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An Examination of Gender Differences on Science Teachers' Digital Learning Environmental Preferences: A Result of Smart Learning Project in Thailand

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Abstract

Currently, technology is growing at a rapid rate, which not only impacts students' learning but also teachers' professional development in this 21st century. Likewise, gender difference in terms of digital technology aspect has attention by today's educational researchers. Digital learning environmental preferences (DLEP) of science female and male teachers are essential because a learning environment that fit teachers' preference would lead them to have more effective teaching and improve students learning performance. This study intended to investigate the DLEP between female and male science teachers. After the science teachers received the training to use various digital technologies to integrate into their science classroom, the DLEP of science female and male teachers were compared by employing a survey consisting of ease of use, continuity, relevance, adaptive content, multiple sources, timely guidance, student negotiation, and inquiry learning dimensions. A total of 244 science teachers (195 females and 49 males) participated in the survey. According to the one-way MANOVA result, it found that there was no significant difference between male and female science teachers' preferences. Consequently, the female and male science teachers showed a similar need for a digital learning environment in their training. This result suggests that teacher professional development programs for different gender of science teachers could implement the same digital learning environments in their professional development.

Keywords: Digital environment, Designing course, Teacher education, Learning preferences, Gender gap

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Introduction

Nowadays, technologies have changed professional learning activity that provides teacher trainees with more flexible and adaptive learning opportunities (Bonsignore, Quinn, & Bendrson, 2013; Sung, Hwang, Liu, & Chiu, 2014). Likewise, digital learning innovations could apply to support learning anywhere and anytime (Chu, Hwang, & Tsai, 2010). For example, researchers have conducted a context-aware mobile learning approach to enhance learning in science parks (Chu et al., 2010). On the other hand, in light of rapid technological development, traditional practices in education for teachers no longer provide potential teachers with all the necessary skills for teaching students to handle society in the 21st century. Smarkola (2008) has implied training teachers in educational technology during their initial teacher education to overcome this obstacle. Moreover, they can gain more confidence in using technology in their classroom instruction. For this purpose, they will require some skills to integrate technology into their classroom teaching and use digital technology as part of the lessons and tools for engaging students' learning.

In Thailand, the KKU Smart Learning Academy (KKU-SLA) project was initiated implement in 2017 to improve secondary school students' learning performance in Science, English language, and Mathematics considering the Programme for International Student Assessment (PISA). The KKU-SLA is trying to find alternative ways to transform and support the teaching and learning of the teachers. Especially, in-service science teachers were encouraged to use digital and hand-held technologies emphasizing mobile devices and applications for application in their classroom.

Additionally, several researchers have mentioned the importance of investigating teachers' teaching preferences (Elen, Clarebout, Leonard, & Lowyck, (2007). Since teachers have been recognized as the stakeholders in students' learning, researchers indicated that teaching preference would affect students' learning (Morrisson & Lowther, 2010). For instance, teachers' low ambition to apply technologies into the classroom would limit students' access to information from the Internet (Webster & Son, 2015). In the Thailand context, Panjaburee and Srisawasdi (2018) suggested that new technologies as learning tools must apply in teaching methods to help all students learn to improve the quality of education in such a developing country. However, teacher professional development with the integration of digital technologies is still needed (Srisawasdi, 2014). One of the key factors facilitating successful technology integration in class is teachers' attitude toward using information and technologies (Bitner & Bitner, 2002). To comprehend teachers' perceptions and preferences in a technology learning environment, Lai et al. (2016) conducted a structural equation model analysis regarding mobile learning environmental preferences on teachers and students. They found that teachers tended to focus on technical issues while using the technology, preferred to have technology support during their learning activities development and that learning content should be considered. Furthermore, numerous studies reported significant positive relationships between teachers' computer use and perception (Rafiee & Purfallah, 2014; Hao & Lee, 2015; Kavanoz, Yuksel & Ozcan, 2015). Hence, teachers' preferences toward digital technologies are essential to foster their learning and implementing those in their regular classroom setting.

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On the other hand, teachers' technology interest may cause by gender differences. Marth and Bogner (2018) revealed that male teachers significantly showed higher technology interest and social aspects than female teachers. Moreover, the gender issue in technology-based learning environments has been noted in some previous studies. The factor was discovered to be related to users' perspectives of technology usage in learning environments (Tsai & Tsai, 2010). Some researchers have reported that male students have more confidence and positive attitudes than females in technology employment (Tsai et al., 2010). However, other studies have reported opposite findings; the gender gap in technology usage does not exist among elementary and secondary school students (Volman et al., 2005). The gender issue in technology usage in technology-based learning environments is still unclear. Therefore, when educators design and develop digital learning environments, there is a need to explore the role of gender in learning preferences. Hence, this study aimed to examine gender differences in teachers' teaching preferences in the context of digital learning environments.

Research Question

This study examines the digital learning environmental preferences between female and male in-service science who attended the KKU Smart Learning Academy project in Thailand. Consequently, this study's guiding research question is whether any difference between female and male science teachers' digital learning environmental preferences.

Significance and Purposes of this Study

The factors that are fundamental to the successful implementation of new technologies are the beliefs and attitudes of teachers toward information and communication technologies (ICT) in teaching and learning. While integration ICT into the classroom is promoted to teachers, there is evidence that reveals the effectiveness of this integration on teachers' preparedness to do so, which is directly related to their confidence and knowledge regarding using ICT, their believes about the effectiveness of ICT in the classroom (Gebhardt et al., 2019). In considering teachers' gender effect, previous studies noted that male teachers are more likely to be using computers personally than female teachers (Jamieson-Proctor et al., 2006; Wozney et al., 2006). Moreover, The International Computer and Information Literacy Study (ICILS) in 2013 reported that female teachers were weekly users of computers for other work-related purposes in school than male teachers significantly in the Russian Federation and Thailand. On the other hand, there were differences between female and male teachers in their confidence in using computer technology. On average, male teachers reported higher ICT self-efficacy scores than female teachers (Fraillon et al., 2014).

According to the mentioned above, it is crucial to explore teachers' learning preferences about ICT or digital technology in education to design a training program that fits their preferences. Consequently, this study investigates in-service science teachers' digital learning environmental preferences in Thailand, specifically in a KKU Smart Learning Academy project. This study aims to investigate the gender effect on digital learning environmental preferences of in-service science teachers. The study results provide insights for teacher educators, educational researchers, and decision-makers on the preference factors for designing a course for training teachers.

Context of KKU Smart Learning Academy Project in Thailand

In Thailand, Khon Kaen University launched an educational improvement project called Khon Kaen University Smart Learning Academy (KKU-SLA) in 2017. This large-scale project aims to improve middle school (13-15 years old) students' learning achievements in science, English language, and mathematics and promote digital literacy and 21st-century skills related to the Programme for International Student Assessment (PISA). The members in this project are lecturers/researchers at Khon Kaen University, Thailand, which from many fields (i.e., Faculty of Education, Faculty of Science, Faculty of Engineering, and Faculty of Human and Social Sciences). They are trying to find effective ways to transform and encourage teaching and learning for schools to use hand-held technologies in the classroom, emphasizing mobile devices, ubiquitous learning systems, and applications for the instructional process. This project started in 2017 involving 45 middle schools from four provinces located in the Northeastern region of Thailand. In 2021, The project involves 203 secondary schools from all 19 provinces located in the Northeastern region of Thailand.

Research Relevant

Technology-oriented Teacher Professional Development

With the rapid growth of information and communication technology (ICT) in an educational context, Williams (2017) noted that effective teacher professional development related to ICT must facilitate teachers' professional learning to gain the necessary skills in the learning and teaching process. Numerous researchers (e.g., Gudmundsdottir & Hatlevik, 2018; Dinçer, 2018) have revealed that teacher professional development courses are insufficient to ensure that teachers can integrate ICT into practice. The programs only focus on supporting them to use ICT without considering integrating ICT into the teaching and learning process of specific content (Tondeur et al., 2012). Another reason is that these courses mainly emphasize technical skills without considering the specific subject matter, pedagogy, and contextual factors (Harris et al., 2009). In addition, Tondeur et al. (2012) noted that if the teacher education course targets only teachers' ICT knowledge and skills without relating them to their subject matters, this knowledge and skills would likely be unused. Consequently, many researchers have mentioned that technology skills and their relation to subject matters should be integrated into teacher professional development programs to provide them with the skills and experiences needed to apply technology to their specific content regarding their curriculum (Niess, 2005).

With the emerging of the Technological Pedagogical and Content Knowledge (TPACK) framework (Mishra & Koehler, 2006), The pure ICT teacher professional development course has begun to change to an ICT course for instructional purposes ICT an integral part of pedagogical content knowledge. Current studies have shown that pre-service teachers started to learn with the technology course for teaching purposes; for instance, Jimoyiannis (2010) used various technologies in coursework to develop in-service science teachers. In addition, Ng and Furgusson (2017) used an adaptive learning platform to support science teachers' TPACK. The finding of this study reveals that the teachers believed that new technology could enhance their teaching. In the Thailand context, Srisawasdi (2014) adapted the TPACK framework to arrange the coursework as a TPACK-computerized laboratory to train pre-service physics teachers. This study demonstrates an effective and encourages practice for the pre-service science teacher. In 2017, Srisawasdi, Pondee, and Bunterm researched by applying a TPACK framework called mobile laboratory learning in science to design a technology-integrated pedagogy module to train pre-service science teachers. The result of this study shows a promising result on improving knowledge related to technology used. Nevertheless, the number of these changes is not enough due to insufficient knowledge, teaching needs, and learning preferences of prospective teachers in using ICT for teaching purposes.

Generally, the ICT-oriented teacher professional development programs have provided the learning with ICT tools as one-shot sessions without continuing support in teaching environments in teachers' instructional contexts (Erdem, 2019). However, preparing the teachers who are familiar with non-digital technologies through traditional teaching methods is critical for the stated training (Williams, 2017). As such, the ICT training program that accommodates teachers' context with experience to the potential benefits of ICT could support them to overcome technical problems (Mishra et al., 2019). Therefore, researchers should provide the learning experiences for teachers on how ICT-related activities work in their educational settings so that they believe the value of ICT integration (Ottenbreit-Leftwich et al., 2010). These training program experiences foster ICT transfer into teachers' teaching contexts (Mishra et al., 2019).

Digital Learning Environments in Science Education and Teaching Preference

Digital learning environments refer to any set of technology-based approaches that can be applied to support learning and instruction (Wheeler, 2012). Many advanced studies in digital learning environments aim to improve students' experience and promote teachers' instruction. For example, Sung et al. (2014) encouraged students to use their mobile devices to observe the real-world environment and proved that these technologies engage them to interact with the learning context. Pinatuwong and Srisawasdi (2014); Buyai and Srisawasdi (2014) suggested that students who may have a positive or negative attitude toward computer simulation can learn from this digital technology resource that can facilitate teaching and learning in school science. Another study reported that educational games could promote engagement and learning for students with special learning needs (Ke & Abras, 2012).

Because the digital technology learning environment is becoming critical, the teaching with the digital tools needs should be paid attention to educational improvement. Kearney, Burden, & Rai (2015) suggested that the learning environment that fit teachers' preference would lead them to have more effective teaching and improve students learning performance (Chu et al., 2010). According to the previous studies, teachers' preferences toward the learning environment have been discussed in the literature to promote technology integration.

Many studies of instructors' teaching preference in information and communication technology (ICT) education have been emphasized in current educational reforms (Bentsen, Schipperjin, & Jensen, 2013). For instance, Kordaki (2013) implied that the integration of technology in education could increase teachers teaching potential. Furthermore, several educators pointed out that the teachers' ICT teaching preference is highly related to their improvement of learning activities (Hermans, Tondeur, Braak, & Valcke, 2008). Those studies mentioned that teachers' preference for applying technology plays an important role when developing technology-enhanced learning activities. Nevertheless, gender differences of technology participants (e.g., students, newcomers, and teachers) might lead to different technology interests. Particularly, in-service teacher males have usually shown higher interest in technology than females (Marth & Bogner, 2018).

Gender Differences in Teachers' Technology Education

Researchers and educators across countries have investigated the argumentation of gender differences in education and their impact on the usage of technology for teaching and learning. Among these investigations, some studies focused on investigating teachers' technology issues between female and male teachers. For instance, Almekhlafi and Almeqdadi (2010) conducted a study by investigated teachers' perceptions of technology integration in the classroom. They found that both female and male teachers have a high perception of their abilities and competencies regarding integration technologies into their teaching. They also found that female teachers have a different method of integration technology compared to male teachers. Similarly, Yukselturk and Bulut (2009) investigated self-regulated learning between female and male learners in terms of technology-enhanced learning. This study revealed that test anxiety is a significant variable for female learners, while self-efficiency and task value are significant variables for male learners' achievement. Moreover, in terms of teachers' training, Braten and Stromso (2004) reported that males showed higher levels of participation than females in Internet-based learning activities and text processing strategies. Zhou and Xu (2007) also reported that female teachers had lower confidence in teaching technology than male teachers.

Nevertheless, several studies have been reported contrast results for gender differences between females and males in computer use and computer applications. For example, Wong and Hanafi (2007) investigated the attitudes toward information and technology courses of pre-service teachers. The results of this study did not show differences between females and males, and both indicated the same levels of attitudes before and after attending the course. At the same

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time, Top et al. (2011) reported that female and male teachers had no significant difference in the usage of web applications. However, they also mentioned that male teachers' scores on behavioral control and self-efficacy were higher than females. In addition, Hong and Koh (2002) found that overall computer anxiety levels between female and male teachers were no significant difference except for the hardware domain.

As mentioned above, it is clear that many studies illustrated various findings on gender differences toward digital technology aspects. Some studies revealed a significant difference between females and males, while other studies showed no such differences. Moreover, Lai et al. (2016) mentioned that teachers required a well-support for technological issues when developing a mobile learning environment. This literature indicated that gender differences seem to be an essential research topic when planning to conduct a teacher's professional development in the digital learning environment.

Methods

Participants

In this study, the KKU Smart Learning project was initiated by Khon Kaen University, Thailand, to training secondary school science teachers to implement digital learning activities in regular courses. The participants consisted of science teachers from 205 schools (244 science teachers, 49 males, and 195 females).

Instruments

The digital learning environmental preferences survey, shortly called DLEPS, was employed to investigate teachers' preferences in digital learning environments. This survey originated from a survey developed by Tsai, Tsai, and Hwang (2012). The survey consisted of eight factors: ease of use, continuity, relevance, adaptive content, multiple sources, timely guidance, student negotiation, and inquiry learning; each factor included three items. Moreover, the survey was designed for raters with a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). The Cronbach's alpha values of each factor were 0.77, 0.77, 0.70, 0.73, 0.76, 0.83, 0.87, and 0.86, respectively. The overall alpha was 0.92, implying that these factors had highly sufficient reliability in assessing the teachers' preference toward the digital learning environment. Additionally, Table 1 summarized a framework of digital learning environmental preferences adapted from Tsai, Tsai, and Hwang (2012).

Table 1.

The Framework of Digital Learning Environmental Preference adapted from Tsai et al. (2012)

Aspect	Factor	Description
Technical	Ease of use	This scale measures how individuals prefer that digital learning environments are easy to use.
	Continuity	This scale measures how individuals prefer the digital technology environment to assist individuals in continuously learning.
Content	Relevance	This scale measures how individuals prefer the digital technology environment represents individual, real-life situations.
	Adaptive content	This scale measures how individuals can access information based on their requirements.
	Multiple sources	This scale measures how individuals prefer digital technology environments consisting of various relevant sources.
Cognitive	Timely guidance	This scale measures how individuals prefer to receive support at the right time and in the right place.
	Student negotiation	This scale measures how individuals prefer to have opportunities to interact with peers in the digital technology environment.
	Inquiry learning	This scale measures how individuals prefer to have opportunities to engage in inquiry in the digital technology environment.

Contexts of the KKU Smart Learning Academy Training Workshop

The technology-based training workshops for in-service science teachers in the KKU Smart Learning Academy project focused on supporting them in using digital technologies for effectively enhancing their students' learning performance in science. In the workshop, many digital technologies were employed in their professional learning. However, courses were also held to understand how to implement digital learning activities in their regular courses. In addition, the potential of digital learning activities was promised by research findings. The examples of 1-year capsule training and each digital learning activity in the workshop were following:

Workshop#1: Hands-on mobile laboratory learning environment

The first workshop presented a hands-on mobile laboratory activity related to the concentration of solution concept to the in-service science teachers in May 2018. At the beginning of the workshop, a biologist presented a basic knowledge of the concept to improve their conceptual understanding. After

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that, the trainees were introduced to a mobile inquiry learning activity developed by Premthaisong, Srisawasdi, and Pondee (2017). They were assigned to follow the process of preparing unknown solutions. Then, a color measure mobile application is an application used for probing the unknown solutions' color then displaying the H-value of the color. Another digital learning tool is an interactive spreadsheet embedded in a mathematical model for automatic plotting graph called Excelet is presented to them. In figure 1, the teachers used a color measure application on their mobile devices to probe the H-value of the unknown solution. Then they plotted the graph on the Excelet by using the data to calculate the concentration of an unknown solution. After the learning activity, participants were encouraged to discuss the possibility of implementing the hands-on mobile laboratory activity in the science classroom.

Figure *1.* Example of the science teachers conducted the hands-on laboratory in the concept of concentration of a solution

Workshop#2: Digital game-based learning environment

The second workshop provided in-service science teachers with a digital game-based learning activity. In this workshop, all in-service science teachers voluntarily attended the training workshop in May 2018. The participants were introduced to the up to date of concept regarding human blood circulatory by a biologist. They experienced multimedia to learn this concept, such as video and PowerPoint slides. Then, a digital game-based inquiry learning session by a science educator is followed. In this session, the role play as a learner is assigned to the participants to interact with a human circulatory system digital game developed by Lokayuth and Srisawasdi (2014). This digital game gave the role play for them as a single red blood cell and assigned missions to carry oxygen gas through blood vessels and go to target organs, as shown in figure 2. Finally, after the learning activity, participants engaged in a whole group reflection discussing the features of the digital game they learned by experiencing the inquiry-based learning activity.

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Figure *2*. Example of the teachers interacted with a digital game for learning a human circulatory system

Workshop#3: Computer simulation learning environment

The third workshop took place three months later, in August 2018. Participants began the day by learning in a whole group about the photosynthesis concept to boost their conceptual understanding. In this session, the expert provided the content for the participants via PowerPoint slides and video then conducted a question and answer activity regarding the learning concept. Next, they were introduced to a photosynthesis computer simulation, as display in figure 3. This digital technology simulates a laboratory about seaweed growth by counting air bubbles recognized as a product from the photosynthesis process. It can also change the parameter regarding the process, such as the light color and the amount of carbon dioxide diffused in the water. After that, this session began with a real-life situation regarding the photosynthesis concept in the inquiry activity. During the activity, they were asked to adjust the parameters and design their experimental process to discover the relationships between the factors and the photosynthesis process. Then, the participants explore the parameters in an inquiry activity on their devices. Lastly, participants then engaged in a whole group discussion about how the feature of the computer simulation could help students learn in this particular content and the crucial issues to implement this activity into their regular class.

Figure *3*. Example of the teachers training workshop with a computer simulation about photosynthesis

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Workshop#4: Microcomputer-based laboratory learning environment

The fourth technology-enhanced science learning workshop was held in February 2019. In this workshop, a microcomputer-based laboratory was used as a digital learning environment for inquiry-based learning. In the introduction session, the participants were introduced to the latent heat concept. They experienced a learning situation related to the learning concept by using online video and PowerPoint. The following session is about learning how to use digital tools, including data logger and temperature sensor technology. This data logger called Labquest2 is a standalone interface used to collect sensor data with its built-in graphing and analysis application. It can display a real-time graph while collecting data from experiments as well. After that, the researchers gave a role play as a learner in an inquiry activity. In the learning activity, the in-service teachers experienced the tools by used them to probe the temperature of cool water then observed this phenomenon through a graph on-screen, as illustrated in figure 4. Then, they analyzed the data gathering from the sensor by using the analysis feature in their data logger. Finally, after the learning activity, participants engaged in a whole group reflection discussing the features of the digital game they learned by experiencing the inquiry-based learning activity.

Figure *4*. Example of the microcomputer-based laboratory training

Our training workshops for teacher professional development focused on integrating digital technology into middle school in a science subject. Each workshop covered two days to promote the in-service science teachers' TPACK in science, technology, engineering, and mathematics (STEM) education. The science concept in the workshop is related to the topics Thailand standard curriculum. Therefore, the participants of this study had the basic concepts and experiences of digital learning. Their responses were sufficiently reliable to describe the needs and opinions of the digital learning environments.

Data collection and analysis

In order to examine gender differences in teachers' digital learning environment preferences, all participants were asked to complete the survey on the internet for 30 minutes after attended training in February 2019. Table 2 displays the digital learning environment workshops in a one-year capsule training. This study used IBM SPSS Statistics 21 as the analytical tool. The Shapiro-Wilk test was used to ensure that the scores did not violate the assumption of normal distribution. To compare the mean scores of female and male in-service science teachers' digital learning environmental preferences, the statistical data technique analysis of one-way Multivariate Analysis of Variance (MANOVA) was used to compare scores in terms of gender difference. A p-value < 0.05 was taken as significant. The researchers reported the mean scores and standard deviations of in-service teachers' scores regarding the DLEPS components for a descriptive overview.

Table 2.

Description of the professional training program and the digital technologies used

Training workshop	Date	Time	Subject matter	Digital technology	Illustration
Workshop #1	12–13 May 2018	12 hours	Concentration of solution	Mobile application	
Workshop #2	19–20 May 2018	12 hours	Human circulatory system	Digital game	
Workshop #3	1–2 August 2018	12 hours	Photosynthesis	Computer simulation	
Workshop #4	4–5 February 2019	12 hours	Latent heat	Hands-on sensor laboratory	

Results

Numerous researchers have mentioned that to increase learning effectiveness in the classroom, digital technology environment support and learning strategies should fit teacher teaching needs and specific content characteristics (Hwang, 2014; Hwang et al., 2014). It is essential to explore the gender difference in teachers' teaching preferences regarding developing a suitable digital learning environment. In this study, 244 teachers' responses of digital learning environment preference, including 195 female science teachers' responses and 49 male science teachers' responses.

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Based on one-way MANOVA, the mean scores did not show any statistical significant difference between females and males on each aspect: Ease of use (EU), F(1,242) = .169, p = .681; Continuity (CO), F(1,242) = .738, p = .391; Relevance (RE), F(1,242) = .081, p = .777; Adaptive content (AC), F(1,242) = .038, p = .846; Multiple sources (MS), F(1,242)= .879, p = .350; Timely guidance (TG), F(1,242)= .482, p = .488; Student negotiation (SN), F(1,242)= .390, p = .533; and Inquiry learning (IL), F(1,242)= .155, p = .694. This means that none of the eight aspects had a statistical significance between females and males. This implies that both females and males had almost equal results on EU, CO, RE, AC, MS, TG, SN, and IL after participating the digital learning environment in the workshops. Table 3 showed the comparison of gender on each aspect considered in digital learning environment.

Table 3.

The Gender Compared Aspects Considered in The Digital Learning Environmental Preference

Gender	*EU*	*CO*	*RE*	*AC*	*MS*	*TG*	*SN*	*IL*
Male (N=49)	*13.16 (2.04)*	*14.04 (1.80)*	*13.86 (1.23)*	*13.33 (1.57)*	*13.71 (1.41)*	*13.57 (1.80)*	*13.55 (1.60)*	*13.71 (1.56)*
Female (N=195)	*13.41 (1.60)*	*13.93 (1.44)*	*13.74 (1.47)*	*13.29 (1.85)*	*13.87 (1.50)*	*13.45 (1.71)*	*13.34 (1.79)*	*13.59 (1.69)*
F-test	*.681*	*.738*	*.081*	*.038*	*.879*	*.482*	*.390*	*.155*

*Note: EU — ease of use; CO — continuity; RE — relevance; AC — adaptive content; MS — multiple sources; TG — timely guidance; SN — student negotiation; IL — inquiry learning; *p<.05*

Discussion and Conclusion

In this research, a gender difference was compared between female and male science teachers on digital learning environment preference, and none of the significant differences between them were found. The researchers expected significant gender differences in teachers' digital learning environment preferences based on the abovementioned research findings. Primarily, males were expected to report a greater preference to participate in a digital technology environment than females. On the other hand, the present study found no significant difference in digital learning environment preference between females and males. The results suggest that gender difference on preference to digital learning environment does not exist among the science teachers. This is perhaps because these science teachers' prior experience of science learning was encountered with technology-enhanced learning and teaching in the workshops, illustrating how the digital technologies integrated into the science classroom could support them to overcome technical problems (Mishra et al., 2019). Another reason may be during the digital learning environment workshops; well support for them when facing the technical issues and proving a proper wireless network communication might affect both female and male science teachers' learning preferences in such environments. This result is consistent with Lai et al. (2016), who found that teachers might need support for the technical issue and an excellent wireless signal in a mobile learning environment. Moreover, Hong and Koh (2002) also mentioned that teachers who perceived support regarding improving their computer literacy skills did not show a significant difference in computer anxiety levels between females and males. Consequently, both female and male in-service science teachers might prefer the same training experience related to their activities work. In contrast with previous findings, which found a significant difference between female and male teachers on technology aspects (Almekhlafi & Almeqdadi, 2010; Yekselturk & Bulut, 2009; Braten & Stromso, 2004; Zhou & Xu, 2007). Therefore, the findings of this study further exposed that to plan a well-designed digital learning environment in professional development, none of the learning needs for different gender should be considered.

Limitations of The Study

This study revealed the results of teachers' digital learning environmental preferences with teachers' gender gap. However, this study has two significant limitations. First, the authors focused on quantitative data collection to compare female and males science teachers' digital learning preferences after participating in the workshops' learning environments. To better understand their learning preferences, quantitative and qualitative data collection should be utilized. Second, the participants in this study were selected from the school involved in the KKU Smart Learning Academy Project in the northeastern part of Thailand. This limits the generalizability of the results for science teachers in the Thailand context.

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