

Technology use in physical education: the teachers' challenges

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ABSTRACT

Physical education (PE) is tactile, practical, and participative, making it more challenging to integrate technology than other academic subjects. This study intends to analyse the challenges faced by physical teachers while using digital technology in PE. This research included physical education teachers (PETs) from nine secondary schools in Selangor, Malaysia. Qualitative research design was applied in this study and the data was collected via semi-structured interviews and analysed using thematic analysis. The technological pedagogical content knowledge (TPACK) framework is used to analyse PETs technology education practises and issues. Results revealed that there were seven themes emerged for the obstacles: i) lack of infrastructure; ii) lack of financial support; iii) lack of training; iv) time and space management; v) perception and attitude towards PE; vi) student-related constrains; and vii) lack of educational resources. These findings can be useful to support education in the 21st century whereby the teachers should get extensive technology training to improve their digital skills, as well as regular and ongoing technology integration training.

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1. INTRODUCTION

The term physical education (PE) refers to a topic that is taught in both elementary and secondary schools, aimed at enhancing students' level of physical fitness and encouraging the balanced development of their bodies and minds [1]. By engaging in structured physical activities, students not only improve their fitness levels but also develop a deeper understanding of the intricate connection between physical health and mental acuity [2]. In addition, through participation in PE, students gain insights into the profound impact of regular exercise on cognitive function, emotional regulation, and overall life satisfaction. This awareness fosters a lifelong appreciation for maintaining an active lifestyle, equipping students with essential tools to navigate the challenges of both their academic pursuits and future aspirations.

In particular, the PE component materials can be categorized according to three learning domains: psychomotor, cognitive, and affective [3]. Each domain contributes to a comprehensive learning experience. Haleem *et al.* [4] stated that the psychomotor skills domain relates to the motor skills required to conduct a variety of physical actions, such as passing and receiving the ball properly. On the other hand, the cognitive domain associated with knowledge [5] related to the thinking process of concepts, principles, and movement strategies. This includes the students' ability to explain the use of force when passing the ball at various distances and speeds, as well as the factors that influence the skill of accurately catching the ball. In addition,

the affective domain focuses on enhancing PE practice by incorporating safety elements, sociological, and psychological concepts, principles, and strategies for effective physical activity [5]. For instance, it emphasizes identifying safety equipment that minimizes injury risks and distinguishing between safe and risky activities during individual and group exercises.

In line with education transformation towards the 21st century, PE must adapt to the changing needs and interests of students. Educational technologies have been demonstrated to positively influence the teaching and learning processes in PE [6]. Moreover, Haleem *et al.* [4] stated that digital technologies are powerful instruments that can improve education in various ways and help the teachers to generate instructional materials and providing new methods in teaching and learning. While technology plays an important role in the education system, teachers who teach PE will have to be creative and adapt to a special way of teaching and approach to deliver the PE contents and activities [7] which includes verbal explanation, physical demonstration, and correction of students' movements, along with verbal communication and physical guidance [1]. In addition, the presence of digitally competent physical education teachers (PETs) is crucial for successful integration of technology in PE lesson [8]. However, Wallace *et al.* [8] found that the PETs find it challenging to effectively integrate digital technologies due to a lack of self-confidence in their digital competence and insufficient resources.

Therefore, it is important to deliver the lesson to suit the classroom environment during the PE lesson with technology [9], [10]. To achieve this, one widely recognized educational technology framework, the technological pedagogical content knowledge (TPACK) can be effectively utilized to integrate technology into lesson delivery. TPACK framework was introduced by Koehler and Mishra in 2009 and use to help the teachers as well as PETs to apply technology to the fullest in their teaching and learning sessions [11]. The framework consists of three components; content, pedagogy and technology. Content knowledge explains the subject to be taught, while pedagogy is the suited teaching approach that can be applicable to the content, and audience. On the other hand, technology component refers to technological use whereby in this context is PE lesson that can be tools, software or even applications. Applying technologies matched with pedagogy and teaching content can provide an innovative and practical solution to delivery PE lessons and assessment. Additionally, a technological approach can enhance teacher-student interaction, engagement, evaluation, and feedback [12].

Researchers have utilized the TPACK framework to explore better ways of integrating technology into teaching and learning. Saputra and Chaeruman [13] revealed various types of research types, research designs, subjects, data collection instruments and data analysis techniques of TPACK especially in the secondary schools. Additionally, Wulansari *et al.* [14] indicated that more technological skills and knowledge are required to meet modern educational challenges in the industrial era 4.0. In a related study, research on improving learning technology in the engineering education department by using teacher knowledge construction using the TPACK framework gave significant results [15]. Similarly, Irdalisa *et al.* [16] also researched the implementation of technology-based guided inquiry to increase TPACK in prospective biology teachers. Furthermore, Habibi *et al.* [17] studied about TPACK implementation on integrating technology among language teachers during teaching practice also support the benefits of it in education.

However, many of the research up to now has been descriptive in nature. Sargent and Calderon [9] have recently revealed that PETs were hesitant to incorporate technology into their lessons due to concerns about its potential to disrupt conventional teaching methods with which they were familiar. Another point that brings to the challenges is transforming teaching and learning, whereby the technology was mostly deployed as a teacher's replacement [9]. Additionally, students frequently opposed the use of technology in PE out of worry that they would become highly dependent on screens and not participate in enough exercise [18]. Apart from that, Almusawi *et al.* [12] in their research also stated that PETs rarely use technology in their instruction because it is widely assumed that PE is a practical subject. As a result, their views, and attitudes towards technology in general are constrained by technological and organizational.

Despite limited qualitative research on PETs in integrating digital technology into PE lessons remains a challenge in a subject that traditionally considered practical and hands-on, Viberg *et al.* [19] indicated that PETs behaviours contribute to the effective use of technology in teaching. In addition, PETs' technology adoption is the most likely component to make technology integration in education successful. Teachers must have a greater awareness of the potential given by the different technologies, and they must get ongoing support to empower them to critically evaluate and adapt their teaching methods. Therefore, the novelty of this research is based on its unique focus and approach compared to existing studies on TPACK. While previous research has explored TPACK in various educational contexts, this study specifically targets a population that has not been extensively studied particularly in the field of PE. Moreover, this research addresses this significant gap by documenting the PE specific technology integration challenges which include considerations related to time and physical space as well as students related constraints. By illuminating these unique challenges, this study provides valuable insights that can inform more effective technology integration strategies specifically tailored to the distinctive nature and objectives of PE. Thus, the goal of this study was to investigate the challenges teachers have when incorporating technology in PE lesson which involve all education domains; cognitive, psychomotor, and affective.

2. METHOD

2.1. Design

A case study technique with a qualitative approach was selected as the research strategy. This technique is appropriate for addressing the research questions because it allows for a complete knowledge of the current state of technology integration in teaching and learning, as well as the challenges that teachers experience. Furthermore, qualitative approaches are able to explore the complexities of social interactions and offering deep and detailed insights into the research being studied [20].

2.2. Participants

They were nine participants who were selected from nine secondary schools in a district of Selangor, Malaysia. The location of this study was chosen in accordance with [21] recommendations, which state that a study's location should be open to the public, free of obstacles to conducting research, highly likely to yield detailed data, allow for the freedom to conduct research and be a place where it is simple for study subjects to take part in research. In addition, constraints on time, geography, and budget are all considered when choosing the schools for this study.

Participants in this study were chosen based on the researcher's criteria and qualities, including the teachers' who have been experiencing teaching PE lessons at secondary schools and the willingness to participate in the study. In choosing study participants, the researcher refers to Limna [22] who stated that purposeful sampling should be based on the need to address research questions, the participants' willingness to cooperate and be interviewed, and their capacity to provide the necessary information.

2.3. Instrument

The questionnaires for the interview session have been evaluated by experts with expertise in technology education and PE. Nonetheless, the researchers themselves serve as the primary tool in this investigation [23]. Additionally, according to Hennink *et al.* [24], tools for qualitative measurement need to be adaptable enough to enable data collection on intricate topics like the social context of group interactions, individual interactions and learning processes, and multiple points of view.

2.4. Data collection

This study was carried out with the approval from the Education Policy Planning and Research Division in purpose to it complies with ethical norms followed by the approval from the Ministry of Education (MOE) of Malaysia the Selangor Education's approval Division (JPN Selangor). After that, all letters of recommendation from JPN Selangor and gathered from the MOE were submitted to the principal of each institution selected to lead the study to be granted permission to carry out the learn at that institution. Every study subject has been invited to sign a statement indicating their agreement to take part in this investigation. This is due to debatable ethical issues considered when performing a study to ensure that the study subjects to and are ready to open their heart when taking part in the study [25].

Researchers conducted interviews in the form of focus groups to get the information needed for this research. The focus groups analysed in this study were designed to compare different perspectives on the use of technologies, as well as other challenges faced by the participants. Face-to-face semi-structured interviews were employed in this study to help the researcher stay on track with the study's goals and research questions [26]. The thematic analysis in this study was carried out whereby the data from the verbatim interviews were analysed using the NVIVO software. According to Coleman [27], validity and reliability refer to how well and consistently a study's results reflect the topic under investigation. To increase the study's validity and reliability, the researcher employed expert verification techniques.

3. RESULTS AND DISCUSSION

The qualitative data in this study was utilized to examine the challenges of incorporating technology into PE lessons. The findings indicated that technology could be done in PE in secondary schools. All views and opinions from PETs will be explored and discussed. There were five males and four females' teachers involved and each of them received a bachelor's degree in PE as in Table 1. In addition, they were one participant has been teaching for 6-10 years, one participant has been teaching for 11-15 years services and seven participants have been teaching above 16 years services. All the participants were from different schools that had taught PE for over five years in their school. Therefore, it was determined that the participants had the authority, expertise, and skills required for PE.

All participants gave explanation on the integration of technology which allow a wide range of perception and challenges of using it in PE lesson. Transcripts of all interview from the focus group were generated and thoroughly read to ensure accuracy. The finding revealed seven themes associated with

challenges using technology in PE lessons were constructed; i) lack of infrastructure; ii) lack of financial support; iii) lack of training; iv) time and space management; v) perception and attitude towards PE; vi) student-related constraints; and vii) lack of educational resources. Participants' quotes are used to illustrate those themes and to ensure that the findings reflect the voices of the participants. To contextualize each quote, the number of the participant and the number of focus group session is provided.

Table 1. Interview participants' demographics (n = 9)

Participant no.	1	2	3	4	5	6	7	8	9
Age group	41-50 years	41-50 years	41-50 years	41-50 years	41-50 years	51 above	31-40 years	31-40 years	41-50 years
Years of PE teaching experience	20	16	17	16	17	22	14	7	19
Academic qualification	Bachelor's degree in PE								

3.1. Lack of infrastructure

The interviews represented that lack of infrastructure including inadequate technological facilities, unreliable internet connectivity, and inconsistent electricity supply, emerged as critical barriers. Furthermore, unsuitable classrooms and insufficient equipment were also identified as obstacles to effective technology integration. In particular, participants stated that liquid crystal display (LCD) projectors are limited in school and every committee field is provided with limited LCD projectors to bring in class. Among the participants statements were:

"The LCD needs to be borrowed and competed for with other teachers because the quantity is limited." (P5/S1)

"Shortage of LCDs; LCDs are supplied based on specific fields in the school." (P6/S2)

"The LCD is located in the computer laboratory, and since there aren't many of them, anyone who wants to use one can borrow it there. The issue arises when the LCD projector is not returned after being borrowed and the other teachers have to hold off. In conclusion, there are not enough LCDs for usage in schools." (P9/S2)

In addition, participants explained that internet networking is not covered for the whole school. Besides, there was an internet network in some schools that only can cover a certain area instead of the whole school. Consequently, some teachers must utilize their mobile data to connect to the internet. This circumstance was articulately described by the participants:

"Teachers have to use their internet data to connect with the internet in class." (P8/S2)

"For instance, the internet connection issue occurs during Movement Control Order whereby only a few students can join Google Meet. However, this is limited to a small area." (P5/S1)

These limitations significantly also affect the delivery of indoor activities and the use of digital tools in teaching, particularly during unfavorable weather conditions. Unsuitable classrooms and insufficient equipment worsen the challenges, making it difficult for teachers to create an engaging and effective learning environment.

"There was no suitable place for indoor activities during rainy weather." (P1/S1)

"There were insufficient spaces to display content as projection screens were damaged." (P6/S2)

"The overall environment was described as unconducive for school activities, further complicating the execution of PE lessons" (P8/S2)

The absence of reliable technological facilities, coupled with inconsistent internet connectivity and frequent disruptions in electricity supply, creates substantial barriers to effective implementation. These issues are further compounded by the unsuitability of classroom environments and the scarcity of essential equipment needed to support digital tools and platforms. Such limitations hold up the seamless integration of technology in PE, restricting teachers' ability to deliver dynamic, technology-enhanced lessons. Addressing these infrastructural gaps is crucial to enable a conducive environment for integrating digital tools, ultimately fostering more engaging and effective teaching practices in PE settings [28]. In contrast, the finding from Frelin *et al.* [29], the technology facilities have never been a threat to teachers' conventional teaching and

learning. Nevertheless, the researchers also stated that suitable application needed to be utilized due to the needs of the students as well as the content materials.

3.2. Lack of financial support

Based on the results of the interviews, lack of financial support also one of the challenges faced by PETs in terms of the technology tools provided. Technology facilities and tools provided in each school are not similar depending on the school budget or financial support. These constraints limit the availability of necessary technological tools and infrastructure, creating disparities between schools with differing budget allocations.

“Schools with restricted budgets face significant difficulties in acquiring the necessary equipment to support digital integration effectively.” (P1/S1)

“The availability of technological facilities depends heavily on the allocated budget, with low-budget schools unable to provide adequate tools.” (P3/S1).

“There is insufficient funding for technological equipment, with only elite schools being able to afford such resources.” (P4/S1)

“Limited financial resources for purchasing technology were also highlighted.” (P7/S2)

Financial limitations restrict schools' ability to invest in essential technological tools, maintain existing facilities and provide training for teachers to effectively integrate technology into their pedagogical practices. Similarly, finding through study by Wallace *et al.* [8] stated that limited resources and insufficient funding emerged as the most significant constraints for the teachers. This imbalance leads to inequitable access to digital resources, disadvantaging students and teachers in less affluent schools. In addition, owing to the lack of educational facilities equipped with digital gadgets, it was impossible to incorporate technology into PE sessions [30]. Consequently, both teachers and students in these schools' face limitations in adopting technology-enhanced educational practices. Addressing this issue necessitates systemic reforms including the equitable allocation of funds and targeted financial support for under-resourced schools. Such measures are essential to bridge the financial gap, enabling all schools to foster effective and dynamic technology integration in PE settings.

3.3. Lack of training

From the findings, lack of training is one activity that must be emphasized in a way to integrate TPACK simultaneously. The research additionally discovered that the authorities' courses and training for digital competency do not emphasise on integration of technology especially in PE itself. This is demonstrated in the subsequent interview excerpts:

“There is no training to the PE teachers on how to apply the digital technology in PE specifically.” (P2/S1)

“There is no special training on how to use the technology in PE. That is why I am not ICT competent.” (P3/S1)

“There is no specific training for PE teachers but there was training for other subjects.” (P6/S2)

The above passages explain that all the participants did not attend any technology training. In addition, the researchers found that the technology training in education mostly participated by information and communication technology (ICT) teachers since they practice and use the skills in school. The ICT teachers assist the PETs in specific areas of technology when needed. Despite this, researchers found that all participants expressed a willingness to attend technology courses specifically focused on PE to improve their skills in using technology for educational purposes. They also agreed and provided positive feedback that technological skills are essential to enhance their competencies in digital technology and to apply these skills in PE sessions.

Moreover, most training programs focus primarily on managing classroom instruction, which leads teachers to feel that their preparation for integrating technology into their teaching is inadequate [31]. Therefore, Gleddie and Morgan [32] highlighted trained educator as the important element in the physical literacy praxis (PLP) who has the related knowledge, understanding and skills to deliver a well-planned and purposeful programme. It is crucial that PETs training includes step by step technical explanations and examples that align with their existing content knowledge. By adopting this approach, PETs can gain a comprehensive understanding of the technological outcomes and learn how to integrate technology more effectively into PE. In addition, Ardiç [31], effective in-service training programs should address teachers' technological, pedagogical, and content knowledge needs, incorporate hands-on training with technological tools, and focus on fostering positive attitudes and self-confidence to enhance technology integration in

classrooms, enabling active student interaction with technology. Continuing professional development (CPD) would be an ideal setting in which digital competence could improve [8], [33]. Therefore, the CPD must extend beyond simply imparting basic digital competencies to explore strategies that leverage teachers' interpretative and creative potential.

3.4. Time and space management

The results highlight challenges related to time and management in integrating technology into PE lessons. These challenges arose from the need to balance the operational demands of technology with effective classroom management, which often leads to inefficiencies during teaching sessions. Managing ICT equipment while simultaneously supervising students consumes valuable time and attention, making it difficult to maintain an effective learning environment.

"There are time constraints in operating ICT devices such as setting up LCD projectors while controlling students." (P2/S1)

The dynamic nature of PE lessons whereby it often conducted in open or outdoor spaces, complicates the use of digital tools, which are traditionally designed for stable indoor settings. Therefore, the PETs face difficulties in allocating sufficient time for both the setup and implementation of technology within limited class durations, particularly when considering the need to balance practical activities and theoretical instruction. These constraints result in reduced opportunities for effective technology integration, impacting the delivery of interactive and engaging lessons. Research highlights that overcoming these challenges requires designing technology tailored for flexible, physical learning environments, alongside professional development programs to train educators in optimizing time and resources. In addition, policy initiatives could support schools in equipping PE spaces with portable, durable technological solutions to ensure their seamless adoption in various educational scenarios [28]. Such efforts would enable a more balanced approach to integrating technology into PE, enhancing both teaching efficiency and student engagement.

3.5. Perception and attitude towards PE

The finding also revealed that PE within the educational curriculum is often undervalued, as it is not typically perceived as a non-major subject. This marginalization leads to a diminished focus on PE, both in terms of instructional emphasis and resource allocation. As a result, there is a notable lack of prioritization when it comes to integrating technology into the PE curriculum, as explained in the following passage.

"The subject will be taken by other subject teachers if they need extra time to revise with the students." (P4/S1)

"Emphasis on interests PE subject is less than subjects the other subjects." (P2/S1)

"The use of the computer lab will be prioritised for other teachers. We are only can use it if there is available slot." (P9/S2)

PE is often marginalized in schools as reflected in teacher perceptions. PE in Physical and Health Education is a non-major subject in Malaysia and has lower priority. However, finding from Dudley and Burden [34] stated that increasing the amount of time dedicated to PE in the school curriculum can lead to substantial improvements in students' overall learning outcomes. Besides, research by D'Isanto *et al.* [35] indicated that PE can improve physical health and fitness as well as social skills and teamwork among the students. Promoting technology integration in PE requires addressing these systemic challenges by elevating the subject's importance, providing equitable access to technological tools, and offering targeted training programs to build teachers' confidence and competence in using digital tools in their instruction. These steps could transform the perception of PE and enrich its educational potential [36].

In addition, the attitude among senior PETs is another challenge to integrate TPACK in PE as they lack of knowledge, especially in technology. Many of them accustomed to traditional teaching methods, may struggle with this transition due to insufficient technological proficiency. The reluctance to adopt technology also limits the ability to create a dynamic and interactive learning environment that aligns with contemporary educational standards and student needs.

"Senior teacher and counting to retire give accuse to use technology in PE." (P7/S2)

"There are senior teachers who wish to employ technology in their classrooms and those who do not, without a doubt." (P9/S2)

In addition, finding by Martinez-Rico *et al.* [37] stated that in general, the digital competence of teachers decreases over time. Although the older teachers' initial hesitation was evident, recent study by

Beardsley *et al.* [38] indicated that their confidence in using technology for various teaching tasks has significantly increased, along with their motivation to improve digital skills. This shift suggests a growing recognition of the importance of digital literacy in modern education, and it highlights the potential for professional development programs to further support these teachers in adapting to technological advancements.

3.6. Student-related constraints

The findings highlighted challenges from the varying access to digital devices and differences in student engagement levels during PE lessons. These constraints interfere with the effective integration of technology into PE, as not all students have access to devices or show interest in the activities provided.

“Not all students have tablets or other devices, and conducting PE outdoors poses challenges in bringing gadgets or digital tools to the field.” (P3/S1)

“Not all students are interested in certain games, with those who lack interest merely observing their peers engage in the activities.” (P4/S1)

These challenges often include a lack of digital literacy among students, varied levels of motivation, and difficulty adapting to technology-enhanced PE sessions. Students may struggle to understand the purpose of using digital tools, leading to reduced engagement and participation. Furthermore, disparities in students' access to personal devices can hold up inclusive learning experiences. Addressing these constraints requires targeted initiatives to develop students' digital competencies and foster equitable access to resources to maximize the benefits of technology integration [39].

3.7. Lack of educational resources

The findings demonstrated that restricted digital PE modules also contribute to limited resources for learning digital skills especially those that focus on giving content examples in PE. This limitation is evident in their inability to apply pedagogical strategies within technological platforms. Moreover, the participants also highlighted limited questionnaires in PE that can be used in teaching and learning as well as assessment. These questionnaires play a crucial role in evaluating student understanding, measuring learning outcomes, and guiding instructional improvements. Without access to such assessment tools, the participants faced challenges in accurately assessing student progress and providing targeted feedback to enhance learning experiences.

“The teachers only have basic technology skills such as using Google Meet, searching for materials on Google Site but have no skills to build pages/sites related to PE. For example, I can record videos but have no skills to apply pedagogy in the videos.” (P1/S1)

“There are limited modules in PE especially related to questionnaires. Moreover, using internet games like quizzes or Kahoot for theoretical problems in the lesson, such as the different forms of dance, and the number of rugby players can help the students to understand better, but the teachers must know how to use them the first place.” (P8/S2)

There are several modules related to technology in education but the module that explains how PETs can use the technology in PE is limited. The deficiency in integrating technology from insufficient training in both digital tools and their application within the context of PE, highlighting a critical area for professional development. Similarly, in the research done by Jeong and So [40] which was conducted in Korea, teachers faced the difficulties especially when conducted the PE lesson through online included limited environmental conditions and limited content that meet the PE value, lack of expertise in operating online PE lesson and limited evaluation guideline which resulting online methods impossible. In addition, the finding in the research conducted by Centeio *et al.* [41], the teachers experienced major challenge integrated technology due to acquiring new knowledge in implementing an online curriculum. Therefore, governments can take this advantage to upskill teachers' ability in applying technology specifically in PE lesson which then lead to speed up students flexible learning and empower them to pursue innovations, which will lead to better learning outcomes [42].

Overall, by employing the TPACK framework, this study not only identifies barriers including lack of infrastructure, training, and financial support but also highlights the specific constraints unique to PE such as time and space management and student-related factors. In addition, this research revealed that technology integration based on the TPACK framework must also address and correlates with the facilities and the PETs digital competence. Because of restricted facilities, some of the most educated PETs in technology are unable to integrate the technology in PE lesson. PET's digital competence must also be strengthened in order to create 21st century abilities in teachers in order to fulfil future expectations and compete in the digital world of

education with specialized digital training for PETs. The module may benefit through the digital training as Kunokman and Filiz [43] stated that the PETs should be introduced with new technologies and guided.

4. CONCLUSION

The primary objective of this research is to investigate the challenges PETs faced when incorporating technology into their PE sessions. Our findings reveal that PETs encounter significant obstacles, particularly within the framework of the TPACK model. The findings emphasize that barriers such as inadequate infrastructure, financial constraints, lack of targeted training, time and space management issues, and unfavorable perceptions of PE significantly hinder technology integration. Additionally, student-related constraints and the limited of PE-specific educational resources further complicate the process. These challenges are rooted in their difficulty to effectively integrate technological knowledge with pedagogical strategies and content expertise.

Despite these challenges, many PETs recognize the potential benefits of technology in PE, including enhanced student motivation and more diverse learning experiences and methods. In addition, the new learning requirements demand innovative approaches to make teaching and learning sessions more engaging. Therefore, it is crucial to develop a module specifically focused on integrating technology into PE to ensure that PETs are proficient in using technology. This study could be extended to the development of a module that specifically addresses how PETs use technology in PE is relatively novel compared to existing literature. While many studies and educational modules have focused on the integration of technology in various educational contexts, such as classroom teaching, online learning, and administrative functions, the application of technology in PE remains limited. This gap signifies an innovative opportunity to contribute to the academic discourse and practical implementations in educational technology. Moreover, PETs should get organized and ongoing training on how to integrate technology into PE to enhance their digital competence especially to support the education in 21st century. Considering the fact that this research was conducted for PETs in Malaysian secondary schools, these issues may be applied by teachers in a variety of school or settings for future research.

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AUTHOR CONTRIBUTIONS STATEMENT

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C : **C**onceptualization

M : **M**ethodology

So : **S**oftware

Va : **V**alidation

Fo : **F**ormal analysis

I : **I**nvestigation

R : **R**esources

D : **D**ata Curation

O : Writing - **O**riginal Draft

E : Writing - Review & **E**ding

Vi : **V**isualization

Su : **S**upervision

P : **P**roject administration

Fu : **F**unding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

INFORMED CONSENT

We have obtained informed consent from all individuals included in this study.

ETHICAL APPROVAL

The research related to human use has been complied with all the relevant national regulations and institutional policies in accordance with the tenets of the Helsinki Declaration and has been approved by the authors' institutional review board or equivalent committee.

DATA AVAILABILITY

The research data supporting this study's findings can be obtained from the corresponding author, [NA], through reasonable request.

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