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Technological Pedagogical Skills for Teaching Technical Subject in School

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Abstract: Teaching in the 21st century entails the application of latest educational technology; it requires significantly different pedagogical skills compared with teaching in a traditional classroom using the whiteboard (chalk and talk). However, teachers' pedagogical skills in using educational technology and its alignment to learning content have yet to be determined. In addition, the characteristics of the 21st century students have changed in terms of focus, motivation, and intelligence in learning. Therefore, this study was conducted to determine the 21stcentury pedagogical skills of teachers in using the recent educational technology. A survey was conducted using questionnaires that involved 282 teachers from the primary schools in the South-west of Johor, Malaysia (i.e. Batu Pahat, Kluang and Pontian). Data were analysed using mean, standard deviation and percentage in order to interpret the data. This is the result: the teachers have demonstrated a high level of skills in a total of 15 constructs of pedagogical skills in the 21st century teaching and learning using technology. The highest mean of pedagogical skills constructs includes improving students' thinking, adapting material, and evaluating information. The implication is that, teachers should continually update their pedagogical skills for teaching and learning in the 21st century, in order to support students' learning and impart knowledge effectively; such efforts are necessary to counter students' declining interest and motivation, especially for the theoretical part of technical subjects in the school.

Keywords: TVET teacher training, TPACK, Cybergogy, Educational technology, enGauge 21st Century Learning Model

1. Introduction

Teaching the technical subject in the school requires the recent technology, in order to introduce technology and machines so as to capture students' learning interest; this could be done as early as in the primary school. The right and appropriate pedagogical skills could stimulate students' interest to learn, for example, watching a video, slide shows, animation, models, simulation that includes the most recent virtual and augmented reality devices. In the latest phase of development, the application of educational technology has created a new teaching and learning concept known as Cybergogy. Notwithstanding this concept, pedagogical skills refer to the ability of the teacher to plan, select, and manage materials for delivering the content that could facilitate students' learning. These skills are essential for teachers to draw students' attention, and they are the most important criteria in developing good teachers (Hashim, Yaakub & Ahmad, 2003; Kereluik, Mishra, Fahnoe and Terry, 2013).

Previous research indicates that many authors had conducted researches regarding the 21st century learning (Cheryl, 2002; Berry, 2012; Leavitt, 2012; Ling Koh & Chai, 2015);they focused on students (Baru, Abdullah, Ali, & Yusoff, 2014) using the innovative teaching approaches (Nussbaum and Sharples, 2014) in helping students to acquire knowledge (Kereluik, Mishra, Fahnoe & Terry, 2013). However, there is a lack of studies that emphasised teachers' pedagogical skills in using technology. This is because maintaining students' focus during the teaching and learning

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session is not an easy task, especially for students in the 21st century. It is crucial to carry out research on how to teach students using technology in the 21st century, so that the pedagogical techniques are consistent with the content, students' characteristics, and technology-based education adopted by the teachers. In line with the demands of "educational 4.0", teachers need to have pedagogical skills coupled with technology agility (cybergogy) in order to deliver syllabus content during the teaching and learning process (Orhan, 2007). It is based on the TPACK framework, and this study is in line with three main variables: Technology, Pedagogy, and Content Knowledge (Shulman, 1986, 1987; Chin Yu and Franz, 2018). Thus, the integration of these variables needs a specific research in order to obtain insights into the effective approaches of teaching and learning that meet 21st century students' characteristics.

The enGauge 21st Century Skills model was developed by the North Central Regional Educational Laboratory (NCREL) and Metiri Group (2003). This model emphasises the aspects of digital literacy, thinking, creativity, effective communication and high productivity components in the 21st century learning. This study focuses on the literacy component of digital-era that stresses effective learning outcomes delivered by teachers; the improved learning results are achieved by capturing the students' attention during the learning session (Zamri Mamood et al., 2014). The digital literacy-era highlights eight major constructs, namely basic scientific literacy, literacy, technology literacy, economic literacy, visual literacy, information literacy, cultural diversity literacy and global awareness. In investigating these topics, the scope of this study includes three important components of literacy that are common for teaching and learning: technology literacy, visual literacy, and information literacy.

Gaps are observed to exist in the previous researches in terms of suitability of teachers' pedagogical skills in relation to the characteristics of the 21st century education (Sharon, 2011). According to teacherthought.com, 21st century students are very much different from those in the past; the major differences encompass new media and instructional styles, more personalised learning platform and interest, and transfer-by-design learning approaches. In the traditional teaching practice, the teachers use presentation slides; they read the information from the slides while students listen to the teachers. This is followed by teacher-student interaction during or at the end of the teaching session. This pedagogical approach is in contradiction to the 21st century education: it does not take into account the 21st century students' characteristics. Hence, it is necessary for teachers using the traditional pedagogical approach to adopt new educational technology that meets the needs of the current students. The new pedagogical skills include these elements: selection of materials, determining the suitability of the technology-based teaching aids and content of education. These pedagogical skills need to be fine-tuned, and the effectiveness of which has yet to be ascertained (Shulman, 2005; Mohamad Yatim, 2018).

The 21st century pedagogical approach provides students with much room for learning participation. For instance, the use of learning platform for interaction such as forums on the Learning Management System (LMS) generates active involvement of the 21st century students. The teacher's role will be changed to providing encouragement and motivation for students to actively engage in the forum. In this manner, students' learning will be more effective and rewarding (Shindler, 2008; Abdul Halim, 2018). The teachers may also instruct students to retrieve more information by searching with specific scopes and guidelines; with this guidance, students will gather information that is aligned to an expected learning goal. In addition, learning is not limited to the classroom time frame or space; students can acquire information at any time and from anywhere in the world by accessing the global resources in the cyberspace (Sharuddin, 2007; Tasir & Ing, 2018). Therefore, this study was conducted to explore the pedagogical skills of teachers for teaching students using the 21st century technology; this is particularly relevant in teaching the theoretical part of the technical-based subject in the primary school.

2. Research Methodology

This study deployed a quantitative survey design using the questionnaire. The sample consists of 291 subjects, randomly selected from 1174 technical-subject teachers; these teachers are from the schools located in the south-western region of Johor (i.e. Batu Pahat, Kluang and Pontian).

The questionnaire consists of two parts: Part A contains items pertaining to demographic information; Part B contains 15 constructs of pedagogical skills in the 21st century using technology (from previous qualitative exploration study) with 48 items that are measured using Likert scale. The pilot test was implemented involving 30 teachers (different groups of TGP). The aim was to establish the reliability and internal consistency using Cronbach's Alpha. The result is 0.98 indicating a high level of reliability (Hair, Ringle & Sarstedt, 2011).

The data collection was performed in two stages with the first stage using Google Form. However, after two weeks, only 76 forms were returned. Consequently, as a second-stage measure, the questionnaires were distributed by hand to the teachers of each school. As a result, a total of 215 completed forms were gathered. With the two stages of data collection, a total of 291 sets of questionnaires were collected. After a procedure of careful screening, 282 sets of forms were ready for data analysis.

Data were analysed descriptively using mean, mode and percentage; and an inferential statistic process was performed using the Analysis of Variance (ANOVA) in order to interpret the results.

3. Results

A demographic analysis indicates an imbalance of gender distribution, with a total of 88 male and 194 female teachers. Fifty percent of the respondents have more than 15 years and eleven percent of them have less than five years of teaching experience.

A total of 15 constructs of pedagogical skills in the 21st century teaching and learning using technology were measured using 48 items. The results indicate that *improving students thinking* is the highest mean score for the construct (M = 4.21, SD = 0.46). The second and third constructs that were rated higher respectively are *adapting of materials* (M = 4.11; SD=0.50) and *evaluating information* (M = 4.10; SD = 0.46). The lowest mean score is for the construct of *using recent application* during teaching and learning. Table 1 shows the mean scores for the rest of the constructs.

Table 1 mean score for teachers' pedagogical skills in the 21st century using technology

N	Construct	Me	SD
1	Applying teaching delivery skills	4.	0.4
2	Exploring technology	4.	0.5
3	Evaluating information	4.	0.4
4	Using recent application	3.	0.5
5	Integrating multiple media	3.	0.4
6	Adapting of materials	4.	0.5
7	Diversifying techniques	3.	0.5
8	Interpreting visuals	3.	0.4
9	Guiding information access	4.	0.4
1	Collecting students' reflection	3.	0.5
1	Stimulating students' thinking	3.	0.5
1	Improving students' thinking	4.	0.4
1	Developing students' soft skills	3.	0.5
1	Motivating	4.	0.5
1	Nurturing values	4.	0.5
1	Providing support	3.	0.6

The main findings reveal several interesting items. Teachers are helping students to relate the content of the lesson to an actual application (M = 3.99; SD = 0.62), and they are also guiding the students to think out of the box in matters relating to content lesson (M = 3.93; SD = 0.64). The study also shows that the teachers customise their content to suit the ability of the students in teaching and studying (M = 4.15; SD = 0.59). In addition, teachers also use various techniques to search for information from the internet to obtain content lesson effectively, with time saving in the following items (M = 4.14; SD = 0.52). Hence, these are the items that have a lower mean score. Teachers encourage students to respect the teachers in the online preparation for the beginning of the teaching and learning session (M = 4.15; SD = 0.62), and use the video clips as induction before beginning the teaching session (M = 3.73; SD = 0.68). Table 2 indicates the mean scores for the specific items.

Table 2 Interpretation of the mean scores of items with the highest level of mastery for teachers' pedagogical skills

No	Item	Standard Deviation	Mean
1	I help students to relate the content of the lesson to an actual application	0.62	3.99
2	I help students to think out of the box relating to content	0.	3.93
3	I customize the contents of learning to students' abilities	0.59	4.15
4	I used to find information from the internet to enrich content lesson before teaching.	0.52	4.14
5	I give students with best compliment for using online resources	0.62	4.15
6	I use the video clips as induction before start teaching.	0.68	3.73

4. Discussion

Pedagogical skills for teaching the technical subject in the 21st century is based on the enGauge 21st century Learning Model. The three main components were used as the framework of the study, namely technology literacy, visual literacy, and information literacy. The primary aims of this study are to ensure the alignment of technology, pedagogy and content delivery, as mentioned in the TPACK framework (Shulman, 1986, 1987; Chin Yu and Franz, 2018). An exploration of a qualitative study previously conducted indicated that 15 constructs were related to the pedagogical verbs; these terms were used to establish the questionnaire items for this study purpose. These verbs reflect teachers' actions in delivering the content when using the technology-based teaching aids. Each of these verbs was named as an element; each was used to gauge the extent of teachers' pedagogical skills in to draw students' attention in learning and creating an environment for the effective 21st century teaching and learning.

This study found that the teachers have a high level of pedagogical skills in using technology to teach the theoretical part of the technical-based subject. For instance, teachers searched for information from the internet in preparing the lesson plan. Teachers accessed the internet to collect relevant materials and information in preparing for teaching, such as videos, audios, animations, and pictures. The main purpose was to expose the students to the actual world scenario, and to stimulate their thinking for effective learning. Teachers also shared information links with the students; thus, the student could further explore the information on a particular topic, which is aligned with the 21st century students' characteristics. These diverse resources include media and instructional procedures, personalised platform and interest, and transfer-by-design approaches. Previous research also indicated that this approach of employing the pedagogical skills can improve students' cognitive process and information literacy (Organization for Economic Cooperation and Development-OECD, 2011). Therefore, it is important to appropriately adapt or adopt the learning content commensurate with students' ability to embrace the class learning activity (Yu, Abrizah & Sani, 2016).

Based on the reports from previous researches, the teachers were confused about information literacy and as a result, students were not engaged in in-depth learning, which was indicated by assignments prepared by the students (Allen & Seaman, 2011). In this study, the teachers demonstrated a high level of technology-based pedagogical skills by incorporating some elements such as audios, videos, pictures and animations, which facilitated students' direct engagement in learning (Leavitt, 2012). In teaching the theoretical part for the technical-based subject, for example, the topic of electrical generation such as hydro-electric power plan, the best way to improve the students' understanding is using videos and animations. Posting a video in front of a class without a teacher's prior explanation might not help students' understanding. Thus, it is the teachers' responsibility to prepare the students cognitively and affectively before they watch a video or animation.

In line with the demands of "educational 4.0", teachers need to have technology agility coupled with pedagogical skills (cybergory) so that they can deliver syllabus content during the teaching and learning process (Orhan, 2007). The findings of this study indicate that teachers prepared the necessary before a teaching session using technology. The most important aspect was that teachers selected an appropriate material such as a relevant video or animation, edited the video clips to cut short the playing time, in order to meet the intended learning outcomes. The main reference should be aligned with the TPACK framework (Shulman, 1986, 1987; Chin Yu and Franz, 2018), based on the three elements of technology, pedagogy and content knowledge. The integration of these var iables will bring about the effectiveness of teaching and learning process and maintain students' interest during the learning session.

5. Conclusion

This study is a follow-up investigation of a qualitative research to explore the pedagogical skills in the 21st century. A total of 15 constructs emerged and were used in this survey study, which was based on the enGauge 21st Century Learning Model. The significance of this study is underpinned by the TPACK model, which justifies the importance of including technology elements in the pedagogical skills; this is a crucial educational aspect of teachers in teaching the students in the 21st century. The results show that teachers have rated high scores for pedagogical skills in all the constructs, leading to a conclusion that teachers possess a high level of 21st century pedagogical skills that incorporate the recent educational technology. This shows that teachers have updated their pedagogical skills through training and self-exploration. The implication is that, teachers should continually upgrade their pedagogical skills for teaching and learning in the 21st century, so that they can support students' learning and impart knowledge effectively in tandem with students' interest and motivation, especially in teaching the theoretical part of the technical subject in the school.

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