TPACK IN HIGHER EDUCATION: ANALYSIS OF THE COLLABORATIVE TOOLS USED BY LECTURERS

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Abstract: Globalized Online Learning as one of the shifts to transform the higher education system to align with global trends employ technology-enabled innovations such as video-conferencing and live streaming and is expected to dramatically reshape pedagogy in the 21st-century. Technology in higher education should transform the teaching and learning processes beyond the transmission of knowledge through teaching facts and concepts as content knowledge, but in acquiring skills by interacting, applying, evaluating, creating new knowledge and problem-solving. Therefore, integrating appropriate technology in the pedagogy can contribute significantly to the effectiveness of instruction, and learning. Collaborative learning (CL) has been shown to stimulate cognitive processes and enable learners to generate new knowledge through social interactions. Technology can support the CL using tools for effective collaboration. However, lecturers do not seem to have the knowledge and skills to integrate collaborative tools (CT) for teaching. According to the National e-learning Policy, by 2020, 75% of lecturers should have acquired technology pedagogy content knowledge (TPACK) to employ CT in their curricular designs for generating new knowledge. Hence this study employed one group pre-test and post-test experimental groupdesign to measure 37 volunteer lecturers' ability to use TPACK in CL. To analyze the lecturers TPACK, a rubric was developed based on the performance rating scale. The results show that the most commonly used CT among lecturers areinstant messaging, YouTube anda discussion forum. Most importantly, lecturers need to identify a suitable CT to teach a specific given subject because of their ability to use CT for collaboration were below expectation. The findings of this study provide insights for lecturers, the need to develop skills in TPACK so that they can teach in a meaningful way using collaborative tools.

Keywords: *TPACK, collaborative learning, collaborative tool, teaching in higher education*

INTRODUCTION

Globalized Online Learning is a tool to alter the higher education system to bring into line with global trends bythe useof technology-enabled innovations such as video-conferencing and live streaming and is expected to dramatically reshape pedagogy in the 21st-century(MOHE, 2015). Due to that, it is important for lecturers to be well-equipped with the necessary knowledge and skills to integrate technology into their teaching process since they play an essential role in determining the effectiveness of technology in education.

In Malaysian institutes of higher learning, technology should transform the teaching and learning processes beyond the transmission of knowledge through teaching facts and concepts as content knowledge, to acquiring skills by interacting, applying, evaluating, creating new knowledge and problem-solving as well as higher-level thinking is required (Dewitt, Alias, & Siraj, 2015, Martin, 2006; Ronen & Pasher, 2011). Hence, this can be achieved through social interactions and cognitive process during collaborative learning (CL)(Dorothy DeWitt, Alias, Siraj, & Hutagalung, 2014; Dorothy DeWitt, Alias, Siraj, & Zakaria, 2014), technology support CLfor effective collaboration.

Therefore, it is pertinent for lecturers to know the suitable collaborative tools (CT) to use, as well as the methods of using these toolsin order to implementpedagogically appropriate solutions for teaching different domains of learning. According to the National e-learning Policy, by 2020, 75% of lecturers should have acquired technology pedagogy content knowledge (TPACK) to employ CT in their curricular designs for generating new knowledge. Thus, the present study was designed to measure the lecturer's ability to apply TPACK to integrate content, pedagogy and technology in the teaching process by answering the following **research questions:**

i. **to what extent** lecturers implemented different type CT for teaching?
ii. what is the lecturer's ability to identify and select collaborative tools to teach the certain knowledge and skills (TCK)?
iii. what is the lecturer's ability to use collaborative tools for purpose of collaboration (TPK)?

Collaborative Learning (CL) and Tools (CT)

Collaborative learning (CL) has been proven to be an effective instructional method for a group of learners working together towards a shared common goal through problem-solving, task accomplishment or knowledge creation (Bernard, Rubalcava, & St-Pierre, 2000; Dillenbourg, 1999; Kuo, Belland, &Kuo, 2017; Laal & Laal, 2012). CL happenswhen a participant of learners acquired knowledge, skills and attitudesthrough a group interaction (Johnson & Johnson, 2004). Besides that, in CL, learning happens naturally whereby the students and lecturers' interaction and responses are usually unplanned.

Since the activities and interactions are less structured, CL provides a great opportunity for students to learn concepts, rules, problem-solving, cognitive strategy, motor skills and develop an attitude as learners build knowledge through social interaction. Therefore, by incorporating a high-level technology instruction in the form of collaborative tools (CT) such as wikis, blog, podcast, instant messaging, and discussion forum itenhances students learning through knowledge building, engaging and motivating learners in the learning activity. CT has been shown to be useful for learning since it is known for its task-specific collaborations with goals and work-oriented activities(Cheung & Vogel, 2013; Dewitt, Alias, & Siraj, 2015).

Integrating CT for learning increases interactions among learners (DeWitt, Siraj, & Alias, 2014)allow the communities of common interest not only to be a passive user of the available tools, but also to create, share, contribute and comment on the content through it enhances various file formats that can be shared or edited online(Cheung & Vogel, 2013; Churchill, 2011) and develop student-centered personalized learning environments (Sigala, 2007). Thus, lecturers need to be aware of the educational potential of collaborative tools and utilized it in an appropriate way to promote CL for higher level thinking skills.

Technological Pedagogical Content Knowledge (TPACK)

Integrating CT into instruction can be done by incorporating technology pedagogical content knowledge (TPACK) as a body of knowledge that lecturers need for effective technology integration. Mishra and Koehler (2006) have advocated a conceptual framework of TPACK that consist of content knowledge (CK) concerning knowledge of the subject matter, pedagogical knowledge (PK) concerning practices and the process of teaching and learning, technological knowledge (TK)concerning knowledge of how to work with and apply technological tools/softwareand intersection of technological content knowledge (TCK) concerning how teaching might change as the result of using particular technologies, technological pedagogical knowledge (TPK) concerning the use of various technologies in teaching and understanding that using technology may change the way individual lecturer teachesand pedagogical content knowledge (PCK) concerning the way teaching method matches the subject matter.

Based on TPACK model, for effective adoption of new technologies, lecturers are required not only to have the knowledge about technology (CT) but alsoto have experienced the successfulintegration of CT in a teaching and learning environment. To be effective in integrating CT in teaching, the lecturer must understand the concepts of using CT; pedagogical techniques in collaborative ways to teach different domain of learning as shown in Figure 1

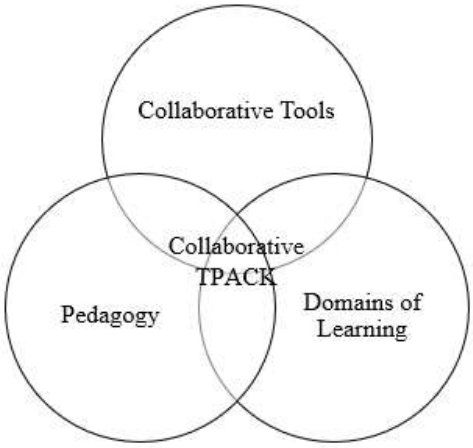

Figure 1. Collaborative TPACK

METHOD

Sample

The participants for this study are selected from one of the public higher education institutions in Klang Valley. Selection of the participants are based on certain criteria. All the samples were selected among those who are involved withTPACK training. All participant must possess a doctoral degree in a related field and have teaching experiences at least minimum of 1 year in any field of study. According to G-power software version 3.1, the recommended sample size is thirty-four (*n*= 34) instructors. The participants number was 37 lecturers.

In order to provide an overview of the participants' details for this study, descriptive statistics are included. This study involved48.6% female lecturers and 51.4% male. Most of the lecturers (70.3%) are aged in between 35-44. In terms of teaching level, 56.8 % of the lecturers are teaching the undergraduate level while 27% teaching the postgraduate level followed by 13.5% of them teaching both the undergraduate and postgraduate level and only 2.7% teaching the foundation level. Most of the lecturers (89.2%) have teaching experiences between 1 to 5 years in their current university. All the participants in this study were informed face to face during the TPACK course to complete the online Knowledge Test. All 37 lecturers (100%) responded to the online test.

Design of the Study

This study employed one group pre-test and post-test experimental group. However, only the baseline is reported wherethe researcher collects data on lecturer's current knowledge on CT and CL without any intervention in place. After filling in the informed consent form, the lecturers are requested to log in into their LMS system to access the Google Form link to the Knowledge Test on CT. Google Form was used because its free application and allow the lecturers to complete the test anytime and anywhere before the TPACK course.

The Knowledge Test consists of questions pertaining to CT and its usage in teaching different domain of learning outcome, such as concepts, discrimination, rules, problem-solving, cognitive strategy, the attitude and motor skill.The test was administered to the lecturers before theTPACK training course.

Data collection and analysis

In order to score the Knowledge Test, a rubric was adopted based on the Technology Integration Assessment Instrument (TIAI) by Harris, Grandgenett, & Hofer (2010). To confirm the content validity of the Knowledge Test and the marking rubric were examined by four experts from the area of Instructional Design, Educational Technology and TPACK who have more than five years' experience in teaching and training. The experts are given module outline to review the questions listed in test to ensure the questions are related to the module content. As a result, the experts' comments on the choice of words as well as order of questions. Hence, minor modification made to enhance the final version of the test.

Based on the rubric, when the lecturer is able to identify more than two (2) CT to teach the knowledge/skill, 3 points will be awarded, followed by 2 points whenthe lecturer is able to identify at least two (2) CT to teach the knowledge/skill, 1 point will be awarded when the lecturer is able to identify at least one (1) CT to teach the knowledge/skill. Finally, 0 point will be awarded when the lecturer is unable to identify CT to teach the knowledge/skill.

All the scores were recorded and analyzed to determine each individual's score and converted into percentages. The percentages later matched with the overall performance rubric adopted based on Behaviorally Anchored Rating Scale (BARC) by Feng et al. (2017)with the rating scale of(75%-100%) for outstanding, (49%-74%) for satisfactory, followed by (23%-48%) for improvement needed and finally (0%-22%)for below expectation depending on the total score of lecturer's ability to identify/select CTand use CT for the purpose of collaborationto teach specific domain of learning outcome.

FINDINGS

In answering the first research questions, to what extent lecturers implemented different types of CT for teaching **were analyzed and reported as shown in Table 1 and Figure 2.** The results show that YouTube (10.8%), instant messaging, IM (10.8%) and video developmental tools (8.1%) are the types of CT used in a very large extent by the lecturers in the teaching process.

These results are similar to previous study by Snelson & Elison-Bowers (2009) that most instructors used video as a medium to develop students' attitude to value individual differences and to increase students' interest in subject taught since video is a powerful agent to display people emotion through the audio-visual. A study conducted by Sun, Lin, Wu, Zhou, and Luo (2018) on collaborative learning activities using WeChat found out that using the mobile instant-messaging app, WeChat resulted in more social interactions. This shows that IM tools have been used widely in the online discussion (Branon & Essex, 2001; Hou & Wu, 2011)

However, many tools are still underutilization such as Virtual Reality (81.0%), Podcast (78.4%), Infographic posters (75.7%), Blog and Students Response System (73.0%), Wiki and Microblogs (70.3%), Survey Tools (62.2%) and Interactive wall (64.9%).

Based on the previous study, although Virtual Reality provides the opportunity to the students to learn topics that are difficult to demonstrate with the traditional method, the high financial cost of setting up VR system is one of the drawbacks that limited the application of VR in the education (Christou, 2010). This could be the possible reason of virtual reality is underutilization.

Findings also show that podcast and blog are not been used by the lecturers. However, these findings of the current study do not support the research. According to previous study,the integration of podcasts in the online learning environment has become more common (Caladine, 2008; Copley, 2007) and it may be delivered via LMS or uploaded to the iTunes University that serves as the podcasting-hosting site (Bolliger, Supanakorn, & Boggs, 2010). Several authors reportedthat podcasting engaging learner with the content through knowledge construction and co-production of learning material(Bolliger et al., 2010; Middleton, 2016).Blog also widely used to improve the learning process for various purpose in promoting effective learning(Ifinedo, 2017; Shana & Abulibdehb, 2015; Top, 2012).

Table 1
The extent different type of CT has been implemented in the teaching process

Collaborative tools	Not at all (%)	to small extent (%)	to some extent (%)	to a large extent (%)	to a very large extent (%)
Discussion Forum	45.9	16.2	21.6	10.8	5.4
Wiki	70.3	10.8	10.8	8.1	0.0
Blog	73.0	13.5	10.8	2.7	0.0
Podcast	78.4	16.2	5.4	0.0	0.0
instant messaging	32.4	13.5	16.2	27.0	10.8
Youtube	21.6	21.6	27.0	18.9	10.8
Microblogs	70.3	13.5	13.5	2.7	0.0

Students Response system	73.0	2.7	24.3	0.0	0.0
Survey Tools	62.2	13.5	18.9	5.4	0.0
Virtual Reality	81.1	13.5	5.4	0.0	0.0
Interactive walls	64.9	21.6	10.8	2.7	0.0
video development tools	67.6	10.8	8.1	5.4	8.1
infographic posters	75.7	13.5	5.4	2.7	2.7
Mind mapping	70.3	13.5	5.4	8.1	2.7

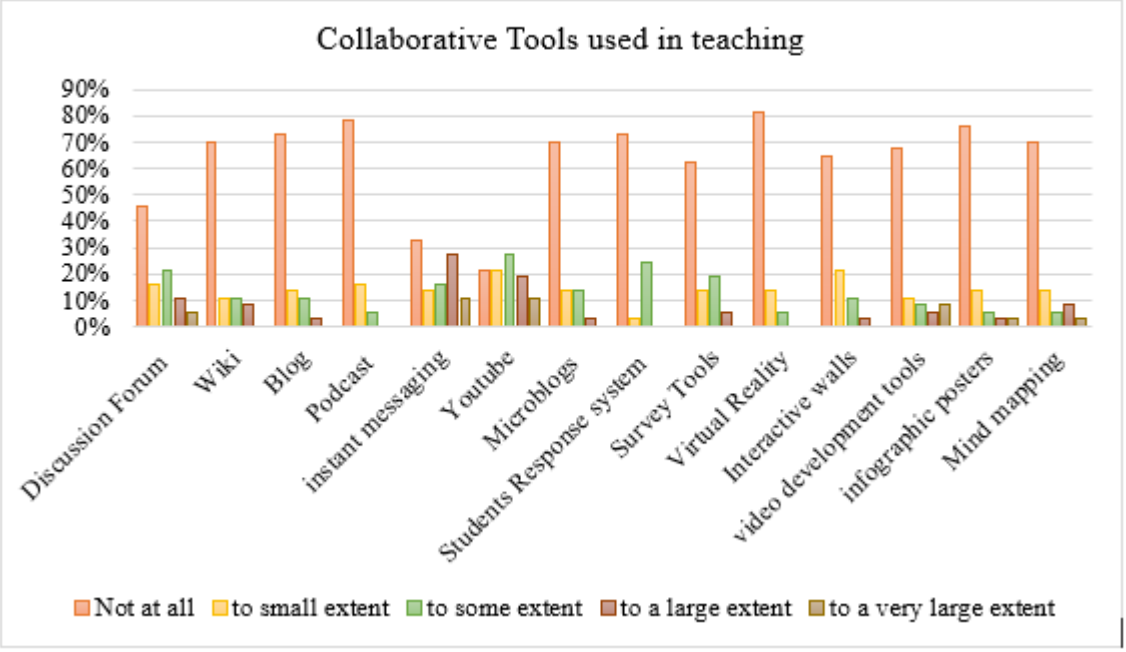

Figure 2. The extent different type of CT has been implemented in the teaching process

The next research question focuses on the lecturer's ability to identify and select CT to teach certain knowledge and skills (TCK). As shown in Table 2, 66.7% of the lecturers are at the satisfactory level when the lecturerscould identify at least two (2)C Tusedto teach concepts (e.g. understand the meaning of family, justice, community, mass, acceleration, force, etc.). Next, 53.2% of the lecturers are at the satisfactory level when the lecturers could identify at least two (2)CT to teach discrimination (e.g., differentiate the physical and functional features between PCs, laptops, smartphones, and smartwatches; differences between Wi-Fi and a Bluetooth network, etc.).

However, only 45.9% of the lecturerscouldidentify atleast one (1) CTused to teach rules (e.g. knows how to multiply numbers, to construct a sentence, or to play a game, etc.) hence there is a need for improvement. The similar case with the problem solving and cognitive strategy when only 43.2% of the lecturers could use atleast one (1) CL in teaching both types of knowledge, therefore, improvement is required. Finally, when teaching motor skills only 35.1% of the lecturers could identify at least one (1) CT to teach the skills.

These findings shows that, teaching in an effective way using TPACK is not just about how well instructors can teach with a technology (Jen et al., 2016) but also design the instructional strategies that are linked to type of skill or task instructors wish students to learn (Spector, 2016). Therefore, instructors are able to differentiate in detail the specific learning outcome they are setting either consist of learning domain such as verbal information, intellectual skills, cognitive strategies, attitude, or motor skills since there is no one size (learning domains) fit all instructional tasks (Jen et al., 2016).This is an indication thatthere is a need for improvement among lecturers to teach meaningfully using CT.

Table 2
Total Score of TCK

Knowledge/Skill	Score on TCK (%)	Level
Concepts	66.7	Satisfactory
Discrimination	53.2	Satisfactory
Rules	45.9	Needs Improvement
Problem Solving	43.2	Needs Improvement
Cognitive Strategy	43.2	Needs Improvement
Attitude	46.8	Needs Improvement
Motor	35.1	Needs Improvement

In the last research question, thelecturer's ability to use CT for the purpose of collaboration (TPK) was determined. As shown in Table 3, the lecturer ability to use CT for collaboration to teach different knowledge and skill is low. Only 18.9% of the lecturers could use CT for collaboration in teaching motor skills. Similarly, for problem-solving, only 18% of the lecturers were able to use CT for collaboration.

This followed by teaching discrimination (12.6%), teaching concepts (11.7%), teaching rules (9%) and attitude (8.1%). Teaching cognitive strategy with CT shows the lower score compared to the other domain of learning with only 3.6% lecturers could integrate CL for collaboration. This means that the lecturer's ability to use CL for the purpose of collaboration is below expectation.

These findings show that, instructors should understand the nature of CL to identify how CL activities can be carried out effectively through its tools.As highlighted in the past literature that CL is known for its task-specific collaborations with goals and work-oriented activities (Cheung & Vogel, 2013; Dewitt et al., 2015). Without knowledge and skill in CL, instructors will continue to limited their technology usage to basic activities such as drill and practice, using the Internet to fill in free time by information searching, use the computer as reward activity when students answer correctly, using Microsoft Word processing for designing worksheet and assessment instead of incorporate higher- level technology instruction (Hsu, 2012, 2013).

Table 3
Total Score of TPK

Knowledge and Skill	Score on TPK (%)	Level
Concepts	11.7	Below Expectation
Discrimination	12.6	Below Expectation
Rules	9.0	Below Expectation
Problem Solving	18.0	Below Expectation
Cognitive Strategy	3.6	Below Expectation
Attitude	8.1	Below Expectation
Motor	18.9	Below Expectation

CONCLUSION

The findings show that the lecturers only haveTKbut however, just having TK does not guarantee that the instructors can implement technologies into their teaching practice because teaching and learning processes in the twenty-first century require the instructor to move from designing lesson with technology for information transmission and drill-and-practice (Koh, Chai, Benjamin, & Hong, 2015) to restructure learning activities to critical thinking, problem-solving, communication, collaboration and knowledge construction through a social learning environment (Learning Partnership for 21st Century, 2016). Hence, lecturers need to be technologically and pedagogically competent by having the knowledge and skills to identify suitable tools to teach different content areas rather than just having knowledge on a variety of technologies used in learning environments.

Next, the lecturers lack the knowledge on the collaborative learning meaning and usage. Even though the instructors used YouTube, Instant Messaging or video development tools in the teaching process, they are still lacking the

knowledge to incorporate those technologies with an appropriate task that can promote collaborative learning among students. As mention in the past literature that collaborative learning is known for its task-specific collaborations with goals and work-oriented activities(Cheung & Vogel, 2013; Dewitt et al., 2015) hence instructors should understand the nature of collaborative learning, identify how collaborative learning activities can be carried out effectively through its tools.

Therefore, the lecturers still need to upgrade their knowledge and be aware of the educational potential in collaborative learning and CT. They need to be ready to be trained to benefit from the advantages of collaborative learning and CT since instructors play an important role in ensuring that the technology integration promotes effective teaching and learning (Boza & Conde, 2015).

The lecturers need more opportunity to explore as many as CT beyond the general usage and integrate them into instruction that will promote students learning. To achieve that, learning opportunities in the form of training, workshop or seminar is to be provided so that thelecturers can develop ameaningful way of teaching with CT and put into action in the teaching process.

Findings of this study have importantimplications for lecturers and higher education institution. Specially, preparing the lecturers to incorporate higher- level technology instruction (Hsu, 2012, 2013; Jimoyiannis, 2010; Jimoyiannis & Komis, 2007) in the form of CL tools such as wikis, blog, podcast, instant messaging, and discussion forum is to enhance students learning through knowledge building, engaging and motivating learners in the learning activity. This is because, teaching and learning in higher education can be more successful and innovative where learning is more than just the transmission of knowledge (Dewitt, Alias, & Siraj, 2015). The focus should be on acquiring skills for interacting, applying, evaluating and creating new knowledge as well as problem solving (Martin, 2006; Ronen &Pasher, 2011).

Moreover, higher education institution should focus on providing training and CPD programmme related to teaching and learning with technology by emphasizing not only the theoretical and concept aspect but provide room for inquiry or reflection on instructors actual teaching approaches. Thiswill help to determine the effectiveness of the training programmeto equip instructors with relevant and significant knowledge and skill that will influence their teaching practices (Abbott, Stening, Atkins, & Grant, 2006; Olivero, Bane, & Kopelman, 1997).

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