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Malaysian Primary School Teachers' Self-Assessment of TPACK and their Blended Learning Practice

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With the advent of salient technologies, the education field cannot remain idle as technological development, and the value of knowledge need to go hand in hand. Therefore, teachers, being at the forefront of the education field, need to equip themselves with the necessary knowledge to ensure a successful teaching and learning process. Despite numerous studies examining teachers' level of Technological, Pedagogical, and Content Knowledge (TPACK), there is limited research that investigates how teachers translate their TPACK in a blended learning classroom. Hence, this study investigates teachers' self-assessment of their TPACK towards blended learning implementation in the primary English as Second Language (ESL) classroom and how their TPACK is congruent with their blended learning practice. The sample consisted of 144 Malaysian primary school teachers in the state of Negeri Sembilan. The instruments used were questionnaires and classroom observations. The findings indicated that teachers overall assessed themselves to have a high level of TPACK towards blended learning implementation. Concurrently, teachers' high TPACK were congruent with their blended learning practice, suggesting that all participants exhibited various facets of TPACK in their blended learning classrooms. As a consequence, the findings highlight the importance of having adequate TPACK to achieve optimal use of blended learning in line with the current 21st-century learning.

Keywords: teachers' knowledge, TPACK, blended learning, primary ESL classroom, 21st century learning

INTRODUCTION

The advancement of technology in the 21st-century has brought many changes in various sectors worldwide. The education sector is no exception as the advent of technology offers vital reasons for educational institutions to make changes in line with emerging trends (Tanis, 2020). The term 'blended learning' is not something new in the educational landscape as various scholars have supported and considered blended

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learning as the 'new norm' in educational technology and course delivery (Adams et al.,2020, Dziuban et al., 2018; Evans et al., 2020). Blended learning refers to the combination of both traditional face-to-face instruction and computer-mediated instruction (Graham, 2006). Accordingly, Azhar and Hashim (2022) mentioned that teachers need to possess adequate technological knowledge in order to effectively integrate digital tools with traditional teaching methods. Therefore, the Technological, Pedagogical, and Content Knowledge (TPACK) framework was introduced by Mishra and Koehler (2006) to help teachers to create effective teaching with technology.

According to Schwirzke et al. (2018), blended learning in the primary school setting is still emerging, therefore contributing to the scarcity of research on blended learning. Moreover, despite many research examining teachers' level of TPACK, there is limited research that investigates how teachers translate their TPACK in a blended learning classroom. Hence, investigating teachers' self-assessment of TPACK will provide a basic understanding of the teachers' level of understanding towards the use of blended learning and their actual practice of implementing blended learning in their classroom.

Furthermore, a study by Noor et al. (2020) on teachers' usage of technology during the pandemic found that many teachers try to use multimedia, but are incompetent in using it, therefore posing a problem to the whole teaching and learning process. As such, the effect of the COVID-19 pandemic had made vast changes where teachers had to adapt to ways of teaching and new modes of delivery in which most of them had no prior experience (Schlichter, 2020). At the same time, it also posed a great challenge for teachers who are not well-versed in using technology as it required teachers to swiftly equip themselves with digital competence to cope with the new mode of delivery. Hence, it can be inferred that successful implementation of blended learning is highly dependent on the knowledge of teachers to adapt to the integration of online pedagogy and to take on new roles in the process of teaching and learning (Paliwal & Singh, 2021). Therefore, this study will investigate the teachers' self-assessment of their TPACK towards blended learning implementation in an English as Second Language (ESL) classroom and how their TPACK is congruent with their blended learning practice. The present research addresses the following research objectives:

i) What is the self-assessment of primary school teachers regarding the levels of TPACK in relation to blended learning implementation?
ii) To what extent is teachers' TPACK congruent with their blended learning practices?

Literature Review

Teachers' Knowledge

The advancement of technology brings forth new demands for teachers to enhance their digital skills. Hence, when discussing teachers' knowledge, Shulman's (1986) emerged as the main reference for researchers. He believed that teachers have a set of knowledge called pedagogical content knowledge (PCK). He also claimed that the emphasis on teachers' subject knowledge and pedagogy were being treated as mutually exclusive domains in research concerned with these domains. However, the emergence of digital

technology has radically changed the nature of learning and teaching, hence justifying the need for other forms of knowledge to cater to the change.

Therefore, an expansion of Shulman's (1986) model in the form of TPACK was proposed by Mishra and Koehler (2006). As such, the theoretical underpinning of this model is that teachers should equip themselves with different types of knowledge in order to achieve a successful and effective classroom practice. On a similar note, it also aims to scrutinize the complex, multifaceted and situated nature of teacher knowledge required by teachers for optimal technology integration. The basis of the TPACK framework revolves around three core components which are pedagogical knowledge (PK), content knowledge (CK), and technological knowledge (TK). The three components intersect to form four hybrid components of knowledge namely, PCK, technological pedagogical knowledge (TPK), technological content knowledge (TCK), and TPACK. This model can be represented in Figure 1 below:

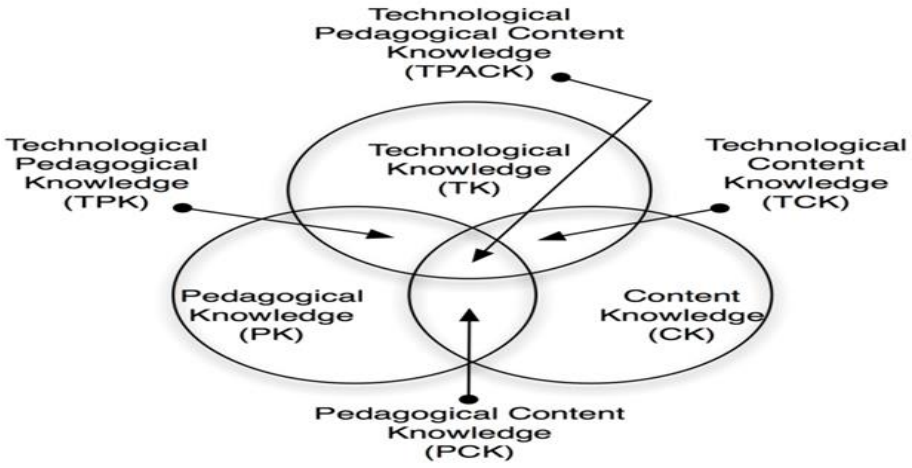

Figure 1
TPACK model by Mishra and Koehler (2006)

As mentioned by Kimmons and Hall (2018), researchers utilized TPACK to evaluate technology integration among pre-service and in-service teachers. Thus, a number of studies explored TPACK among teachers of various subject matters such as the teacher, student, curricular content, general pedagogy, technology, and also learning contexts. For example, Santos and Castro (2021) who examined Bulacan pre-service teachers' TPACK revealed that teachers mastered of the elements of TPACK. Besides, the authors also noted that pre-service teachers' TPACK applications were mainly influenced by TPK and TCK. Similarly, Kurt et al. (2014) explored TPACK of 22 pre-service English teachers. They concluded that pre-service teachers considered the relationship between content, pedagogy, and technology while planning and implementing their lessons. On the other hand, Fontanilla (2015) compared beginner and experienced teachers' readiness to integrate technology into teaching and has found that there is a significant negative correlation between TK and years of teaching experience.

Blended Learning

The emergence of blended learning as one of the approaches in the education context has improved the traditional deliverance of knowledge. The term blended learning has been used and interpreted in a variety of ways within the field of language teaching. Hrastinki (2019) posited that the most widely common definition of blended learning is the combination of both face-to-face (physical environment) and computer-mediated instructions (virtual environment). Generally, the basic principle of blended learning is the integration of both face-to-face learning and computer-mediated instruction to produce an optimal pedagogy to fulfil the educational purpose, resulting in an integrated learning experience for students. As educators search for ways to complement the advent of technology in education, some supported that blended learning might be the shift needed to be in line with the principles of 21st-century learning. Therefore, it is not about solely using technologies, but it is about how the technologies are applied to get the best advantages they can offer. This is further reiterated by Tucker (2019) who emphasizes that blended learning is a term that covers many types of models, but the goal is to combine active, engaged learning online with active, engaged learning in the classroom to give students more control over the path, pace, place and time of their learning.

Over the years, the use of blended learning has certainly shown various benefits in for both teachers and pupils, especially in terms of pupils' language skills. This is in confirmation with Hong and Stapa (2023) who also found that blended learning has a positive outcome in improving various language skills, engaging pupils, and promoting skills such as communication, information literacy, creativity, and collaboration. Besides, McHone (2020) maintained that blended learning also improves pupils' learning achievements and promotes a sense of community among pupils. For instance, recent research by Boudadi et al. (2024) found that learners in a gamified learning environment using the Moodle platform performed better than those who learned in a traditional way, and they also exhibited higher intrinsic and extrinsic motivation. Similarly, Gouseti et al. (2020) found that employing digital technologies in everyday learning has been found to spark playful learning, increase motivation and engagement, and enhance pupil interest, which therefore offers many exciting opportunities for improved communication and collaboration practices among the teacher and pupils. Although it cannot be proven that blended learning can function optimally in the primary school setting, there is a consensus by both critics and advocates of blended learning that the effectiveness of blended learning will always depend on the knowledge and readiness of the teacher (Schwirzke et al., 2018). Hence, as we are geared towards a new method of teaching and learning in the foreseeable future, primary school teachers are required to adapt and adopt this new way of learning. This decision is in line with the seventh shift in the Malaysian Education Development Plan 2013–2025, which is to use technology to improve the education system (Kementerian Pendidikan Malaysia, 2018).

METHOD

This research adopted the mixed-method research design to examine Malaysian primary school teachers' self-assessment of their TPACK towards blended learning and how

their TPACK was congruent with their blended learning practices. According to Creswell and Plano Clark (2018), applying a mixed-method approach combines the unique strength of multiple methods to gain a more comprehensive understanding of a phenomenon. Therefore, the explanatory sequential strategy was used. In the first phase, quantitative data in a form of questionnaires were used. Therefore, based on Krejcie and Morgan's Table of Sample Size (1970), 144 primary ESL teachers in the state of Negeri Sembilan, Malaysia were chosen using random sampling. The questionnaire contained 17 items, and the items were adapted from Schmidt et al. (2009) and Mahdum (2015). The psychometric properties of the scales were tested, and the results displayed good internal consistency and construct reliability. The results showed that the Cronbach Alpha value is 0.845. Based on Taber (2018), the Cronbach Alpha value of 0.70 or greater is widely considered desirable.

In the second phase, five teachers (Refer Table 1) were chosen purposively based on their years of teaching experience to undergo classroom observations. The reason for choosing teachers with various years of teaching experiences was to see how different teachers of different age profiles translated their TPACK into practice. Furthermore, these observations served to see whether teachers' TPACK is congruent with their blended learning practice. Concurrently, it also allowed the triangulation of data sources, thus removing the biasness of a single method. The researcher observed two 60-minute lessons for each teacher. Permission was obtained from the school's headmaster prior to the observation, and the teachers were only informed on that very day regarding the observation. This point was imperative to ensure that the teachers did not alter their usual classroom practices to suit the context of the research. The survey data gathered were analyzed using Statistical Package for Social Science (SPSS) version 25.0 to obtain descriptive statistics. Moreover, teachers' observation was video recorded, transcribed, and analysed using content analysis with reference to Christou (2023) where the steps included familiarization with the data, coding, searching for themes, reviewing themes, defining and naming themes, and writing up.

Table 1
Observation participants

Participants	Age	Years of Teaching Experience(s)
Teacher 1	25	1 year
Teacher 3	26	2 years
Teacher 7	33	9 years
Teacher 8	38	14 years
Teacher 14	56	32 years

FINDINGS AND DISCUSSION

Quantitative Findings

In this section, the researcher presents the mean scores of knowledge items responded to by the research participants in this study. Respondents of this study assessed their TPACK towards blended learning by responding to the 17 items. They rated each item based on the Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Accordingly, the mean scores were presented in Table 2 below.

Table 2
Mean scores of teachers' knowledge

Item	Mean	Level
1. I can select effective teaching approaches to guide pupils thinking and learning in English	4.42	High
2. I make my own lesson plan	4.33	High
3. I can make difficult topics easier for pupils to understand.	4.24	High
4. I make questions on my own to measure my students' understanding of the lesson.	4.32	High
5. I know about the technology that I can use for teaching English in a blended learning classroom.	4.42	High
6. I know computer applications related to English.	4.42	High
7. I use technologies to develop learning activities and pupils' tasks in a blended learning classroom.	4.41	High
8. I use technologies as my source to develop my own knowledge.	4.47	High
9. I can choose technologies that enhance the teaching approaches for a blended learning lesson.	4.44	High
10. I can choose technologies that enhance pupils' learning for a blended learning lesson.	4.42	High
11. My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom.	4.21	High
12. I am thinking critically about how to use technology in my classroom.	4.32	High
13. I can adapt the use of the technologies that I am learning about to different blended learning activities.	4.38	High
14. I can teach lessons that appropriately combine English, technologies and teaching approaches.	4.28	High
15. I can select technologies to use in my blended learning classroom that enhance what I teach, how I teach and what students learn.	4.29	High
16. I can choose technologies that enhance the content for a blended learning lesson.	4.38	High
17. I can use strategies that combine content, technologies, and teaching approaches that I know for a blended learning classroom	4.35	High
Average	4.36	High

Based on Table 2 above, the mean scores of each item ranged from 4.21 to 4.47 with an average mean score of 4.36. Therefore, it is evident that all 17 items were at a high level, thus indicating that the overall research participants elicited that they have a high level of TPACK towards blended learning implementation. Therefore, the evidence suggests that teachers are not only aware of the different components of TPACK but are also proficient in applying this knowledge to create a blended learning environment. This is in accordance with Chieng and Tan (2021), Juanda et al. (2021), Juwait et al. (2022), Pangket (2022), and Azhar and Hashim (2022) who obtained similar results regarding teachers' TPACK levels. By understanding how to harmonize content, pedagogical strategies, and technological tools, teachers are able to create lessons that engage students and facilitate deeper learning experiences. As such, each component of TPACK was discussed accordingly.

Firstly, PCK has always been regarded as one of the most important teacher factors in the educational context (Wang et al., 2020). Item 1 to Item 4 which obtained high mean scores shows that teachers have high PCK. In other words, they have a great understanding of the material, the reasons for choosing the material, and plans to teach the material to students. This rich conceptual understanding, combined with expertise in developing, using, and adapting teaching procedures, strategies, and approaches for use in particular classes can be attributed to teacher education and teacher training. In the current teacher education programs, the Ministry of Education has set the curriculum to include courses on pedagogy, curriculum design, classroom management, and subject-specific content courses with the main objective of developing teachers' PCK. Moreover, teacher trainees under teacher training institutes are also required to complete three-phase of school-based experiences and two-phase of practicums to expose pre-service teachers to real classroom settings. Hence, it is unsurprising for teachers to have high PCK as they are well-trained to teach in schools.

For example, among all the PCK items, Item 1 which is *"I can select effective teaching approaches to guide student thinking and learning in English"* shows the highest mean score of 4.42. This indicates that teachers are very positive that they can develop various strategies and materials which are tailored to their pupils' needs to teach the target content. Shulman (1986) quoted that *"Since there are no single most powerful forms of representation, the teacher must have at hand a veritable armamentarium of alternative forms of representation, some of which derive from research whereas others originate in the wisdom of practice."* Thus, it emphasized that teachers should possess a variety of teaching strategies that incorporate various learning materials to create a fun and meaningful learning environment for the pupils. In a blended learning classroom scenario, it is up to the teacher to 'blend' different teaching strategies to supplement students' needs as there is no set of formula or recipe for a perfect blend. Hence, teachers can use various technological synchronous and asynchronous tools to teach different content, which allows a different learning experience for pupils.

Moreover, Item 3 with a high mean score shows that teachers possess the PCK to make difficult topics easier for their pupils to understand. This aspect is vital as not all teachers are well-versed in adapting to the different abilities of pupils in the classroom. In the Malaysian classroom context, it is also not uncommon to have mixed-ability classes. Ansari (2013) posited that such classes may pose a challenge for language teachers who are not equipped with the required PK to deal with mixed-ability classes. Hence, Al-Subaiei (2017) recommended the differentiation strategy when teaching a classroom with diverse abilities. Differentiated teaching occurs when a teacher designs a lesson that modifies either the topic being covered, the technique used to learn, or the learning outcome expected from students to ensure that students with varying starting points receive the education necessary for their growth and success. Therefore, it is crucial that teachers have adequate PCK to cater to different pupils of different abilities. For instance, teachers can divide their pupils into various groups and incorporate different student-centered methods such as role-play, in-class activities, quizzes, and others to improve their participation.

Additionally, teachers' TCK is another important construct that involves the association of technology with content. In other words, it does not only involve teachers knowing their subject matter but also the knowledge of how to represent the content using digital technology (Juanda et al., 2021). This includes the teachers ' ability to find, adapt or create materials that are based on technology. Therefore, the high mean scores of Items 5 to 8 pointed out that teachers have high TCK, thus showing that teachers are competent in applying various forms of media such as text, graphics, audio, video, and any combination of these to teach a certain topic. With the availability of different educational tools, it has become a norm in the teaching scenario to use various digital tools to present subject matter in the classroom. This is because technology has enabled teachers to save time and costs, and increase efficiency, which has led teachers to opt for technological tools rather than conventional teaching aids (Haleem et al., 2022).

On top of that, Janssen et al. (2019) mentioned that the effective use of ICT in the classroom also necessitates the thoughtful integration of technology and pedagogical processes during lesson preparation. Accordingly, Items 9 to 13 reflected on teachers' TPK or the understanding of how to apply technology to assist general teaching strategies without reference to specific content. The high mean score of each item under this category shows that teachers know about various digital tools and the ways to use these tools effectively to teach English. For example, Item 9 and Item 10 which are *"I can choose technologies that enhance the teaching approaches for a blended learning lesson"* and *"I can choose technologies that enhance students' learning for a blended learning lesson"* obtained high mean scores of 4.44 and 4.42. This implies that teachers are aware of various technologies available for educational needs which enables new learning approaches to emerge in the learning process. No doubt, there are many emerging tools that are not specifically developed for educational purposes, hence requiring teachers' flexibility and creativity to repurpose these technologies to have pedagogical applications. Thus, it called for teachers to have adequate TPK to allow them to select suitable technological tools and maximize the potential of these tools in their blended learning classroom.

As a consequence of technological advancement, the usage of the virtual classroom through blended learning has extended the way teachers can create a meaningful learning experience for pupils in the classroom. For example, pupils can conduct exercises, play instructional games, engage in high-fidelity simulations, and experience other forms of virtual reality using technology. By engaging in these collaborative experiences, students can construct their own meaning and build their cognitive and social skills. However, Santos and Castro (2021) posited that the rapid pace of technological change certainly poses a challenge for teachers to integrate new tools into their classroom practices. Hence, teachers are demanded to be creative and flexible in designing blended learning activities in order for them to choose the appropriate technology to complement different pedagogical approaches used.

However, despite the high overall TCK and TPK shown by teachers, it should be noted that there are several teachers who disagree and strongly disagree with the items under these constructs. This indicates that they are not competent with the use of various tools to teach English in their blended learning classroom. Upon inspection of their

demographic information, those teachers have more than 22 years of experience and are 50 years old and above. Therefore, a possible explanation for their low response to the TCK construct is due to the age factor. In the opinion and experience of the researcher as a primary school teacher, senior teachers (more than 15 years of teaching experience) tend to be more comfortable and contented with their current teaching approaches despite the emergence of various new educational technologies. They felt that using technology to teach is rather tedious, time-consuming, and difficult. This is understandable as those groups of teachers were not trained in the same way as younger in-service teachers and pre-service teachers as the technology of those days was not as advanced.

This scenario is validated by previous studies by Kazu and Erten (2014) and Mahdum (2015) who outlined the age factor as one of the reasons influencing teachers' competence in using technology. Another study by Luik et al. (2018) found statistically significant negative relationships between age and TK and positive relationships between age and CK, thus indicating that older teachers tend to have lower TK, hence have less interest in the usage of various technologies. Contrarily, a recent study by Schmid et al. (2021) proved otherwise where they did not find any significant difference in terms of technology mastery among teachers of different ages. The mixed findings indicate the ambiguity in these areas, therefore requiring cautious interpretation and more studies due to the differences in settings and other contextual factors. In light of the findings, researchers generally agreed that continuous professional development is required by teachers irrespective of their age or teaching experience so that they can utilize technology optimally to present the subject matter.

Lastly, Items 14 to 17 relate to TPACK which it is the knowledge of using various technologies to teach and represent the content. As stated by Akyuz (2018), TPACK refers to the previously described areas with a focus on how technology can be confronted with the pedagogical need to teach the appropriate content in a blended learning context. Based on the TPACK items, it is clear that teachers agree that they have a high TPACK level. The findings are in confirmation with Pangket's (2022) and Azhar and Hashim's (2022) study who yielded the same results regarding teachers' TPACK levels. The results can be anticipated as the Malaysian Ministry of Education places a strong emphasis on the development of teachers' TPACK in order to prepare teachers for the 21st-century classroom as well as to produce well-rounded and effective teachers through various initiatives.

To link to the above, Rauf and Suwanto (2020) found that one of the most capital-intensive expenditures made by the Malaysian government is on education where about six billion ringgit were invested in educational technology. For example, initiatives such as the Digital Education Learning Initiatives Malaysia, various professional development programs, and training courses were introduced to promote the use of technology in teaching and learning. All these initiatives have been made available to Malaysian teachers to help them improve their TPACK and skills. Hence, in line with 21st-century classrooms, it is clear that Malaysian ESL teachers' TPACK skills are emphasized in order to assure effective blended learning happened in the classroom. (Azhar & Hashim, 2022).

In addition, teachers should understand that having TPACK is very much related to the principles of the communicative language teaching approach where the goal is to achieve communicative competence through technology-mediated instruction (Bugueno, 2013; Destiani & Purnawarman, 2020). To relate to the findings above, Item 17 which is *"I can use strategies that combine content, technologies, and teaching approaches that I know for a blended learning classroom"* garnered a high mean score of 4.35. This pointed to the fact that teachers have the knowledge to integrate technology to teach the subject through various authentic tasks. Thus, the role of the teacher and technological tools should go hand-in-hand to reap the best benefits that technology can provide. Teachers should appreciate the comprehensive role of technology where it can be used to perform a task, find information related to the subject matter, encourage communication, obtain comprehensive input, and assess pupils' performance.

Contrarily, a local study by Jerry and Yunus (2021) disclosed that primary school ESL teachers possessed limited knowledge of blended learning. As a result, it posed a major challenge in implementing the teaching approach in the ESL classroom. No doubt, teachers dealing with pupils whose daily lives are becoming increasingly tech-oriented must enhance their collaborative working environment and their ICT skills (Patel & Thakkar, 2017). In light of their findings, the COVID-19 pandemic certainly contributes a lot in terms of making teachers and pupils understand and use technologies. In fact, Howard et al. (2021) and Scherer et al. (2021) added that the TPACK model has been extensively used to measure teachers' online teaching readiness during the COVID-19 pandemic. Consequently, teachers now are more familiar with the various learning platforms and websites to download materials and videos, conduct simulations, and conduct assessments. Hence, teachers with higher TPACK tend to utilize different learning resources depending on the essence of the concepts conveyed. Despite the positive outcomes as a result of the pandemic, continuous professional development is still necessary since the implementation stage of blended learning requires a great deal of work. As such, consistency in assisting teachers is pivotal to ensure that teachers effectively utilize blended learning tools in their classrooms.

Qualitative Findings

Teachers' PCK and Blended Learning Practice

Firstly, the findings found that teachers' PCK were congruent with their blended learning practice. When observing teachers' blended learning practices, it became evident that the teachers adeptly applied a range of instructional strategies, representations, and assessment methods, all of which were indicative of their PCK. Firstly, teachers' PCK was displayed when they prepared lesson plans that outlined the content and learning standards, lesson objectives, activities, and reflections which is in congruent with Item 2 from the questionnaire regarding lesson planning. These plans served as blueprints, guiding teachers in combining a rich blend of media, technology, and teaching methodologies to effectively convey content to their students.

Additionally, from their lesson plans, the deliberate selection of instructional methods and materials also demonstrated teachers' understanding of the content and concepts

being presented, thus bridging their PCK and their classroom practice. For instance, one example of teachers' display of PCK is regarding the types of teaching aids selected by the teachers to teach the subject matter. During the observations, Teachers 1, 3, and 7 leveraged videos from YouTube while Teachers 8 and 14 opted for PowerPoint presentations to teach their respective topics. When asked about their choice of materials, the teachers cited reasons such as authenticity, ability to augment pupils' engagement, and catering to pupils' learning styles. At the same time, it is in confirmation with Items 1 and 3 from the questionnaire which are "*I can select effective teaching approaches to guide pupils thinking and learning in English*" and "*I can make difficult topics easier for pupils to understand*". Putting technology aside, it was evident that the utilization of various instructional strategies not only accommodated diverse learning styles but also promoted active engagement and comprehension of all pupils, thus underscoring teachers' PCK.

Moreover, teachers' PCK was also apparent based on their use of various assessment practices such as online quizzes, worksheet exercises, and presentations. These choices not only demonstrated their understanding of the subject matter but also their awareness of how different assessment methods could engage students and enhance learning outcomes. Therefore, when examining teachers' practices, it was observable that Teachers 8 and 14 opted for more challenging activities like discussions and presentations whereas Teachers 1, 3, and 7 classes opted for simpler assessment practices like online worksheets and online quizzes. Hence, the display of PCK here was not the type of technology used but rather what the teachers believed worked best for their pupils according to their level. Based on the arguments above, the findings demonstrated a clear congruence between teachers' PCK and their actual classroom practice.

Teachers' TCK and Blended Learning Practice

The findings supported that teachers' TCK mirrored their classroom practice. Based on Juanda et al. (2022), effective teaching required teachers to develop an understanding of how subject matter could be modified using different technologies. Hence, teachers' TCK here was viewed based on how they used technology to supplement their lesson content. From the questionnaire and interviews, it was evident that the teachers all expressed adequate knowledge of various digital tools that could be used to teach different topics, hence underscoring their high TCK.

Hence, congruent to their TCK, it was evident during the observations that the teachers exhibited their TCK by matching discipline-specific tools to the content in their classroom practices. This means that teachers not only utilized textbooks as their teaching resources, but their lessons were supplemented by other technological resources from the internet such as YouTube, Liveworksheets, Powerpoint presentations, and other educational websites to represent the subject matter. For example, Teacher 3 used YouTube to supplement her reading lesson. Instead of just providing the reading text to her pupils and conducting reading-aloud sessions, she allowed them to watch a video on YouTube related to the text. Another example was observed in Teacher 7's classroom, where she used presentation slides and videos to

explain the concept of past tense. Instead of using the chalk-and-talk method, which is widely used to explain grammar rules, she chose to present the rules of past tense in a more informative and interesting way through presentation slides and videos. Indirectly, her pupils were able to learn in an enjoyable manner rather than through memorization and drilling, which proved to be difficult and boring (Hong & Stapa, 2023). This finding is further substantiated by Kok et al. (2024) who found that pupils had higher learning satisfaction when teachers used interactive videos in their teaching.

As such, the examples above highlighted how teachers used technology to represent and enhance the lesson content. Through the judicious integration of multimedia resources, interactive activities, and scaffolded learning experiences, teachers adeptly navigated the intricacies of content delivery, thus underscoring their TCK. Hence, these findings were similar to those of Chieng and Tan (2021), who conducted a study on Malaysian science teachers' TPACK level and how the different knowledge dimensions correlated with the integration of ICT. They used multiple regression to determine which independent variable was the largest predictor of technology integration and found that teachers' TCK emerged as one of the two main significant contributors to the integration of ICT, with the other construct being teachers' TPACK.

Teachers' TPK and Blended Learning Practice

Next, teachers' TPK was found to be congruent with their blended learning practice. When exploring the data from the questionnaire, it showed that teachers considered themselves to be able to use technology to support their pedagogy. In practice, it was observable that their blended learning practice matched their TPK. For example, Teachers 1, 3, and 7 used videos to gauge pupils' attention and to enhance their understanding. At the same time, they created assessment instruments using technology, such as online quizzes and online worksheets. As such, it was evident that the blended learning activities conducted by these teachers involved the use of authentic materials, catered to diverse learning styles, and engaged pupils to participate actively. Therefore, this supported the statement from the questionnaire: "*I can choose technologies that enhance the teaching approaches for a blended learning lesson*" from the questionnaire, demonstrating high congruence as the teachers were seen integrating various tools to enhance their teaching and to meet their pupils' needs, thereby exemplifying their proficiency in TPK. This is in agreement with Chai et al. (2013), who posited that the effective TPK is characterized by bringing in authentic problems through technological representation, which engages students in active sense-making with the aid of technology. In a way, the findings supported this notion through the use of authentic videos that allowed pupils to relate their real-life experiences.

Furthermore, another display of TPK is when teachers created activities where pupils could work collaboratively and mediated by technology during lessons (Jaipal & Figg, 2015). In a technology-enhanced lesson, teachers needed to provide pupils with opportunities to use technology during the lesson to construct knowledge. This pedagogical approach was evident in Teachers 8 and 14 classroom observations, where pupils were given ample opportunities to engage with various technological tools and resources throughout the lesson. Therefore, it was clear that encouraging group

discussions, facilitating web-based activities, and guiding pupils in the creation of multimedia presentations based on the lesson topic were common strategies employed by these teachers. By fostering collaborative exploration and creation processes, Teachers 8 and 14 skilfully blended technological resources with pedagogical strategies, hence demonstrating their adept utilization of TPK.

On top of that, it was posited that teachers might have the knowledge of different emerging digital tools, but they may not know how to integrate them effectively into their classrooms, thereby highlighting the importance of TPK. Accordingly, one interesting finding that can be discussed here is regarding the impact of teacher education on teachers' TPK. The TPK item "*My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I used in my classroom*" from the survey resonated with how the teachers used blended learning in this study. Taking Teacher 14 as a prime example, it can be inferred that her long years of teaching may have provided her with extensive PK, whereas the professional development courses that she attended allowed her to build up her TK. As a result, the combination of both knowledge domains enabled her to integrate technology effectively in her classroom, as seen in her blended learning practice. However, Schmid et al. (2020) mentioned that focusing solely on TK would not directly translate to TPK or TPACK. Instead, the transfer from each knowledge domain to another must be addressed deliberately, which stresses the role of teacher training in providing different learning opportunities to develop and exercise the different components of knowledge, and more importantly, their combinations.

As such, all the findings above provided evidence that teachers' TPK was reflected in their classroom practice. The findings concurred with Aniq and Drajati (2019) who found that the TPK level of majority of their participants was sufficient for teachers to prepare and utilize technological tools in their teaching and learning. Nonetheless, Ogalo et al. (2020) mentioned that the current emerging technologies are not developed for educational purposes, which therefore requires teachers to have TPK that allows them to repurpose these technologies for specific pedagogical applications. In their study on teacher cognition regarding Kenyan secondary school English teachers' TPK using a mixed-method approach, they found that teachers lacked TPK, which resulted in ineffective integration of technology in their respective classrooms. At the same time, they found a positive correlation between teachers' TPK and the use of technology to teach English. Their findings suggested that when teachers had high TPK, they could integrate technology effectively, and vice versa.

Teachers' TPACK and Blended Learning Practice

As TPACK is the intersection of synthesized knowledge (PCK, TCK, and TPK), the findings naturally concluded that teachers' TPACK was also congruent with their blended learning practices, based on the congruence observed in all previous knowledge domains. Specifically, the teachers in this study reported having high TPACK and simultaneously exhibited TPACK in their classrooms. Looking back, all TPACK items from the questionnaire recorded high mean scores, indicating that teachers had high levels of TPACK.

Upon investigating teachers' blended learning practice, all the teachers displayed a blend of technology, content, and pedagogy in their teaching. For instance, during the classroom observations, Teacher 1 used videos to help pupils understand the reading text and later assessed their understanding via online worksheets and group discussions. This simple yet comprehensive execution depicted how she combined the three knowledge domains to reflect her TPACK. By choosing to use videos, Teacher 1 demonstrated an awareness of how to select and integrate appropriate technological resources in line with the subject matter. Furthermore, the utilization of online worksheets to assess understanding reflected her PK regarding formative assessment techniques and provided an understanding of how to design activities that effectively gauge pupils' learning and provide feedback for improvement. Moreover, the use of online worksheets implied an alignment between the instructional content and the assessment method, indicating that Teacher 1 understood how to scaffold learning experiences to support pupils' acquisition of CK through technology. Overall, it was evident that Teacher 1's practice exemplified the integration of TPACK, which aligned with the TPACK item "*I can use strategies that combine content, technologies, and teaching approaches that I know for a blended learning classroom*" from the questionnaire.

Similar to Teacher 1, the observations of the other teachers in this study (Teachers 3, 7, 8, and 14) also demonstrated similar exhibitions of TPACK. By strategically employing various technologies that supported content and facilitated pedagogical strategies aimed at promoting learning outcomes, the teachers created a blended learning environment that optimized pupils' engagement and comprehension of lesson content. Thus, the observations of Teachers 1, 3, 7, 8, and 14 certainly underscored the effective application of the TPACK framework in blended learning environments which therefore, concluded that teachers' TPACK was congruent with their blended learning practices. This indicated that teachers possessed high TPACK and exhibited their it in their blended learning practices, which aligns with the findings of Habibi et al. (2020); Neumann et al. (2021); Chieng and Tan (2021), all of whom confirmed the positive relationship between teachers' TPACK and blended learning practice. Similarly, the findings also concurred with Ocak (2015), who conducted a multiple case study to examine observable indicators of science teachers' TPACK. His research aimed to delve deeply into the design and execution of technology-enhanced instruction. The findings provided insights regarding discernible indicators of TPACK throughout the processes of designing and implementing technology-enhanced science instruction. Additionally, the study also shed light on teachers' motivations regarding the integration of technology into their teaching practices.

Closely related to the findings above, a recent study by Öztürk et al. (2023) examined the relationship between pre-service teachers' TPACK and their blended learning readiness levels. The study involved the participation of 477 pre-service teachers. Data were collected using the Blended Teaching Readiness Instrument and the TPACK-deep Scale. The finding revealed a significant and positive high-level correlation between pre-service teachers' TPACK levels and their blended learning readiness. As such, their findings provided important insights into how TPACK can influence teachers' blended learning readiness, which, in turn, affects teachers' actual blended learning practice.

Furthermore, Kurniasih et al. (2022) measured the readiness of elementary school teachers to implement blended learning. Their findings indicated that teachers who possessed strong TPACK skills were more capable in implementing the blended learning approach effectively.

CONCLUSIONS

To sum it up, this research certainly has managed to provide some inputs on teachers' self-assessment of TPACK towards blended learning implementation and their blended learning practices. Based on the questionnaire, it has shown that teachers generally assessed themselves to have high TPACK towards blended learning implementation. This is further supported by the observations of teachers' classroom practice where teachers' TPACK are reflected when they conduct blended learning. Therefore, it highlights the importance of having adequate TPACK for successful blended learning integration. Moreover, it calls for teachers to reflect their current level of knowledge as they should be aware of the significant impact technology is having today as part of the 21st century teaching and learning. At the same time, it suggests practical recommendations for the Malaysian Ministry of Education and curriculum makers to formulate a curriculum that can fit the concept of a blended learning in the Malaysian primary school contexts. In light of the findings, future researchers can conduct a large-scale study comparing teachers' TPACK towards blended learning in other settings such as the secondary schools or urban setting, which in turn, will reveal how teachers in different contexts and settings conduct blended learning differently.

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