The Effect of Field Specialization Variation on Technological Pedagogical Content Knowledge (TPACK) Among Malaysian TVET Instructors

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ABSTRACT

Technological Knowledge is directly related to productivity, enhanced performance and service quality. Technology integration in the Technical and Vocational Education and Training (TVET) curriculum is expected due to high application of technical knowledge and technology applications. TPACK is a professional knowledge framework that gives flexibility and provides dynamic strategies to TVET instructors to enhance and therefore improve the teaching and learning process. This study analyzed the impact of Field Specialization variation on the level of knowledge gained. It is found that regardless of the large variation and multiple perspectives of specialization existing among TVET instructors, specialization is not a factor that influenced the level of knowledge gained. Therefore, this study contributes to the understanding that there are other factors that may influence the knowledge gained among Malaysian TVET instructors.

Keywords: *TPACK; professional knowledge; specialization; technology integration; technological knowledge.*

INTRODUCTION

The level of knowledge gained by instructors is an element used to measure the quality and effectiveness of training provided by TVET institutions (Scheerens, Luyten, & Ravens, 2011). Knowledge contributes to the differences occurred in actions taken and decisions made (Clarke & Hollingsworth, 2002) which was built up from the experiences, belief and the culture around them. According to Coggshall, Behrstock-Sherratt, Drill, Menon, and Cushing (2011), 90% of teachers across different generations view that technology use can assist teaching; however, only half of the teachers felt that technology use in teaching and learning is very effective.

Studies have found that the level of knowledge gained varied from one cohort to another. Shaharom Noordin and Faridah Sapiee (2010) found that physics pre-service teachers had moderate level of knowledge while Yeo Kee Jiar and Siti Sara Abdul Halim (2010) found student teachers' knowledge to be at high level. Others found that the level of knowledge among school teachers was unsatisfactory (Ehlers, 2010; Richards, 2010). Female teachers were reported to dominate good pedagogical knowledge but have difficulty in gaining technology knowledge as compared to male teachers (Low, 1999; Shaharom Noordin & Faridah Sapiee, 2010).

Therefore, in order to address quality problems effectively, a good understanding on the competency level of the cohort studied is required. The variation in the level of knowledge gained by different cohorts leads to a question on what affects the variation. Is field of specialization one of the critical factors? What about other demographical aspects such as age or gender?

Professional Knowledge

In Technical and Vocational Education and Training (TVET), besides the standard teaching and learning professional knowledge, instructors also need to acquire specialized knowledge related to teaching and learning of a particular job title. It covers the concepts behind each theoretical and practical application as well as the knowledge on how to expand existing knowledge to create a new one (Muttaqin, 2007).

The teaching and learning strategy chosen should account for any recent changes and current practices by industry as well as students' knowledge background. In order to stay relevant and competitive with the explosion of knowledge across national boundaries, TVET instructors must acquire multiple specializations, engage in high level of thinking and participate in a transformative learning processes (Mishra, Koehler, & Henriksen, 2011). To do that, a dynamic framework on professional knowledge is needed to enable new knowledge formation and provide flexible teaching strategies. As knowledge evolves rapidly in line with technology advancement, instructors need to manipulate existing knowledge and continuously develop new knowledge (Niess, 2011).

Technology Integration

Technology in education involves the use of digital or analog equipment (Plair, 2010) as well as the use of information and communications technology (ICT) such as animation and simulation software (Khan, 2011) to facilitate teaching and learning process implementation as well as daily tasks. According to Ertmer and Ottenbreit-Leftwich (2010), the new definition of effective teaching is the one that uses relevant ICT resources as a meaningful pedagogical tool to help students understand. Having the capability to integrate technology in teaching and learning will help in delivering effective teaching (Hairani, 2006; Md. Johan Othman & Dinyati Lukman, 2011; Sidhu & Kang, 2010)

Technology used in TVET is divided into two main categories, namely the standard technology and the specific technology. Standard technology refers to analog equipment such as books, chalk, chalkboard, or digital devices such as internet, computer hardware and software as well as digital media (Lux, 2010; Mishra & Koehler, 2006). Specific technology refers to the equipment and machines used specifically to perform a certain job scope (Guthrie, Harris, Simons, & Karmel, 2009). An example of specific technology will be the knowledge on offset printing machine for printing work or how to operate the splicing machine for a fiber optic installation module.

Mordini (2007) in Gupta, Fischer, and Frewer (2011) stated that technology has a social function that is capable of transforming society both through the manipulation of physical or symbolic objects and acculturation. Technology functions as the bridging gap between theory and practical teaching (Eidsheim, 2009). This view is supported by Madden (2012) who found that smart phone usage can improve content delivery and students' focus toward learning. Technology enables instructors to create transformative learning by applying constructive learning and integrating technology into their teaching. Technology can be applied in the analysis process or in decision-making as well as in enhancing teaching techniques (Means, Padilla, DeBarger, & Bakia, 2009).

Technology is often associated with increased productivity. Similarly in education, technology acts as an enabler to help instructors to perform comprehensive teaching and promote brain-based learning (Knight & Elliott, 2009). Technological application is found effective in increasing student motivation and understanding (Buzan, 2006; Jensen, 2000; Knight & Elliott, 2009).

Technological Pedagogical Content Knowledge (TPACK)

Theories and models on professional knowledge are very broad and had been studied from various perspectives (Ohi, 2007). The nearest to the TVET instructor's profession is the Technological Pedagogical Content Knowledge (TPACK) framework proposed by Mishra and Koehler (2006). TPACK is a specialized knowledge referring to the knowledge and ability to integrate technology based on certain pedagogical strategy to teach a specific content knowledge. It is an expansion of the professional knowledge framework introduced by Shulman (Shulman, 1986, 1987).

According to Shulman (1986), mastering Content Knowledge (CK) alone does not ensure effective teaching. Shulman listed seven fundamental types of knowledge required by each teaching personnel (Shulman, 1987; Tengku Zawawi Tengku Zainal, Ramlee Mustapha, & Abdul Razak Habib, 2009) and Pedagogical Content Knowledge (PCK) is one of them. PCK is a specific knowledge where Content Knowledge is matched with Pedagogical Knowledge (PK) (Shulman, 1987).

Recognizing the role and importance of technology applications in education, Mishra and Koehler (2006, 2008) introduced a conceptual framework on TPACK by adding the technological knowledge elements to the Shulman (1987) PCK framework. This framework was agreed by many other researchers such as Knight and Elliott (2009) and Shin et al. (2009) which states Content Knowledge alone is not enough to help TVET instructors prepare students for the future. TPACK is a framework that allows instructors to carry out the teaching and learning process effectively through technology integration (Sahin, 2011; Schmidt et al., 2010).

Mishra and Koehler (2006) integrated the TK dimension into the PCK model (Shulman, 1987b); they introduced four other new fundamental knowledge dimensions, namely: (a) Technological Knowledge (TK), (b) Technological Pedagogical Knowledge (TPK), (c) Technological Content Knowledge (TCK), and (d) Technological Pedagogical Content Knowledge (TPACK) in addition to the existing three professional knowledge types (PK, CK, and PCK) proposed by Shulman (1987).

TPACK in Teaching and Learning

TPACK provides instructors with strategies to match learning content with specific teaching techniques using appropriate technology (Archambault & Crippen, 2009; Koh, Chai, & Tsai, 2010). As in other professions, the ability to use technology to increase teaching and learning effectiveness is essential and expected (Ertmer & Ottenbreit-Leftwich, 2010). Technology applications in the classroom are now a necessity and accordingly, all instructors are expected to acquire technological knowledge and apply technology integration in the classroom.

Guthrie et al. (2009) reported that the TVET teaching and learning process requires high usage of technology since the syllabuses were designed based on hands-on, conscious creation, and collaborative experience concepts. In addition, rapid technological development, increase in enrollment, and financial constraints had forced TVET institutions to switch to software based applications such as animation and simulation software usage to complete the teaching and learning process (Eidsheim, 2009). With TPACK, instructors are able to re-evaluate the purpose of learning and make students think outside the box (Mishra et al., 2011).

This particular transition is important since the current group of students comes from the “Net-Generation” who are digitally literate and fond of using ICT applications (Pittman, McLaughlin, & Bracey-Sutton, 2008; Short & Reeves, 2009). The so called “Net-generation” was also identified to have short attention span and technology has been identified to have the capability to boost their concentration level in the classroom (Mayes, Calhoun, Bixler, & Zimmerman, 2009). Hence, TPACK could be the bridging tool to reduce the existing digital divide between instructors and students besides improving TVET effectiveness (Jamalludin Harun & Nur Khairul Safrah Jamri, 2010). TPACK also has been identified as an agent of multidisciplinary integration (Francis, 2010).

Coggshall et al. (2011) also reported that teachers from the Y generation cohort (those born between 1977 and 1995) are the most knowledgeable teachers compared to the previous generation due to their high interest in technology. However, the same study showed that the Y Generation teachers still feel hesitant to use technology in their profession. This situation was also detected by other researchers (Johari Hassan & Fazliana Rashida Abdul Rahman, 2011; M. Al-Muz-Zammil & Abd. Muezzam Shah, 2010; Wahid, 2010) who found that although the use of ICT for personal purposes and shared digital literacy among teachers and prospective teachers is high, the rate of use in the learning process, however, is still at a moderate level or lower.

A study conducted in Australia on prospective teachers found the knowledge of technology perception of 345 final year students at two universities in the whole Queensland was still at a low level even though the percentage of computer ownership (99.4%) and access to broadband internet (96.5 %) was high. A similar finding was reported by Ertmer and Ottenbreit-Leftwich (2010) in the U.S. whereby 88% of teachers use technology in administrative work and 93% of them use technology to communicate, but the use of technology in teaching and learning is still low.

One study in Malaysia had also found that although the level of ICT facilities provided was high, the level of ICT use by instructors in teaching and learning was still at a low or moderate level depending on the level of study (Johari Hassan & Fazliana Rashida Abdul Rahman, 2011; Md. Johan Othman & Dinyati Lukman, 2011; Naser Jamil, Leong, & Fong, 2010).

Field of Specialization

Field of specializations in TVET normally was determined based on job titles. Its database keeps on expanding in line with economic growth and technological advancement. According to the Malaysian Standard Classification of Occupations (MASCO), there are ten main groups of occupation classification sub-divided into 4310 occupation codes (Department of Labour, 2008). The National Occupational Skill Standard (NOSS) developed by the Department of Skill Development was clustered into 29 main sectors covering 1310 job titles (Department of Skills Development, 2011). The competency of TVET graduates is assessed based on NOSS and currently available from Level 1 to level 5.

Extant theory and empirical evidence showed that specialization is capable of enhancing knowledge growth (Carnabuci & Bruggeman, 2009) and specialization can be seen either as a property or as a process. Specialization as a property in the technological domain refers to the combination of ideas forming a uniform entity of related knowledge. Alternatively, specialization as a process describes the expansion of knowledge from a related area. Andersson and Ejermo (2008) supported the statement by Carnabuci and Bruggeman and mentioned that knowledge specialization is determined by the technology field or domain of the knowledge itself.

Due to the existing variation and the massive knowledge specialization, an understanding to what extent the variation affects the professional knowledge gained is needed. One needs to know whether field of specialization is one of the critical success factors affecting TVET quality (Bhuasiri, Xaymoungkhoun, Zo, Rho, & Ciganek, 2012; Pittman et al., 2008).

Purpose of Study

The guiding research question which this study explored was: What is the level of knowledge (TPACK) gained by TVET instructor currently and how does TPACK level vary across field of specialization? Therefore, this study attempted to measure the current status of the professional knowledge gained and its variation based on field of specialization for the sample of TVET instructors who are different from previous samples in terms of curriculum, specialization, qualification and the teaching and learning orientation. The findings are expected to enable better understanding of teacher thinking besides providing feedback to TVET instructors on their current performance.

METHODOLOGY

An exploratory mixed method study was carried out using survey and interview. The level of professional knowledge gained and the emerging factors that influence instructor knowledge were obtained using questionnaires while in-depth understanding regarding the factors influencing professional knowledge was obtained via semi-structured interview. A total of 300 instructors (220 male and 80 female) from nine TVET institutions were chosen based on random stratified proportional sampling method. The stratification was made based on specialization cluster and level of instruction namely certificates, diploma or advanced diploma.

The survey used was adopted from Lux (2010), Schmidt et al. (2010), Nurhayati (2006) and Siti Atiqah (2008) and then adapted to suit the Malaysian TVET system. It was sectioned into three main aspects namely the demographical information, professional knowledge and the factors influencing professional knowledge. Demographical information included, among others, age, gender, education level and field of specialization. The field of specialization was studied based on six main clusters offered in the TVET institution studied namely (a) Mechanical and Production (MP), (b) Electrical and Electronics (EE), (c) Civil and Building (CB), (d) Printing (P), (e) Information and Communications Technology (ICT), and (f) Non-metal Construction (NMC). Professional knowledge was measured using 29 questions on a Likert scale using the TPACK model ($\alpha = .93$) covering all seven components of knowledge as proposed by Koehler, Shin, and Mishra (2012). The overall professional knowledge was measured by taking the mean of all seven dimensions as suggested by Lux (2010). Personal and organizational factors were evaluated through 59 questions based on three constructs each ($\alpha = .86$). Content validity and pilot study were carried out to ensure the data obtained are precise and reliable.

In-depth study was conducted using a semi-structured questionnaire on three respondents with teaching experience of more than 20 years from the same specialization area. The interview sessions were recorded, transcribed, and cross checked. The findings of analysis were peer reviewed to confirm the themes identified.

RESULTS AND DISCUSSION

Descriptive analysis found that the level of professional knowledge among TVET instructors was at a moderate level ($M = 3.16$, $SD = 0.38$). Even though the difference was not significant ($t(298) = 1.60$, $p = .11$), an analysis done on all seven TPACK domains indicated that male instructors gained higher knowledge compared to female instructors. Field of specialization was not a contributing factor to the variation in professional knowledge level ($F(5,300) = 0.73$, $p = .60$) among TVET instructors in Malaysia.

This information could be used to plan better professional development programs for the TVET instructors. The finding on TPACK level indicated that even though the pedagogical aspect was not emphasized in preparing novice instructors as claimed by Ehlers (2010), the level of professional knowledge among TVET instructors is still acceptable. Consequently, in-depth study needs to be done to investigate why the skill gap among TVET graduates still exists even when the instructor level of knowledge is at an acceptable level. As mentioned by Fitz-Gibbon and Kochan (2000) as well as Scheerens (2000) an effective training program depends on multiple aspects at input, process and output levels.

The knowledge gap existing between genders as report by Shaharom Noordin and Faridah Sapiee (2010) and Coleman, Atkinson, and Thrasher (2011) did not exist in this cohort studied.

From the interview responses, it was gathered that pedagogical aspect was considered less important in TVET teaching and learning by the instructors since the curriculum involves a lot of machine operations and hands- on activities. Technological knowledge both on standard and specific technologies was said to be more important than pedagogical knowledge. Analysis on the sources of knowledge revealed that professional knowledge development is best done through practical activities either via On-Job Training or Off-Job Training. As suggested by Guthrie et al. (2009), respondents to this study also agreed that a good relationship with the related industries enables TVET instructor to expand their knowledge specifically on innovation capability, organizational culture and actual work operations.

Table 1: One Way ANOVA Analysis

a) Descriptive

Specialization	N	Mean	Standard Deviation	Standard Error	95% Confidence	
					Lower	Upper
MP	122	3.21	0.42	0.035	3.13	3.27
EE	123	3.13	0.38	0.035	3.06	3.19
CB	6	3.03	0.22	0.16	2.72	3.34
P	5	3.08	0.33	0.17	2.74	3.42
NMC	8	3.12	0.30	0.14	2.85	3.39
ICT	36	3.15	0.35	0.064	3.02	3.27
Total	300	3.16	0.385			

b) ANOVA

	Sum of Squares Type III	Df	Mean Square	*F*	Sig.
Specialization	0.545	5	0.11	0.73	.60
Error	43.74	294	0.15		
TOTAL	44.29	299			

Another possible explanation for the result obtained could be the limitation of the data collection method. The fact that 66% (n = 201) of the respondents were aged between 18-35 years might have contributed to the moderate level of TPACK since this later generation is known to be more technology savvy (Becker, Fleming, & Keijsers, 2012). Yang and Chen (2010) also reported that digital technology is capable of reducing the gender knowledge gap.

Areas of specialization used in this study were too narrow and only focused on manufacturing clusters offered in the TVET institutions studied. In addition, the majority of the instructors (N = 242; 80.6%) in this study came from Mechanical and Production (MP) as well as Electrical and Electronics (EE) clusters. Therefore, the result might be influenced by the dominance of EE instructors' TPACK level. As mentioned by Carnabuci and Bruggeman (2009), knowledge specialization in this study only considered specialization as a property and no consideration was made on specialization as a process.

CONCLUSION

The professional knowledge of TVET instructors was found to be at satisfactory level and therefore eliminated the presumption that low quality of the Malaysian TVET system was caused by low instructor knowledge. The research findings suggested that other factors might influence the professional knowledge of TVET instructors in Malaysia and the variation in specialization field does not influence instructors' capability which was claimed to contribute to low performance of TVET graduates. Further investigation should be carried out to identify what other major factors influence the TPACK level among TVET instructors in Malaysia.

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