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Technology Leadership and Teachers' Technology Integration in Malaysia: Concept and Issues

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Abstract

The integration of technology in teaching and facilitation (PdPc) is a practice that is often debated by scholars due to its potential impact on students' learning. Relevant policies are being implemented in Malaysia's educational system but past studies have found some existing gaps such as the level of technology leadership is still uncertain, teachers still lack the knowledge and skills to integrate technology in PdPc, and there is a lack of research on the relationship between technology leadership and teachers' technology integration, especially studies that utilised the International Society for Technology in Education Standards for Education Leaders (ISTE-EL) model. Therefore, this concept paper aims to discuss the concept, models, issues, and research suggestions on technology leadership and teachers' technology integration in Malaysia. Schools need visionary technology leaders and teachers who are competent in Technological Pedagogical Content Knowledge (TPACK) to achieve educational goals through technology. The discussion in this concept paper is expected to assist future researchers in making informed decisions when conducting research related to this topic so that policymakers in the Malaysian Ministry of Education (MOE) will have relevant and meaningful data for future educational policy planning.

Keywords: Technology Leadership, Technology Integration, ISTE-El, TPACK, Educational Leadership

Introduction

The development of technology in the 21st century has undeniably made a huge impact on most sectors around the world. Work that was burdensome in the past has been facilitated with the help of technology. In the education sector, technology integration is growing rapidly as well due to its potential impact on students' learning. Although there are studies that found the integration of technology in PdPc does not has an impact on students' learning

performance, but in general, most studies showed that technology does has a positive effect on students' learning (Talan, 2020). Integrating technology in PdPc will create a conducive learning environment, support teaching and learning process, and improve students' achievement, motivation as well as 21st century skills (Das, 2019; Willis et al. 2019; Wali and Popal 2020; Carstens et al. 2021; Lee et al. 2022). This means that teachers who integrate technology will be able to improve students' learning performance, which in turn will contribute to the overall quality of a country's education level.

In relation to this, one of the factors that can influence teachers' technology integration is technology leadership. There are several different interpretations regarding the concept of technology leadership, such as that technology leadership represents guidelines, practices or organisational decisions that support the efficient use of technology in the classroom (Anderson and Dexter 2005). Technology leadership consists of technology committee, principal days, principal e-mail, staff development policy, school technology budget, district support, grants dan intellectual property policy. Besides that, Davies (2010) has parsed on the meaning of technology leadership that has been expressed by previous scholars and he found out that most previous definitions of technology leadership were primarily based on its functionality, unilateral, personal and organisational. Technology leadership should take into account broader social, political and economic influences by involving other stakeholders such as organisational vision and expenditure, technical experts, parents, teachers and students. Dasmo et al. (2021) have also synthesised a few current scholars' opinions on technology leadership and summarised it into eight indicators that include design and management, interpersonal and communication skills, teacher development and training, technology and infrastructure support, excellence in professional practice, digital teaching and learning culture, digital citizenship, as well as evaluation and assessment. Technology leaders who have these skills and characteristics will be able to improve the practice of technology integration in their respective schools.

In Malaysia, technology leadership refers to a combination of leadership strategies and techniques that focuses on technology, particularly in the aspects of equipment access, technology updates, and an understanding that professional development and technology integration is a dynamic field (Juraime & Izham 2017). Ghavifekr & Wong (2022) shared the same opinion by stating that technology leadership is a combination of leadership strategies and techniques whereas Yusoff & Izham (2023) defined technology leadership as a leadership style that utilises technological elements to lead schools. Based on the opinions from both foreign and local scholars, it can be concluded that technology leadership encompasses a wider scope of tasks and it is important to involve other relevant parties to improve the practice of technology integration in schools. In the Malaysian context, technology leadership is better understood as a leadership style that uses various technology-based strategies and techniques to improve school's technology integration (Hamid et al. 2021; Yusoff and Izham 2023). However, both parties share a common point, which is that technology leadership has the potential to improve teachers' technology integration (Dexter and Richardson 2019; Lim and Yusoff 2021; A'mar and Eleyan 2022). Given the importance of both variables, this concept paper will discuss the concept, models, issues, and research recommendations regarding technology leadership and teachers' technology integration in Malaysia.

The education system in Malaysia is based on Malaysia Education Blueprint 2013-2025 (PPPM) which was launched in 2013 (KPM, 2013). PPPM is a comprehensive strategic plan that contains 11 shifts to improve the country's education level. Among the elements that are focused in the PPPM are students' achievement, access and equity, school leadership and management, Information and Communication Technology (ICT) in education, and cooperation with external communities. From the aspect of school leadership and management, the Malaysian Ministry of Education (MOE) has stated in the fifth shift of PPPM that high-achieving leaders will be placed in each school. This shows that MOE recognises the importance of school leaders in leading the change to 21st century learning era. Indeed, leadership is among the key factors in determining the success of school organisational change (Zaliha et al. 2022). To achieve the goal of integrating technology in school organisations through the expertise of school leaders, MOE has integrated elements of ICT educational resources in the National Professional Qualification for Educational Leaders Programme (NPQEL 2.0) to enable school leaders to understand and master the use of technology in improving PdPc processes in schools (Shunmugam et al. 2023). MOE efforts in improving school leaders' training programmes will not only train school leaders to become proficient technology users, but also as technology leaders who can influence technology integration among teachers during PdPc.

The policies related to ICT in education have been outlined in the PPPM's seventh shift, namely leveraging ICT to scale up quality learning across Malaysia (MOE, 2013). This shift aims to increase internet capacity and improve learning quality in critical subjects across the country. It also shows that MOE places great importance towards understanding and implementing a culture of technological literacy in education, particularly among teachers (Kamaluddin & Husnin 2022) as they are the main implementers in championing the initiative of integrating technology in PdPc. Since the launch of PPPM, various programmes and efforts have been implemented by MOE to celebrate these initiatives such as the launch of Sekolah Bestari, 1BestariNet, Maya-Frog Learning, and most recently the Digital Educational Learning Initiative Malaysia (DELIMa) with the collaboration of Google, Microsoft and Apple (Ali, 2021). These initiatives demonstrate MOE's commitment to meeting the demands of the digital age and preparing the next generation to face increasingly complex global challenges. However, every educational policy comes with its own challenges. According to Sincar (2013), technology leaders tend to face various types of challenges which include training deficiencies, bureaucracy, resource scarcity, resistance to innovation and students' socioeconomic status. In addition, Abdullah & Misfer (2020) found three main challenges that are quite similar, namely lack of financial resources, school ICT infrastructure and technological skills among school leaders. In the Malaysian technological leadership context, the financial or ICT infrastructure aspects are not major barriers to technology integration efforts anymore because most schools have received appropriate support from the government and private sector, but the aspect that should be emphasised now is the need for an efficient ICT management system (Mohd Norakmar Omar et al. 2019). Thus, school leaders should always equip themselves with current knowledge and skills regarding technological leadership theories or models from organisations that are recognized by scholars from around the world such as the International Society for Technology in Education (ISTE) to foster the integration of technology among teachers. This is because it is the teachers who will determine the type and method in which technology is used in their classrooms.

Leadership Definitions and Concept

Trying to fully understand the term leadership is like unravelling an endless knot. New leadership concept and theories will always emerge. This trend is actually reasonable, considering that human needs have changed with the passage of time, therefore the function of leadership must also change along with human needs. Bolden (2004) has provided a clearer picture of the issue regarding the definition of leadership by stating that although the topic of leadership has existed for hundreds of years, the understanding of leadership is still unclear. This is due to the existence of two main issues, namely leadership is a complex idea that is susceptible to personal interpretations and individual theoretical stances. There are certain individuals who consider leadership as results of leaders having certain traits, while others see leadership as a social process that emerges from group interactions.

One of the popular reviews of leadership decades ago is by Northouse (2004) who has stated that leadership is a process, involves influence, takes place in a group context, and leads to the achievement of objectives. Thus, he defined leadership as a process in which an individual influences a group of other individuals to achieve a common goal. The concept of leadership is often confused with the concept of management. An individual who holds a high position in a hierarchy is not necessarily a leader who exhibits leadership characteristics. The comparison between leadership and management has been further explained by Marion & Gonzales (2014) in which leadership focuses on influencing groups of individuals under them to achieve certain goals and drive change, goal-orientated, and is always looking for new ways to solve problems. In contrast, management focuses on formal positions to promote organisational stability and efficiency, standardisation of procedures to maximize profits or results, and exploitation of existing resources and processes. In summary, leadership emphasises change and exploration, while management emphasises stability and exploitation of resources.

Furthermore, there are also plenty of theories that underlie the term leadership. At least more than ten leadership theories have existed since the 1840s in which Benmira & Agboola (2021) have categorised into trait, behavioural, situational and new eras. Leadership in the trait era can be understood as traits that a person naturally has but the focus of leadership has shifted to the actions and skills of that particular person in the behavioural era. In the situational era, leadership emphasises on how leaders should adapt their approach based on the environment. Leadership theories evolved rapidly during the new leadership era which led to the emergence of various leadership theories such as transactional, transformational, partnership, collaborative and collective. These theories focus on the overall organisational system and how to motivate their respective subordinates to achieve better results.

Overall, it can be concluded that leadership is a complex concept, different from management and based on various different theories. However, there are some keywords that captured succinctly the essence of leadership based on the above discussion, which are "influence" and "goal achievement". Therefore, leadership can be defined as the way leaders influence their subordinates to achieve certain goals. This definition may change according to the context and goal that the organisation is trying to achieve.

Technology Definitions and Concept

On the other hand, technology is a term that has many different meanings and depends on the context as well. Therefore, it is important to understand the origin of this term and the definitions that have been expressed by past scholars to better understand the concept of technology. According to Koc & Demirbilek (2018), the term technology comes from the Greek words "*techne*", which refers to making and art, as well as "*logic/logos*" which means words, thoughts, speech or principles. From this linguistic point of view, technology can be defined as an effort or learning process to produce a craft or master an art. This definition is the reason why technology is commonly understood as the application of scientific knowledge and skills to realistic worldly issues.

Western scholars have discussed on the definition and concept of technology as early as the 1990s. For instance, McOmber (1999) has criticised Bush's (1981) definition of technology, which is that technology is a kind of human cultural activity to solve issues using science and mechanics. Technology consists of personnel, systems, equipment, processes and resources developed to perform tasks and increase competitiveness in specific ecological, economic and social contexts. He stated that the benefits offered by technology in Bush's (1981) definition are subjected to the influence of cultural situations only. McOmber (1999) then compiled three definitions of technology from three different perspectives, namely instrumental, industrial and novelty perspectives. From an instrumental perspective, technology is defined as the organisation of knowledge for practical purposes. Technology is seen as a mere instrument or tool in this perspective. From an industrialised perspective, technology is seen as a product of a particular historical time and location. Most cultures already have and are using technology compared to ancient times. Although most societies without technology still exist and are labelled as "pre-industrial", this actually connotes that they will have it sooner or later. Proponents of the industrial perspective consider technology as an event that occurs alongside with other practices or objects. Additionally, according to the novelty perspective, technology is the latest and most innovative instrumental creation resulting from human imagination, especially for creations that are not fully understood yet. This perspective indicates that the narrative of technological development is a continuous discontinuity. This is due to the fact that new technologies will always replace old technologies and lead to the need to reorganise existing social structures, values and priorities.

In addition, Wahab et al. (2012) have compiled the definitions of technology from as many as 19 scholars and organisations. In essence, technology is a mixture of knowledge, skills and practical arts to create useful tools and methods, as well as the systematic application of science to solve problems. Among the uses of technology are the conversion of resources to commodities and the development of products and services. Technology may be concrete, such as machines and equipment, or something intangible, such as organisational structures and knowledge. In brief, it can be said that technology is the creation and use of instruments, machines, materials, and procedures to solve the problems faced by humans and improve their quality of life. Moreover, Koc & Demirbilek (2018) have also discussed several perspectives on the definition and concept of technology by (Feenberg, 1991). There are four intended perspectives of technology, namely instrumental, deterministic, substantive and critical views. Given that the instrumental perspective has been discussed in the initial section, only the deterministic, substantive and critical view perspectives will be discussed.

From a deterministic perspective, technology and society have a direct interactional relationship in which technology will develop independently and influence the development of society itself, which in turn will also have a direct impact on humans. Technology is the main driver of social change, often without regard to cultural, political or economic factors. From a substantive perspective, technology is not considered as a neutral tool but is shaped by human values, beliefs and interests. Technology and society have a dynamic and reciprocal relationship according to this perspective. It can shape society, but society can also shape the development and use of technology conversely. The concept of technology according to the critical view challenges the autonomy of the substantive field and the notion of neutrality in the instrumental field. This is because it questions how technology affects power dynamics, inequality and human welfare by taking into account social, cultural, political and economic aspects.

The term '*technology*' is often used interchangeably with ICT as well. To better highlight the differences or similarities between these two, a deeper understanding of ICT is called for. According to Toomey (2001), ICT refers to technology that is used to access, collect, manipulate and deliver information. On the other hand, UNESCO (2009) defined ICT as a broad range of technological instruments and resources to transmit, store, create, share or exchange information. These technological instruments and resources include computers, internet, live broadcasting technology, tape broadcasting and telephony. ICT can also be understood as different sets of technological tools and resources for communicating, sharing, creating and managing information (Alkamel & Chouthaiwale 2018). Hence, when compared to technology, it can be said that technology is actually a broader term of ICT as it encompasses both tangible and intangible elements such as knowledge, machines, devices and procedures. Technology can also be applied seamlessly into other fields such as manufacturing, transport and health (Ahuja et al. 2024) whereas ICT emphasises specifically on the use of digital technologies that support information sharing and communication only. Naturally, the fields of manufacturing, transport and health will need to use ICT to communicate and support information transfer but the operation of machines such as cranes or trains would be classified under the use of technology rather than ICT. However, when applied in the educational context, both technology and ICT would share more commonalities, as the PdPc process is essentially dissemination of knowledge in the form of information through communication. This argument is supported by Lawrence (2022) who defines ICT as all types of technologies that are used to manage and communicate information and their use, especially in education. In short, technology is a broader term of ICT but in education, particularly the PdPc process, they can carry the same meaning. In fact, in the US education system, the term ICT is synonymous with technology and educational technology (Lloyd, 2005).

To conclude, the various definitions and concept brought by scholars have highlighted that technology is something dynamic, complex and has a widespread influence on society. Thus, if applied into the education world, it can be said that technology is the creation and use of instruments, tools, devices, materials and procedures to solve educational problems and improve the overall quality of education. The educational problems in question may stem from aspects of administration, policy, teachers' commitment, students' performance, human resources and so on. This is because the use of technology is ubiquitous and can be applied in most educational activities, school management effort, documentation work and

financial affairs (Karakose et al. 2021). However, the focus of technology in this concept paper is narrowed down on technology leadership and teachers' technology integration in the classroom for PdPc processes only.

Technology Leadership Definitions and Concept

If the stated definitions and concept of both technology and leadership is combined as technology leadership, then technology leadership can be understood as ways in which leaders can use to influence their subordinates to achieve certain goals using technology. Before finalising this definition, it is vital to take into account more views from other scholars for a more thorough understanding of technology leadership. According to Anderson & Dexter (2005), technology leadership refers to school leaders who always prioritise the use of technology in their school organisation. They will always create opportunities for teachers to improve their technology skills and encourage them to use technology in the classroom.

Besides that, Faridah & Azlin (2020) define technology leadership as a combination of various strategies and techniques needed to integrate technology to improve the level of educational achievement. Ghavifekr & Wong (2022) brought forward a broader definition, namely technology leadership refers to all knowledge and skills that school leaders need to know and can do regarding technology. In addition, technology leadership is also considered to be function-oriented, in which they are given emphasis to explore the practice of using and integrating technology in schools (Zhang et al. 2022). There exist definitions that specifically define technology leadership as a type of leadership style as well such as by Jailani & Izham (2023) who define technology leadership as a type of leadership style that uses technological components to lead schools. These technology leaders will utilise various leadership techniques to improve the level of education through the use of technology.

At present, technology integration in schools is no longer a new phenomenon. Various programmes and initiatives have been implemented by the MOE to strengthen the use of technology in education, in line with the objectives of the seventh PPPM shift (MOE, 2013). However, this goal will not be achieved if the infrastructure provision to schools is not fully utilised by the school community. Therefore, a significant portion of the responsibility in realising this MOE's desire will rest on the shoulders of school leaders as they are the role models in using technology in schools and are responsible for leading school culture change towards technology integration (Korkmaz et al. 2022). This shows that technology leadership should be emphasised by all relevant stakeholders as it is an important element to foster technology integration in schools by employing various methods such as creating clear technology integration vision for their schools and improving teachers' technological skills.

A school leader who practices technology leadership is responsible in setting strategic vision and direction for integrating technology into the educational environment. This vision may include the desired outcomes for integrating technology into the PdPc environment, such as increasing students' engagement, promoting critical thinking skills, and enhancing access to educational resources. This statement is supported by Dasmo et al. (2021), who argue that one of the key characteristics of a technology leader is having a robust technology vision that can be shared by all stakeholders in the school. They tend to produce a school technology plan that is specific, measurable, achievable, relevant, time-bound (SMART), and alligned with

the curriculum. This clear vision is vital as it increases the success rate of an initiative because teachers will be more aware of and understand the administrators' expectations.

Additionally, technology leaders can enhance teachers' technological proficiency as well because they can influence teachers' behaviour by being role models of technology users. Yu & Prince (2016) support this argument by stating that school leaders are the most influential individuals in encouraging the school community to use technology in their daily activities. This implies that the behaviour of technology leaders will significantly impact teachers' technology integration. For instance, school leaders who voluntarily chose to obtain technological certifications in education such as Google Certified Educator, Microsoft Certified Educator, or Apple Teacher, offered under the MOE's DELIMa initiative (Adnan & Husnin 2024) will inspire and encourage other teachers to follow their lead. Subsequently, more teachers will be equipped with the necessary technological knowledge and skills that can help them in integrating technology in PdPc. This is especially useful in situations that require them to use ICT-based teaching aids (BBM) such as YouTube, Minecraft Education, Schoology, Google Slides and so on. If such efforts are consistently practiced, surely the quality of PdPc process will improve as the digital learning needs of 21st-century students are met (Mohid et al. 2018).

In the Malaysian education system, technology leadership is becoming an increasingly popular factor due to its potential impact in achieving MOE's goals. Many local scholars have studied about the relationship between technology leadership and other various variables such as teachers' performance (Yusof et al. 2021), Technological Pedagogical Content Knowledge (TPACK) competency (Ong & Hanim 2023), students' digital competency (Mokhtar & Norman 2023), teachers' commitment (Jailani & Izham 2023; Leong & Hanim 2023), and teachers' online teaching and learning (Sanmugam et al. 2023). The mixed results shown by these studies indicate that the topic of technology leadership is still in its infancy in Malaysia and deserves to be studied in greater depth.

To sum up, there are several elements of technology leadership, which include roles, strategies, techniques, knowledge, skills, functions, and leadership styles of school leaders. Among all of the mentioned elements, this concept paper will utilise the technology leadership definition by Jailani & Izham (2023) who defined technology leadership as a type of leadership style because the meaning of leadership style is broad enough to encompass most of the forms and functions of technology leadership that have been discussed. Therefore, this concept paper will define technology leadership as a type of leadership style demonstrated by school leaders to influence and encourage school members to achieve certain goals using technology. A competent technology leader will be able to promote technology integration in schools by producing clear technology integration vision and improving teachers' technology skills.

Technology Integration Definitions and Concept

In this era of Industrial Revolution (IR) 4.0, it is undeniable that technology has a significant impact on the ways humans work, communicate and learn. In the context of education, especially during the PdPc process in which the intensity of humans' activity is high, technology integration will transform how the teachers teach as well as how the students learn. However, what is meant by technology integration? Does a teacher who uses a laptop

to project Microsoft PowerPoint slides in a classroom during PdPc can be categorised as technology integration?

In order to understand these two questions, it is imperative to understand the existing definitions of technology integration first. According to Ruggiero & Mong (2015), technology integration is defined as a process to improve teaching and learning. This definition is very general and the instruments to achieve the specified goal are not stated. Besides that, technology integration can also be understood as the way teachers use educational technologies such as hardware or software during teaching and learning to realise a specific teaching process (Backfisch et al. 2021). This definition is better as the instrument to achieve the educational goal is stated, which is the use of hardware or software. In addition, Consoli et al. (2023) have defined technology integration as a process that leads to the use of technology or the sole usage of technology in an educational context to support educational goals. This definition seems like an extension to the first definition and the meaning is broad enough to cover the field of education. This is because in this definition, teachers who use technology for administrative purposes are also included. Therefore, it can be deduced that the definition of Backfisch et al. (2021) is more appropriate for the context of PdPc in the classroom while Consoli's et al. (2023) definition is more suitable to describe technology integration in the field of education in general. Given that this concept paper focuses on technology integration in the classroom for PdPc processes only rather than administrative tasks, hence the definition of technology integration in this concept paper will be the way teachers use technology such as hardware, software or connectivity to enhance PdPc processes in the classroom.

The term technology integration is often used interchangeably with the use of technology as well, a similar case with the terms between technology and ICT. However, Consoli et al. (2023) have provided a useful point to consider when scholars are deciding whether to use the phrase technology integration or use of technology by taking into account the alignment factor of technology use with the educational context elements. Some vital elements include school infrastructure, curriculum, pedagogy, teachers' skills, students' characteristics, learning outcomes, learning environment and assessment. In short, if the technology used can improve any of these aspects of the educational context, then the endeavour can be labelled as technology integration. Turning to the question of whether teachers who use laptops to project Microsoft PowerPoint slides in the classroom during PdPc can be labelled as technology integration earlier, the answer will be dependent on the educational context. If the Microsoft PowerPoint slides projected by the teacher contain accurate information, written with appropriate font size, equipped with visual aids such as images, combined with effective explanation from the teacher which leads to the achievement of learning outcomes, then the use of laptop and Microsoft PowerPoint slides in this scenario can be labelled as technology integration.

That being said, it is not easy to create such scenarios. Teachers need to have the necessary knowledge and skills in advance and be willing to spend time to prepare these technological materials on top of other workloads. In relation to that, Raygan & Moradkhani (2022) have listed three main factors that affect technology integration, namely teachers' TPACK competence, teachers' attitude towards technology integration, and school climate. Teachers need to be competent in all three domains of knowledge, which include technology,

pedagogy, and content to integrate technology in their lessons effectively. In addition, teachers who have a positive attitude towards integrating technology will be more open to integrating it in the classroom. School climate such as culture, environment, leadership, co-operation among school staff can also influences teachers' effort in technology integration. Moreover, Backfisch et al. (2021) have found that teachers' motivation plays an important role in influencing teachers' technology integration. However, teachers' motivation is sensitive to contexts such as the type of technology provided by the school and teachers' experience in integrating technology in the classroom. Lawrence (2022) has also listed three main drivers that can influence teachers' technology integration which include teacher, technological and institutional-level drivers. Teacher-level drivers consist of teachers' attitudes towards ICT and teachers' ICT knowledge whereas technological-level drivers include teachers' perceptions of the usefulness of ICT, teachers' perceptions of the ease of use of using ICT, and suitability of using ICT. Finally, the institutional drivers encompass leadership support and resources.

In conclusion, there are many factors that can influence teachers' technology integration, but the teachers themselves are the most important factor in ensuring the success of technology integration efforts. This is because technology resources provided by stakeholders will be pointless if the teachers do not have the necessary competence to integrate them or have a negative attitude towards technology integration. Conversely, teachers who properly integrate technology in PdPc will create a conducive learning environment, support teaching and learning process, as well as improve students' achievement, motivation and 21st century skills (Das, 2019; Willis et al. 2019; Wali & Popal 2020; Carstens et al. 2021; Lee et al. 2022). Nonetheless, the MOE should always ensure competent technology leaders are placed in each school so that they can optimally leverage the teachers' potential in technology as technology leadership is one of the most important factors that can affect teachers' technology integration.

Technology Leadership Models

National Educational Technology Standards for Administrators (Nets-A) Technology Leadership Model

The NETS-A technology leadership model was established by ISTE in 2009 (ISTE, 2009). ISTE was founded in 1979 by a group of educators who aspired to transform the role of teachers and students in education using technology (ISTE, 2024). Today, ISTE has become a non-profit organisation that connects educators from around the world and is committed to helping educators use relevant technology with effective pedagogy to create meaningful learning experiences. They not only strive to develop technology-related expertise for teachers, students, coaches and administrators, but they also constantly provide professional development programmes (Aslam et al. 2020).

The history of NETS-A model can be traced back as early as 2001 when ISTE established the earliest NETS-A technology leadership standards (Bass, 2019). The NETS-A standards at that time outlined six areas of knowledge and skills that school leaders need to master, namely visionary leadership, learning and teaching, professional practice, support and improvement, assessment and evaluation, and promoting ethical and social use. In 2009, the model was updated due to the growing importance of technology in affecting the society,

workplace and needs of 21st century students (Schrum et al. 2011). Hence, it can be said that the NETS-A model often used by scholars and reviewers is a revised NETS-A model based on the 2001 NETS-A standard. There is one significant change in this new NETS-A model, which is the number of dimensions has changed from six to five. The five dimensions include visionary leadership, digital age learning culture, excellence in professional practice, systemic improvement, and digital citizenship (ISTE, 2009).

The visionary leadership dimension refers to school leaders who lead the development and implementation of ICT vision to promote optimal use of technology with the cooperation of the school community. School leaders normally do so by sharing the school's ICT vision with all school members so that everyone understands its content and can collaborate together to achieve the vision. The dimension of digital age learning culture stated that school leaders need to be responsible for creating and ensuring a technology-based learning environment that can foster students' creativity during PdPc. Therefore, it is advisable for school leaders to fully incorporate the use of ICT in every school operation ranging from carrying out administrative tasks to curriculum planning and meetings.

Meanwhile, excellence in professional practice dimension encourages school leaders to promote professional learning environments and innovations that can equip teachers with the knowledge and skills needed to enhance students' learning through the integration of latest digital technologies and resources. For this dimension, school leaders should always nurture teachers to join professional learning programmes to improve their professionalism in the field of ICT. In addition, is the dimension of systemic improvement. In this dimension, school leaders are responsible to manage the school by providing the best ICT facilities and services. Among the initiatives that school leaders can implement is to collaborate with teachers to improve existing weaknesses based on information from the School Management System (SMS). The fifth dimension is digital citizenship. This last dimension suggests that school leaders should be role models and facilitators in improving school members' understanding of social, ethical and legal issues regarding to technology integration, as well as taking responsibility for issues related to the dynamic digital culture. In other words, school leaders should take the lead in taking appropriate measures towards the safe use of technology to prevent cases such as misuse of technology and cybercrime from occurring.

The NETS-A technology leadership model has received great attention from scholars around the world to the point that it is labelled as golden framework of technology leadership (Arafeh, 2015). This recognition is due to the fact that the NETS-A model not only outlines useful guide and best practices in teaching, learning and technology leadership in education, but the standards in this model can also be used to assess the knowledge and skills needed by school leaders to support learning in the digital era (ISTE, 2014). This argument is supported by the fact that most scholars in Malaysia have used the NETS-A model in their studies (Yusof et al. 2021; Hamid et al. 2021; Ong & Hanim 2023; Mokhtar & Norman 2023; Sanmugam et al. 2023; Leong & Hanim 2023). The use of the NETS-A model by the majority of researchers in Malaysia shows that the NETS-A model has its own advantages, be it used to explain the variables of technology leadership or to assess the level of school leaders' technology leadership. However, Arafeh (2015) has criticised the NETS-A model by stating that the NETS-A model does not provide a clear organisational structure at the foundational level to understand the involved infrastructure components. The second criticism is that

dimensions such as systemic improvement incorporates several concepts that may be confusing to inexperienced and newly trained school leaders.

Arafeh Technology Leadership Model

Arafeh (2015), has established his own technology leadership model by stating that his technology leadership model is more consistent in terms of concepts and includes elements that are essential for the efficient use of technology such as technical, instructional, administrative, resource and behaviour aspects compared to previous technology leadership models. He also claimed that the strength of his technology leadership model is that it can provide a more comprehensive picture regarding the interrelationship between items, processes, people and behaviours to all educational leaders so that they can understand the diverse elements involved in technology leadership better.

Arafeh's technology leadership model contains six types of infrastructure needed for technology integration, namely communication, technical, human, resource, context and core infrastructure. Each of these infrastructures will contain its own main elements and sub-elements, all of which will be strengthened by continuous and comprehensive core practices. For example, the main elements under technical infrastructure are networks, devices and software. These main elements consist of various sub-elements that include modems, computers, tablets, school's internal systems and so on. He has stated that the purpose of this model is to play the role of a guide and starting point for the awareness of educational leaders (Arafeh, 2015). He also explained that not necessarily all school leaders will be proficient in all six types of infrastructure that have been outlined. Therefore, it is recommended that school leaders adopt a distributive leadership style to delegate tasks related to integrating existing technologies, referring to experts and making decisions based on the opinions from other stakeholders.

Although Arafeh has good intentions and indeed established a comprehensive model to help technology leaders develop their technology leadership potential, no studies have been found in Malaysia that utilise Arafeh's technology leadership model. This is probably because the scope of Arafeh's technology leadership model is too broad and there is no specific explanation for each main element, making it difficult for scholars to build suitable instruments based on this model.

International Society for Technology in Education Standards for Education Leaders (Iste-El) Technology Leadership Model

The ISTE-EL technology leadership model was established by ISTE, the same organisation that established the popular NETS-A model. According to Bass (2019), ISTE has redesigned the 2018 NETS-A model by making some changes such as changing the name of administrators to education leaders and modifying the five dimensions under the ISTE-EL model. This new model indicates the transition of the role of education leaders from merely administrators to leaders who facilitate the creation of a conducive learning environment in classrooms, schools, districts and beyond using digital technology (Crompton, 2018). The principles underpinning ISTE-EL model are mostly regarding the practices on how to develop a system of shared empowerment, trust and leadership.

The five dimensions underlying the ISTE-EL technology leadership model are equity and citizenship advocate, visionary planner, empowering leader, systems designers and connected learner (ISTE, 2018). The citizenship and equity dimension focuses on equity, inclusion and digital citizenship practices. Education leaders are responsible for ensuring all students have access to teachers who are competent in using technology to help them achieve their learning objectives. They also need to ensure students have access to the necessary technologies and connectivity needed to engage in meaningful learning activities. In addition, education leaders have a role to play in modelling digital citizenship by critically assessing online sources, engaging in online civic discourse and using digital tools to make positive social impacts. They need to foster responsible online behaviours regarding the safe, ethical and legal use of technology among students.

The next dimension is visionary planner which focuses on how educational leaders engage others in realising the vision, strategic plans and continuous assessment cycles to transform learning using technology (ISTE, 2018). Educational leaders are expected to engage stakeholders in building a shared vision based on learning sciences. They then need to work together to develop a strategic plan that outlines how technology will improve learning. In addition, education leaders should assess progress towards that specified plan, make changes as needed, and assess the impact of technology on learning outcomes. Effective communication with stakeholders is important in this dimension, such as gathering feedback, celebrating successes, and engaging in continuous development. Education leaders are also required to share lessons learnt and best practices with other education leaders to promote continuous learning and development in this field.

Furthermore, the empowering leader dimension emphasises education leaders to create a culture where teachers and students are encouraged to use technology in innovative ways and enrich the PdPc process (ISTE, 2018). Educational leaders should empower educators to exercise professional agency, build leadership skills and embark on personalised professional development. Meanwhile, they must support educators in exercising ISTE standards for educators and learners by providing them with the necessary confidence and skills to do so. Education leaders should inspire a culture of innovation and collaboration as well by allocating time and space for the exploration of digital tools. Additionally, they should support educators in using technology to meet the diverse learning needs of learners, including their cultural and socio-emotional needs. Education leaders are also responsible for developing learning assessments that can accurately measure students' progress and achievement in technology-enhanced learning environments.

The fourth dimension is the systems designer dimension, which outlines guidelines for education leaders to create teams and systems to implement, maintain and continuously enhance the use of technology to support learning (ISTE, 2018). Education leaders are expected to lead the team in creating a reliable infrastructure and system required to carry out the strategic plan in a cooperative manner. Furthermore, they must ensure there are sufficient resources to enable the efficient use of technology in education, and that these resources can be scaled to meet future needs. Education leaders are also responsible for protecting privacy and security by ensuring all school members and students adhere appropriate data management and privacy practices. It is their task to form partnerships that

can achieve or enhance the outlined strategic vision, learning objectives and technology-based operations.

Lastly, is the connected learner dimension. This dimension emphasises education leaders to exemplify and encourage continuous professional learning for themselves and others (ISTE, 2018). Education leaders are required to set goals to keep up with evolving technologies for learning, pedagogical innovations and developments in the science of learning. Besides that, they should always take part in online professional learning networks to collaborate, learn, and mentor other professionals. They should also use technology on a regular basis to engage in reflective practices that promote personal and professional development. Moreover, it is vital that education leaders develop the expertise required to drive system advancement, lead and manage change, and encourage a continuous improvement mentality in order to maximise the learning potential of technology.

Based on the elaborations of the five dimensions of ISTE-EL model, it can be deduced that the ISTE-EL model is more comprehensive and in line with current educational needs because the model contains elements such as equity and inclusivity that are not found in the NETS-A or Arafeh model. There are several foreign researchers who have applied ISTE-EL model in their studies on technology leadership (Bass, 2019; Miller, 2022; A'mar, 2023) but similar studies are still absent in the Malaysian context. In relation to that, it is crucial that future researchers utilise the ISTE-EL model to examine technology leadership further as recommended by (Anderson & Dexter 2005; Bass, 2019. This is because the ISTE-EL model may be a better model compared to the NETS-A model.

Technology Acceptance Model (TAM)

The TAM model has been around for almost three decades but it remains relevant today, despite the fact that many researchers have modified the original TAM model. According to Mugo et al. (2017), the idea of TAM model originated from Fred Davis's Doctor of Philosophy thesis in 1985. He considers system usage as a type of behaviour, hence he has applied the theory of reasoned action to underlie the TAM model. This model was then established to depict how users accept and use technology. There are two important components that make up the TAM model, namely the core variables of user motivation and outcome variables (Scherer et al. 2019).

The core variables of user motivation consist of three main factors that will influence the user's decision in determining how and when to use a given new technology. The three factors are perceived usefulness, perceived ease of use, and attitude towards system use. Davis et al. (1989) defines usefulness as the extent to which a person believes the use of technology can improve his work performance in an organisational context. Besides that, ease of use can be understood as the extent to which a person believes that the use of technology is easy and does not require effort to operate it. Attitude towards system use is the main determinant of whether a user accepts or rejects a system use (Granic & Marangunic 2019). In addition, outcome variables consist of usage behaviour and actual technology use. The TAM model begins with the influence of internal or external variables such as user attitude, pedagogy level, efficiency level, organisational, technological and social influences (Mugo et al. 2017). These internal or external variables will affect the core variables of user motivation, which will then continue to affect the outcome variable. However, an interesting point to note

is that perceived usefulness can influence user's usage behaviour directly. This has been explained by Davis et al. (1989) who stated that users who intend to use technology solely for extrinsic rewards will be more inclined towards cognitive judgements (*user's usage behaviour*) rather than attitudes.

TAM model has been criticised by Kimmons et al. (2020) who stated that this model is less focused on education or learning, emphasises technology and user acceptance, and lacks pedagogical elements. However, Granic & Marangunic (2019) found that the use of the TAM model had deep roots in educational contexts. This matter is further strengthened through several studies that have modified the TAM model with different names such as TAM2, TAM3, TAM-ECEC and so on (Malatji et al. 2020; Rad et al. 2022). In Malaysia, there are also several researchers who used the TAM model to underlie technology integration variable in their studies (Huang & Teo 2020; Hu & Asmaa AlSaqqaf 2021). Therefore, it can be concluded that TAM model is still relevant in the educational context even though it is not as popular in Malaysia. This model has its own strengths such as that it is flexible in a way that its components can be customised to meet different research needs.

Substitution, Augmentation, Modification and Redefinition (Samr) Model

SAMR is an acronym for substitution, augmentation, modification and redefinition. These four components formed the basis of SAMR model. SAMR model was founded by Dr. Ruben Puentedura around 2006 although he had produced several works regarding SAMR model before that (Wahyuni et al. 2019). According to Boonmoh & Kulavichian (2023), the SAMR model was developed to explain the integration of technology in teaching and learning. This model is also often recognised as a ladder that has four levels for educators to choose, use and assess technology in education.

The substitution level is the lowest and most basic level, followed by augmentation, modification and redefinition. In the substitution level, technology is merely used to replace a specific tool without any change in function (Puentedura, 2006). For example, teachers use electronic textbooks instead of printed textbooks. The impact of technology on PdPc in this level is very low. The next level is augmentation in which technology integration is also used to replace tools but it can improve the PdPc process greatly. For instance, students use computers and internet to study a given topic. In this example, technology is not merely used to replace tools but can enhance the effectiveness of PdPc as well when the students seek additional information that is not available in printed textbooks.

Additionally, is the modification level. In this level, technology integration is no longer used to replace functions of previous tools but begins to change aspects of PdPc experiences that can lead to student-centred learning (Oded & Oded 2022). For example, students collaborate with their peers and teachers to produce an online presentation. Such learning activity will transform the way teachers teach and students learn as it moves away from traditional chalk and talk activities. The last level is redefinition. Technology integration is transformative at this level with creation of new tasks that cannot be done without technology. An example would be teachers and students undertaking a virtual tour activity using Google Earth and Google Meet applications to visit famous sites in different countries and meeting students virtually. These kinds of activities are unrealistic and limited if carried out in the real world due to educational policy, time and cost factors. A thorough analysis will

reveal that integrating technology at the substitution and augmentation levels tends to be more enhancement-oriented, whereas integrating technology at the modification and redefinition levels is more transformational. Therefore, Puentedura has categorised the substitution and augmentation levels under the enhancement category, while the modification and redefinition levels under the transformation stage in 2013 (Boonmoh & Kulavichian 2023).

In conclusion, technology integration under the transformation category can improve the effectiveness of PdPc much better than enhancement category. Conversely, a criticism of the SAMR model is that the distinction between levels and student's activity at each level is vague (Kimmons et al. 2020). In the context of education in Malaysia, this model has been used by several researchers to study digital assessment literacy and technology integration (Nair, 2021; Irdena et al. 2023). The SAMR model has also been modified by researchers by applying other theories or models such as TPACK and Bloom's Taxonomy in their studies that showed positive results (Tunjera & Chigona 2020; Nair & Tay 2021). Hence, it can be said that SAMR model is a solid structure that can be used as a guide by educators to integrate technology in the classroom.

Technology, Pedagogy, and Content Knowledge (Tpack) Model

The TPACK model is based on Shulman's (1986) Pedagogical Content Knowledge (PCK) concept which emphasises on the importance of teachers combining content and pedagogy to improve student's understanding of a topic and to cater different learner's abilities. Later on, Koehler & Mishra have added a new component to Shulman's PCK concept in 2005, namely the technological knowledge (Koehler & Mishra 2005). Hence, the basic concept of TPACK was created from there and established as TPACK model in 2006 (Mishra & Koehler 2006). Mishra & Koehler (2006) have defined TPACK as the interaction between three knowledge constructs, namely Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Knowledge (TK) and their intersection with PCK, Technological Content Knowledge (TCK), and Technological Pedagogical Knowledge (TPK) in a given context. Therefore, it can be said that the TPACK model is a model consisting of various knowledge constructs that can provide a new perspective for educators to integrate technology in PdPc.

The TPACK model emphasises that teachers who want to integrate technology in PdPc effectively should take into account the pedagogical and content knowledge aspects as well. This has been further explained by Koehler et al. (2013) who stated that adding new technology to the existing PdPc structure will not lead to efficient learning. Educators must also make changes to their pedagogical and content aspects. There are seven knowledge constructs under the TPACK model, comprising of CK, PK, TK, PCK, TCK, TPK and in the middle is TPACK. CK refers to the knowledge or specialised nature of a field or subject. PK entails the teacher's proficiency in organising and implementing teaching and learning activities to achieve learning objectives. TK denotes the understanding in operating computer equipment and software. The interaction between CK and PK will result in PCK which focuses on the importance of using different teaching methods for different topics. On the other hand, TCK describes the reciprocal relationship between technological and content knowledge due to the fact that technology has created new knowledge and ways of teaching for humans. In addition, it is TPK that explains about the mutual relationship between technology and

pedagogy. Teachers need this knowledge construct to understand the potential of technology to be used as a teaching tool while taking into account their own teaching style.

The synthesis of these six constructs of knowledge will result in TPACK that emphasises on how technology can be adapted to meet the pedagogical needs of teachers to teach specific subjects in different contexts (Koehler et al. 2013). The TPACK model can not only help teachers to effectively integrate technology in PdPc but can also be used as an assessment tool to measure the aforementioned function. Moreover, the TPACK model also recognises the importance of contextual factors. This is supported by Swallow & Olofson (2017) who stated that the TPACK model values contextual factors as they can affect the development and content of TPACK. Factors such as teachers' beliefs, experiences and goals are all related to contextual factors. As a result, Mishra (2019) has revised the TPACK model in 2019 by modifying the context element in the original TPACK model to Contextual Knowledge (PX). PX encompasses all essential factors, ranging from teachers' awareness of readily accessible technology to their understanding of policies that is in place at their school, district, state, or federal levels.

Overall, the TPACK model has outlined the essential components that are needed by teachers to integrate technology efficiently in PdPc. Teachers who are competent in TPACK will be able to integrate technology effectively in their classrooms to enhance PdPc processes (Chieng & Tan 2021; Raygan & Moradkhani 2022). However, Arafeh (2015) has argued that the TPACK model is ineffective in certain vital teaching practices such as lesson design. Nonetheless, if the focus of the study is on the assessment of teachers' technology integration during PdPc, then this shortcoming can be negligible. In regard to that, this concept paper claims that the TPACK model is more suitable for measuring the teachers' technology integration variable compared to the TAM and SAMR models, which place less emphasis on pedagogy. This argument is supported by the fact that most researchers in Malaysia have utilised the TPACK model to assess teachers' technology integration in classroom (Lau & Roslinda Rosli 2020; Intan Marfarrina Omar et al. 2021; Akun & Fitri Suraya 2021; Sampar & Mohamed 2023; Ong & Hanim 2023).

Technology Leadership and Teachers' Technology Integration Issues in Malaysia

The fifth shift in PPPM has stated that high-achieving leaders will be placed in every school (MOE, 2013). Ideally, school leaders in Malaysian schools today are all capable of playing the role of efficient technology leaders in leading the efforts of technology integration among teachers. However, previous researches regarding the level of technology leadership in Malaysia yielded inconsistent results. Although there are plenty of studies that indicated the level of technology leadership practised by school leaders in Malaysia is high (Yusof et al. 2021; Hamid et al. 2021 ; Ong & Hanim 2023; Sanmugam et al. 2023; Leong & Hanim 2023), but the number of studies that showed the overall level or certain dimensions of technology leadership practiced by school leaders in Malaysia that are still at a modest or unsatisfactory level is also comparable to such studies (Yasnain & Khalid 2019; Mokhtar & Helmi Norman 2023; Yusoff & Izham 2023). The same scenario also occurs in a Malaysian state named Sabah where research findings regarding technology leadership there yielded inconsistent results (Huzaifah & Norhaini 2018; Talip & Tiop 2020; Tiop & Talip 2020). Besides that, majority of these past studies utilised the traditional NETS-A model to measure technology leadership. This practice should be changed by using a more recent technology leadership model such as

the ISTE-EL model that is more suitable with current educational needs. Such practice will also correspond to Anderson & Dexter's (2005) suggestion, who stated that standards such as NETS-A will be improved over time, therefore studies on technology leadership should remain current with the latest developments and monitor the changing capacities of schools for technology leadership. So far, only foreign researchers such as (Bass, 2019; Miller, 2022; A'mar, 2023) have utilised the ISTE-EL model in their studies. In Malaysia, similar studies have not been found yet. In conclusion, the level of technological leadership in Malaysia is still uncertain because past studies have shown contradictory results.

In addition, since teachers are the primary implementers in integrating technology in PdPc, they should possess a competent level of knowledge and skills in this field. However, in the global context, Alea et al. (2020) found that only 58% of teachers in the Philippines are willing to use online learning materials and learning management systems. Valtonen et al. (2020) also observed that teacher trainers in Finland still possess low levels of CK, TCK and TPACK despite having a positive attitude towards integrating technology. In the Malaysian educational context, although MOE has stated that it will train all teachers to integrate ICT in PdPc to improve students learning (MOE, 2013), but past studies showed that there is still a significant gap in MOE's goal. One of such studies is by Omar et al. (2021) who reported that the level of ICT skills and the use of technology by secondary school Malay teachers in Kelantan in the teaching of Literary Components (KOMSAS) as well as development of students' thinking is at a moderate level. Sanmugam et al. (2023) also found that teachers in Hulu Langat, Selangor rarely use ICT in PdPc after covid period. This is because they are less proficient and lack of confidence in using ICT to carry out PdPc effectively, resulting in the usage of printed textbooks as the main PdPc material. In relation to that, Akun & Suraya (2021) have found the level of TCK, TPK and TPACK among secondary school teachers in the southern zone of Sarawak to be at a modest level. In the northern zone of Sarawak as well, Chieng & Tan (2021) have discovered that all technology-based knowledge constructs such as the TK, TPK, TCK and TPACK of the teachers there have lower mean scores. Moreover, there are still some Sarawak preschool teachers who possess modest level of TK (Sampar & Mohamed, 2023). In Sabah, only one study related to TPACK was found, which is a study by Juwait et al. (2022) who revealed that the level of TPACK among Physics teachers in Sabah is at a high level. Studies regarding TPACK among primary school teachers in Sabah has never been carried out. This matter should be taken seriously because TPACK is a significant predictor of teachers' technology integration (Chieng & Tan 2021; Raygan & Moradkhani 2022), can reduce the level of teachers' technostress (Ozgur, 2020), and serves as a useful framework for PdPc because TPACK outlined the types of knowledge required by teachers for efficient technology integration (Zhang & Tang 2021). In summary, it can be said that teachers who are competent in TPACK will be able to integrate technology efficiently in PdPc but Malaysian teachers still lack the knowledge and skills from both the aspects of TPACK and general technology integration skills.

The third issue is that studies on the relationship between technology leadership and teachers' technology integration are still lacking, especially those that utilised the latest ISTE-EL model and TPACK model. Such studies have only been conducted by foreign scholars in Palestine (A'mar & Eleyan 2022; A'mar 2023) and in the United States (Fraser, 2020). (A'mar & Eleyan 2022; A'mar, 2023) found that there is a significant and positive relationship between technology leadership and teachers' technology integration while Fraser (2020)

concluded that teachers agreed technology leadership will help them to integrate technology in PdPc effectively. Relevant studies in Malaysia are either lacking or showed contradictory findings. For instance, although (Ghavifekr & Wong 2022; Ong & Aida Hanim 2023) found that technology leadership has a strong and significant relationship with TPACK competence and effective integration of ICT by teachers, but (Raman, Thannimalai & Ismail 2019; Yahya & Raman 2020) reported the opposite finding, which is that technology leadership has no significant relationship with teachers' technology integration and is not a factor that can influence teachers' acceptance on ICT tools integration in schools. This issue worsens when only one relevant study was conducted in Sabah, though the researcher studied about the effects of technology leadership on teacher's self-efficacy (Tiop & Talip 2020). Furthermore, most of these studies related to technology leadership in Malaysia were carried out in Peninsular Malaysia and utilised the traditional technology leadership model. The lack of studies on this topic, especially in the states of Sabah and Sarawak is of concern because MOE's policymakers do not have relevant and comprehensive data to plan for future technology-based policies in education. To sum up, it can be concluded that the issues with this topic in Malaysia is that the level of technology leadership is still uncertain, teachers still lack knowledge and skills to integrate technology in PdPc, and lack of studies on the relationship between technology leadership and teacher technology integration, especially studies that utilise the ISTE-EL model.

Recommendations for Future Research

Based on the stated issues, this concept paper proposes some research recommendations that scholars and MOE policymakers can consider. First of all, researchers are advised to utilise the ISTE-EL model to underlie the technology leadership variable in their studies. Such studies will pioneer the level of technology leadership in Malaysia according to the the latest ISTE model which has the potential to be a better technology leadership model compared to the previous NETS-A model. The next research recommendation is to conduct studies that investigate on the relationship between technology leadership and teachers' technology integration based on both ISTE-EL model and TPACK model. This is because the ISTE-EL model contains elements that are more in line with current educational needs such as equity and inclusivity while the TPACK constructs have significant relationship with teachers' technology integration. In addition, researchers may consider conducting relevant studies in the states of Sabah and Sarawak to obtain a more thorough understanding of the technology leadership and teachers' technology integration landscape in Malaysia as most studies regarding this topic have only been conducted in Peninsular Malaysia. The findings of such research are essential because they provide MOE policymakers with relevant and meaningful data for future educational policy planning.

Summary

To conclude, it can be understood that technology leadership is a type of leadership style that is demonstrated by school leaders to influence and encourage school members to achieve certain goals using technology. On the other hand, teachers' technology integration refers to the way teachers use technology such as hardware, software or connectivity to enhance students' PdPc process in the classroom. Past studies have indicated that both technology leadership and teachers' technology integration elements have their own advantages. Additionally, school leaders who practise technology leadership style have the potential to influence teachers' technology integration. Three technology leadership models consisting of

NETS-A, Arafeh and ISTE-EL models along with three models of teachers' technology integration, namely TAM, SAMR and TPACK models have also been discussed. From the aspect of technology leadership models, the ISTE-EL model merits greater attention because technology leadership studies using the ISTE-EL model have never been carried out in Malaysia. From the aspect of teachers' technology integration model, the TPACK model has been proven as a more suitable model to measure teachers' technology integration. Issues pertaining to this topic will hinder MOE's goal to improve the quality of technology-assisted teaching and learning in Malaysia if not addressed in a timely manner.

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