination and motivation of a student. This game-based learning is said to provide good exposure and experience in helping the learning process (El-Nasr & Smith, 2006). Papastergiou (2009) explained that achievements can be measured indirectly throughout the course of the game because students need to use related knowledge which is relevant to the learning they have learned. Wang (2015) stated that, this learning method contributes to greater engagements by active student, positive learning environment and improved the interaction between students, lecturers and classmates. This learning method also captures the attention of inactive students in the classroom and improves the overall attendance of the class (Cardwell, 2007). Wang (2015) also further explained that game-based learning becomes an useful method for lecturers to assist the learning process.

Further, Jacob and Isaac (2008) conducted a study on perceptions of mobile learning showed that the use of mobile devices among university students is one way to make the subject interesting and an
effective additional learning. This is because the device has become a medium for accessing internet and facilitating students to engage in learning-related activities.

3. Result and Discussion

The development of information technology and information in the digital era encourages the application of such equipment in all areas including tertiary education at the university. Many researchers acknowledge the effectiveness and benefits of mobile technology in stimulating student’s thinking. The change in learning approach has changed from traditional methods to learning approaches that utilize modern technology equipment. The equipment of modern technology includes the use of electronic and digital equipments and mediums such as computers, smartphones, internet technology, multimedia, and various web applications 2.0. Study conducted by Tay (2002), Tal Hochberg (2003), Sulaiman F (2011), and Yu., et al (2015), showed that increase in HOTS among students with technology integration. This statement is supported by Hwang et al., (2013) who explained that learning through mobile technology is a potential approach in generating HOTS among students. Furthermore, today’s generation of having ‘intimate’ character with technology makes their access to mobile applications becomes faster.

A study by the International Telecommunications Union in year 2013 also showed that Malaysia has the fourth highest number of ‘digital citizens’ in the world, and almost 75% of Malaysian youth were ‘digital citizens’. Therefore, this opportunity should be used by educators to sharpen the critical thinking skills through assignments, educational projects, and others through the digital medium because the use of mobile technology has contributed to the ability of critical thinking and problem solving skills. Similarly, a study conducted by Nurul and Zaidatun (2013) showed that learning based on mobile technology able to improve students’ technical skills. This is because the technology can be used in different learning environments similar to the game elements. The applications of these games in mobile technology can produce a generation of students with high imagination ability and thus encourage a high order thinking. This indicates that in addition to fun, subconsciously students can also develop their high order thinking that can be applied into learning.

There are a variety of mobile-based applications of games related to learning such as quizzes or tests to test students’ understanding of a particular topic. These applications will surely attract the interest and enhance student’s motivation indirectly besides encourage students to be more proactive during learning sessions. Based on the findings of the previous study, it is also proved that high order thinking in students (Keong, Sharaf Horani & Daniel 2005; Saemah Rahman et al. 2011) is due to the use of information technology. This facility is not only useful as a facilitator of learning but also helps to build students’ knowledge in a structured and systematic way. In this contemporary situations, the readiness and necessities of students to equip themselves with various skills becomes an essential aspect.

Institution of Higher Education are an extremely relevant platform for them to sharpen up 21st century skills, especially HOTS and technology skills because the younger generation is the pillar of the workforce that can bring change to the economy which requires them to be k-economy knowledgeable, i.e; Knowledge Economy that focuses on high intellectual ability in the production of innovative and inventive products. This can be realized with the help of technology applications that stimulate the creation of creativity and innovation ability, as well as efficiently use technology to access information from a variety of sources in line with global developments. However, continuous efforts must be made to ensure excellence in education especially to meet the current needs and demands. In the learning process, these skills need to be integrated wisely and strategically by taking into account the needs of those elements.

Table 1 below shows the findings of the mobile technology integration study using several learning strategies in improving students’ HOTS achievement.
| Bil. | Researcher/Year                        | Technique/Strategy             | Findings                                                                                                                                 |
|------|---------------------------------------|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Berth, M (2006)                       | Informal Learning (Blog)       | Mobile technology has the potential to provide informal learning as well as encourage student to be communicative, social knowledge, and reflective thinkers. |
| 2    | Sung et.al (2013)                     | Problem solving strategy       | Mobile technology is a great help to students in improving their academic achievements and self-sufficiency besides engaging students in HOTS. |
| 3    | Vasiliov dan Economides (2007)        | Collaborative learning         | Mobile technology helps to achieve student’s HOTS by providing students with complex problems such as problem solving in case studies.         |
| 4    | Cavus dan Uzunboylu (2009)            | Collaborative learning         | Students’ creativity and critical thinking increased significantly by using mobile technology in their learning.                           |
| 5    | Nurul Farhana Jumaat dan Zaidatun Tasir (2013) | Project based learning | Mobile technology makes it easy for students to have dominant control over their own learning process.                                   |
| 6    | Nurul Afn Chua et. al (2017)          | Learning based on smartphone application | The application of technology in smartphones has supported critical skills and enhanced learning effectiveness.                           |

From the table above, there are many techniques used by educators with the help of mobile technology applications. This is proved by Yang et al. (2015) in which his research said that the use of technology able to support productive learning of students. According to him, although the process and experience of learning in each field of study is different, but under the multimedia learning the impact of cognitive development is the same. This is because the role of multimedia learning itself has helped individual learning effectively and led to high order thinking.

In addition, a study by Law, Lee & Chow (2002), related to the characteristics of effective learning practices in the 21st century emphasized on the innovative practices which led to the restoration of learning that were carried out. Their findings showed that students are more positive, that they acquire better ability to learn information literacy skills through the internet, capable of thinking critically, proficient of learning from various sources and able to learn from their community by respecting each other’s ideas.

The study of Aliff Nawi et. al (2014) also found that teachers and students were more satisfied with the developed mobile application. According to him, the use of technology can increase the motivation among students as the construction has creative and innovative values. In addition, Kearsley et al. (1995) reported that online learning had a positive effect on the tertiary education environment. Overall comparisons between conventional classes and online learning, online learning recorded higher levels of critical thinking and produced higher test scores for students using online learning. It has also been reported that online learning provides students with higher levels of satisfaction and endorses frequent discussions.
between students and teachers (Kearsley et al. 1995). This will make the learning process to be more global and outside of the student’s thinking box.

The use of mobile-learning produces a learning experience that can be acquired anytime and anywhere whenever there is an occurrence of learning. Its use will provide a very different educational experience. This situation can transform the conventional education system of classroom-based into a more creative and motivating education besides providing valuable experiences in student learning.

4. Conclusion

Given the importance of technology in honing students’ high order thinking skills, therefore it would be inappropriate for us not to take advantage of the benefits of this mobile application in the 21st century learning. The integration of technology elements in learning is cross-curricular, which means that every field of study can use technological advances to enhance students’ understanding of the subject being studied. Study of internet use in year 2019 by the International Telecommunications Union (ITU) found that 87.4 percent of Malaysians now use the internet compared to 76.9 percent in year 2016. As such, these improvements should be a substance for students in particular, to explore technological advancements to be used in their education and to enhance the ability in creativity, innovation, and high order thinking skills.

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