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ICT Competencies and Technology Leadership Practices among In-Service Teachers in Rural Primary Schools

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Abstract

The evolution of industries has shaped the education and learning process to be vibrant and Information and Communication Technology (ICT) driven. The COVID-19 pandemic accelerated the adoption of educational technology and reshaped pedagogical practices. Notably, the school stakeholders encounter struggles in bridging the gap in ICT between urban and rural schools. Therefore, this study investigated the relationship between ICT competency and technology leadership practices among rural primary school teachers in the Klang district of Selangor, Malaysia. A descriptive-correlational design was employed, and the respondents were 121 teachers from 35 rural government primary schools under the jurisdiction of the Ministry of Education, Malaysia. Permission to conduct the research was obtained from the Education Planning and Research Division (EPRD) and the State Education Department (SED). A Google Form was adopted to distribute the survey form, and the data were compiled and analyzed using SPSS version 24.0. Descriptive analysis indicated that three dimensions of teachers' ICT competency: 1) knowledge, 2) skills, and 3) attitudes are at a high level, and technology leadership practices are also at a high level. Pearson correlation analysis indicated a moderate positive association between the two variables ($r = 0.571$, $p < 0.01$), although the findings should be interpreted cautiously because of the exploratory sample and the absence of cluster-adjusted analysis. In summary, ICT competency and technology leadership practices are important for educational stakeholders. With a great challenge in the educational landscape, teachers and school administrators must now make extensive efforts to advocate for digitalization in education across diverse pedagogical settings.

Keywords

ICT Competency, Technology Leadership, Primary School Teachers, Rural Schools, Malaysia

1. Introduction

Information and Communication Technology (ICT) has become an essential and primary factor in the educational system throughout the globe (Omar et al., 2020). The COVID-19 pandemic and persistent technology gaps among educational stakeholders have accelerated the shift from conventional teaching methods to digital-based education. Indeed, ICT plays a significant role in various educational institutions in advocating qualities in school management and administration, instruction, and student success (Lawrence & Tar, 2018).

The integration of ICT in education has been extensively studied over the past 40 years, and its contribution to the education system is well appreciated (Anderson & Dexter, 2005; European Commission, 2013). As such, the digital age has shifted global society toward a dependence on information and knowledge-seeking through ICT applications, modifying and revamping traditional teaching and learning strategies (Anderson, 2008; Lorenz et al., 2015).

When globalization and ICT expansion began, the new knowledge-based economy brought prosperity and wealth to the nation. This evolution includes competitiveness and the ways in which human beings perform tasks and responsibilities at the workplace. The benefits of digitalization and technology have been evident over the past few years with the implementation of e-commerce, the gig economy, and application-based services that utilize ICT.

Thus, most countries around the globe have invested in ICT to meet the demand of digital transformation. In Malaysia, for example, the total allocation for the education sector rose from RM36.5 billion in 2008 to RM60.2 billion in 2019. Additionally, 19% of the central government's expenditure allocation was distributed to the education sector (Ministry of Finance Malaysia, 2018). Meanwhile, approximately RM6 billion has been spent on implementing ICT-based programs in education from 1990 to 2010 and a total of RM4.47 billion was spent on the Virtual Learning Environment called the FrogVLE program. This substantial financial support reflects the government's commitment to ICT integration and to fostering a culture of digitalization among school stakeholders. In addition, several initiatives at the micro-level include the development of school clubs and bodies, for example, the Computer Club, the Network Project, and the Computers in Education Club. Modern applications and software related to government efforts are the Smart Schools initiative, Educational TV programs, EduWebTV, School Net Project, and 1BestariNet Project. ICT programs have been implemented by the MOE to improve the quality of student learning and empower teachers' competency

in utilizing technology in teaching (Mahmud & Ismail, 2010; Sa'don et al., 2013).

Reflecting on the huge investment by the government, this study aimed to determine the ICT competency and technology leadership practices among primary school teachers, and to examine the relationship between technology leadership practices and teachers' ICT competency.

To address these aims, the following research questions were formulated:

RQ1: What is the level of teachers' ICT competency?

RQ2: What is the level of technology leadership practices?

RQ3: What is the relationship between teachers' ICT competency and technology leadership practices?

To situate these questions within existing scholarship, the following section reviews the literature on teachers' ICT competency, technology leadership, and their interrelationship in school settings.

2. Literature Review

ICT integration took place in Malaysian education in the early 1990s. Since then, the Malaysian Ministry of Education (MOE) has initiated various efforts and intervention programs to provide ICT infrastructure, either hardware or software, to execute ICT-based instructions effectively. MOE aims to develop 21st-century human capital with creative and critical thinking skills who can compete in the challenging job market. For this mission, coping with digitalization and the ICT landscape would enhance individual capability and capacities to cope with the current needs of employment. Despite this, the utilization of ICT has relatively assisted human beings in devising businesses and the economy. Moreover, the ICT application in the context of education is not new. ICT integration in academia was introduced in the United States and many European countries as early as the 1960s. From a global perspective, extensive initiatives have been implemented in several countries, such as the FATIH Project in Türkiye, the 2.0 School Program in Spain, the Learning Resource Center in Saudi Arabia, the U-Taiwan Region Programs in Taiwan Region, and the 1:1 Program in the United States (Alenezi, 2017; Banoğlu et al., 2016; Gil-Flores et al., 2017; Wang & Zhou, 2013). These projects have supported ICT integration in education within their respective national contexts.

According to UNESCO IITE (2017), ICT plays a pivotal role in helping teachers to advocate professionalism, especially in making a transition from pre-service to in-service teachers. To develop ICT competency, confidence, and ICT use must be demonstrated through pedagogical practices. ICT literacy among teachers is a serious matter to be taken care of by conducting a series of training and support. Due to rapid technology evolution, ongoing challenges and new technologies must be addressed from time to time as the education system relies on human capital for future competitiveness in numerous fields. Therefore, as effective technology leaders, they must equip themselves with ICT knowledge and skills as well as possess ICT awareness to execute the aspirations of the MOE.

The role of school leaders is increasingly oriented towards technology leadership (Anderson & Dexter, 2005; Kadela, 2002; Matthews, 2002; Scott, 2005; Seay, 2004). To enact this role effectively, leaders must understand technological change and support teachers by strengthening their confidence and competence in using ICT (Akbaba-Altun, 2006). Indeed, technological competence has become a key requirement for effective school leadership (McLeod & Richardson, 2013; Redish & Chan, 2007). In practice, however, many school leaders in Malaysia are not proficient in ICT, partly because the concept of technology leadership has received limited emphasis in schools. Minimal training and exposure to ICT reduce leaders' interest in technology leadership responsibilities, which in turn hamper the transfer of ICT knowledge and skills to teachers (Byrom & Bingham, 2001). When leaders lack the knowledge and skills to embark on a technology leadership role, systematic and effective ICT integration remains difficult to achieve (Gallego-Arrufat et al., 2017; Nicholas & Wells, 2017), contributing to the broader failure of ICT integration in schools. Taken together, these studies suggest that ICT integration can be optimised when school leaders recognise and act on their role as technology leaders and role models amid the demands of the digital age (Moreira et al., 2019).

The presumption of traditional teaching methods, where teachers play a central role, seems irrelevant in 21st-century academic settings (Omar & Ismail, 2019). When teachers were requested to evaluate their teaching methods, the incisive motion to integrate ICT led to a discussion on their competency in handling pedagogical methods using assistive technologies. Teachers are encouraged to use available opportunities to integrate ICT effectively to improve their teaching techniques (Kör et al., 2016). ICT competency becomes a premise in teaching strategies, since the boom in technologies has also impacted the younger generations.

The adoption of technology in education has received increasing attention. The educational environment has become remarkably flexible, adding more challenging scenarios and uncertainty regarding many aspects when it comes to providing education to people. For this reason, the ideal strategy to empower the utilization of technology in teaching is to ensure that the teacher advances in synchrony with their ICT competency. Teachers' ICT competency is a paramount element for ICT integration in teaching and learning settings (Agyei & Voogt, 2011).

Following the effort of the government in providing top-notch facilities to uphold ICT integration at school, the ICT competence of teachers must be enhanced to maximize the use of the technology acquired. Equipping teachers with knowledge and skills in ICT is crucial as the mission of the ministry is to implement the Malaysian Education Blueprint 2013-2025 (Ministry of Education Malaysia, 2013), where the utilization of ICT is hoped to warrant the improvement of the quality of instruction in Malaysia. The innovative teaching method via the use of technology is hoped to encourage participation among students and increase engagement in learning. Subsequently, a meaningful learning experience

and a quality assessment and evaluation process can galvanize a holistic learning ecosystem. Indeed, ICT integration in the school system reflects efforts from the government to strengthen the quality of education as a whole. To realize this effort, teachers' ICT competency should be taken seriously and given consummate attention for preparation in case any challenging situation arises. In other words, ICT integration is a tremendous success if the teacher is well-versed in using the technology. With a high level of teachers' ICT competency, ICT integration will increase students' performance and increase interaction in learning activities (Cansoy & Parlar, 2018; Lawrence & Tar, 2018; López-Vargas et al., 2017).

The 21st-century teacher demands changes in pedagogical methods from teacher-centered to student-centered (Omar & Ismail, 2019). Students appreciate an intellectual process involving technology utilization, including online and mobile learning. For this reason, teachers should take proactive action to become more competent in ICT (Kör et al., 2016). Past studies have reported several barriers to integrating ICT in the teaching and learning process. Lack of competency, low motivation, lack of self-confidence in using ICT tools in teaching, inadequate ICT equipment, and failure to provide commitment and adherence to school legislation were among the reasons for the aforementioned issues (Balanskat et al., 2006; Brun & Hinostroza, 2014; Joo et al., 2018; López-Vargas et al., 2017; Razak et al., 2019). Perceiving from the premise that there was less effort on ICT integration, teachers may be less likely to integrate ICT when they lack relevant competencies (Raman & Yamat, 2014). Indeed, ICT integration in pedagogical practices is strongly influenced by the ICT competence of teachers, whether or not the teacher serves in an urban or rural area (Ab Rahman et al., 2015). The low level of ICT competence makes it more difficult for teachers who are posted in rural areas to integrate ICT in learning and teaching in the classroom (Raman et al., 2019b).

School transformation involving ICT integration requires meticulous strategies and effort from school administrators. The incontrovertible digital skills of technology leaders and school principals support the ICT needs of all academic activities and contribute to school effectiveness in line with ICT integration efforts to a successful school transformation plan (Tiop & Talip, 2020). However, this mission is contrary to some of the research findings (Richardson & McLeod, 2011; Brockmeier et al., 2005; Flanagan & Jacobsen, 2003; McGarr & Kearney, 2009), which claimed that the limited number of technology leaders jeopardizes the spirit of ICT integration at school. Worse still, school principals in some rural schools encounter challenges in bridging the gap in ICT use between schools (Henke, 2010).

The findings also reported that the school principal does not have an adequate understanding of the concept of technological learning, limited capability in decision making on technology-related issues, insufficient ICT training, limited use of ICT technology in the job, lack of focus on the integration of ICT in the classroom, and is a passive user of ICT to improve 21st-century pedagogical practice (Richardson & McLeod, 2011; Flanagan & Jacobsen, 2003). Research findings by Omar & Ismail (2019) also espoused issues related to school locations, technology

leadership influence, readiness of school administrators to utilize technology in the teaching and learning process as barriers to ICT integration as a whole. Because the transition to ICT integration is unanticipated and unprepared for, the school stakeholders are coerced by the school system to optimize the technology without knowledge and capacity to execute the ministry effort. With struggles and challenges, the key that arises here is whether school leaders practice adequate technology leadership to enhance the ICT competencies of teachers.

3. Methodology

This study employed a descriptive and correlational research design. According to Noraini Idris (2013) and Creswell & Creswell (2018), this method can describe the attitudes, beliefs, perceptions, opinions, behaviors, or current practices of a sample of the studied population. This quantitative study was conducted at rural primary schools in the Klang district, involving primary school teachers as the population. The two variables examined in this study were technology leadership practices by school administrators and ICT competency among teachers. In addition, this study also explored the demographic profiles of the respondents based on gender, age, teaching experience, academic qualification, and involvement in ICT training.

This study was conducted in the Klang district of Selangor. According to the Selangor State Education Department (2019), 93 government primary schools are located in the district. Klang was selected because the district includes both urban and rural school localities, allowing the study to focus specifically on rural primary schools. To identify the study schools, the researchers referred to the official school list from the Klang District Education Office and selected schools categorized as rural based on school location. The target population consisted of 1877 teachers from 35 rural government primary schools in the Klang district. Based on Krejcie & Morgan's (1970) sample size determination guideline, the recommended minimum sample size for this population was 320 teachers. However, this figure was treated as a recommended target rather than the achieved sample size.

A set of questionnaires was developed for this study. There were three sections listed in the survey form: demographics, school administrator technology leadership practices, and teachers' ICT competency. The first section contains six items related to the demographic profiles of the respondents: gender, age, type of school, teaching experience, educational level, and involvement in ICT training. The second section was adapted from Leong et al. (2016) and the Principal Technology Leadership Assessment (PTLA) from the International Society for Technology in Education-Standards for Administrators (International Society for Technology in Education, 2009) in determining the technology leadership practices among school administrators. The items in this section were divided into five dimensions, namely visionary leadership, digital age learning culture, excellence in professional practice, systematic improvement, and digital citizenship. This section contains 32 items to examine technology leadership practices among school adminis-

trators from teachers' perspective, measured on a five-point Likert scale, namely "1 = Strongly Disagree", "2 = Disagree", "3 = Neutral", "4 = Agree" and "5 = Strongly Agree". The final section of the survey was teachers' ICT competency. The teacher ICT Competency Standards developed by Ruuhina (2018) were utilized for this study. The items in this section were divided into three dimensions, namely knowledge, skills, and attitudes towards the use of ICT by teachers. This section contains 21 items and uses the same five-point Likert scale as Section B.

The pilot study was conducted on 30 respondents from one of the primary rural schools that have similar demographic characteristics. The Cronbach's alpha reliability coefficient for technology leadership was 0.987. The teacher's ICT competency also indicated high reliability at 0.977. According to Coakes (2005), alpha coefficients approaching 1.00 indicate strong internal consistency. The Cronbach Alpha values obtained through the pilot study can prove that the items used in the questionnaire are suitable for this study. Data were analyzed using IBM SPSS Statistics version 24.0. Descriptive statistics, including means and standard deviations, were computed to address RQ1 and RQ2. Composite scores for each dimension and the overall construct were calculated by averaging the relevant item scores. Pearson product-moment correlation was then used to examine the association between technology leadership practices and teachers' ICT competency based on these averaged composite scores. The analysis treated individual teachers as the unit of analysis; because teachers were nested within schools, the absence of multilevel or cluster-adjusted analysis is acknowledged as a limitation.

4. Results

The data collection period for this study was from May 7, 2020, to June 7, 2020. Data were collected using a Google Form survey, and 121 valid responses were obtained and analyzed. The exact number of teachers who received the questionnaire link was not recorded in the original administrative record; therefore, a precise response rate could not be calculated. The achieved sample of 121 was below the recommended minimum sample size of 320 based on Krejcie & Morgan's (1970) guideline. Accordingly, the findings should be interpreted as exploratory and should not be generalized beyond the study context without caution. Data collection was also conducted during the COVID-19 pandemic, when teachers' workload, school communication, and online participation may have affected the response level. The details of the descriptive analysis are stated in **Table 1**.

The number of female teachers (72.7%) is higher than that of male teachers (27.3%). Age was grouped into four categories: 21 - 30 (22.3%), 31 - 40 (45.5%), 41 - 50 years (24.8%), and 51 years and above (7.4%). The majority of the respondents are those teachers who serve in a national school of Chinese (61.2%), followed by the national school (30.6%) and the national school in Indian (8.3%). In addition, teachers with teaching experience of 6 to 10 years showed the highest frequency of 32 (26.4%), while the least was those teachers with teaching experience of 16 to 20 years (13.2%). The level of education is divided based on three catego-

ries, namely certificate or diploma in education, bachelor's degree, and master's degree or doctor of philosophy. The percentage of teachers with a bachelor's degree was the highest, 84.3%, followed by a certificate or diploma in education at 11.6%, and a master's or doctor of philosophy at 4.10%. Furthermore, teachers who participated in ICT courses 1 to 4 times had the highest frequency, 84 teachers (69.4%), while the frequency of ICT course involvement of 10 times and above was the lowest with 6 teachers (5.0%).

Table 1. Descriptive analysis of the demographic profiles of the respondents.

Variable	Demography	Frequency	Percentage (%)
Gender	Male	33	27.3
	Female	88	72.7
Age (years)	21 - 30	27	22.3
	31 - 40	55	45.5
	41 - 50	30	24.8
	51 and above	9	7.40
Type of school	National school	37	30.6
	National School of Chinese	74	61.2
	National School of India	10	8.30
Years of teaching experience	1 - 5	26	21.5
	6 -10	32	26.4
	11 - 15	20	16.5
	16 - 20	16	13.2
	21 and above	27	22.3
Academic qualification	Certificate/Diploma in Education	14	11.6
	Bachelor's Degree	102	84.3
	Master's Degree/Ph.D.	5	4.10
Involvement in ICT training (times)	Never	20	16.5
	1- 4	84	69.4
	5 - 10	11	9.10
	10 and above	6	5.00

Note. $n = 121$.

The Level of Teachers' ICT Competency (RQ1)

The teachers' ICT competency construct was developed based on three dimensions: knowledge, skills, and attitudes. Based on the results of this study, the overall mean for teachers' ICT competencies is 3.72 (SD = 0.48). The knowledge dimension obtained the highest mean score (M = 3.76, SD = 0.52), followed by the skills dimension (M = 3.71, SD = 0.52), and the attitude dimension (M = 3.68, SD = 0.55). All three dimensions of teachers' ICT competency had high mean scores, ranging from 3.68 to 3.76. Based on the score interpretation criteria used in this study, scores between 3.67 and 5.00 were categorized as high. Therefore, the respondents reported a high level of ICT competency (see Table 2).

Table 2. Teacher's ICT competencies.

Code	Dimension	Mean	SD
K	Knowledge	3.76	0.52
S	Skill	3.71	0.52
A	Attitude	3.68	0.55
	Teacher's ICT competency	M = 3.72	0.48

The Level of Technology Leadership Practices (RQ2)

This variable encompasses five dimensions: a) Visionary leadership; b) Digital age learning culture; c) Excellence in professional practice; d) Systematic improvement; e) Digital citizenship. Based on the descriptive analysis, technology leadership practice was ranked at a high level (M = 3.85, SD = 0.70). This classification was based on the same five-point mean-score interpretation, in which scores between 3.67 and 5.00 were categorized as high. As shown in Table 3, professional practice excellence obtained the highest mean score of M = 3.92 (SD = 0.73), followed by digital age learning culture (M = 3.90, SD = 0.75), digital citizenship (M = 3.84, SD = 0.73), visionary leadership (M = 3.83, SD = 0.76), and the lowest mean score was for the systematic improvement dimension, M = 3.76 (SD = 0.81).

Table 3. Technology leadership practice.

Code	Dimension	Mean	SD
VL	Visionary Leadership	3.83	0.76
LC	Digital Age Learning Culture	3.90	0.75
PP	Professional Practice Excellence	3.92	0.73
SI	Systematic Improvement	3.76	0.81
DC	Digital Citizenship	3.84	0.73
	Technology Leadership Practice	M = 3.85	0.70

The Relationship between Teachers' ICT Competency and Technology Leadership Practices (RQ3)

Pearson product-moment correlation was performed to examine the association between teachers' ICT competency and technology leadership practices. The analysis indicated a moderate positive association between the two constructs, $r(119) = 0.571$, $p < 0.01$. Additional correlation analyses were conducted for the dimensions of technology leadership practices and teachers' ICT competency (see Table 4). Among the five technology leadership dimensions, systematic improvement showed the strongest correlation with teachers' ICT competency (r = 0.605), whereas visionary leadership showed the weakest correlation (r = 0.406). These findings suggest that, within this exploratory sample, higher perceived technology leadership practices were associated with higher reported ICT competency among teachers. However, because the analysis did not adjust for teacher clustering within schools, the significance levels should be interpreted cautiously.

Table 4. The relationship between teachers' ICT competency and technology leadership practice.

Technology leadership dimension	Knowledge	Skills	Attitude	Teachers' ICT Competency
Visionary Leadership	0.393**	0.379**	0.340**	0.406**
	0.000	0.000	0.000	0.000
Digital Age Learning Culture	0.520**	0.461**	0.468**	0.528**
	0.000	0.000	0.000	0.000
Professional Practice Excellence	0.505**	0.468**	0.446**	0.518**
	0.000	0.000	0.000	0.000
Systematic Improvement	0.538**	0.550**	0.562**	0.605**
	0.000	0.000	0.000	0.000
Digital Citizenship	0.536**	0.461**	0.512**	0.549**
	0.000	0.000	0.000	0.000
Technology Leadership Practice	0.546**	0.506**	0.512**	0.571**
	0.000	0.000	0.000	0.000

Note. **$p < 0.01$ (2-tailed).

5. Discussion

Teachers' ICT competency is a critical element in determining the effectiveness of ICT integration in teaching and learning processes (Agyei & Voogt, 2011). Hence, ICT competency is central to integrating ICT into 21st-century teaching and learning and to implementing technology-related educational plans at the ministry and educational-provider levels. Leveraging technology fosters innovative ICT use that empowers student learning and makes the school's ICT environment more vibrant and widely accepted.

Teachers' preparedness to adopt ICT integration will enhance teachers' ICT competency (Baharuldin et al., 2019; Rahman et al., 2018). Based on the findings, the high level of ICT competency among teachers can be explained by their willingness to integrate ICT into daily tasks, especially in teaching and learning settings. Motivated teachers who embrace technology in their daily tasks will eventually increase their enthusiasm and self-inquiry to learn and try out new technology (Bordbar, 2010; Ab Rahman et al., 2015; Rahman et al., 2018; Raman et al., 2019a; Raman et al., 2019b; Varol, 2013). In addition, within the exploratory sample of this study, the findings suggest that ICT competency among rural primary school teachers was at a promising level. Teachers with higher reported ICT competency may be better prepared to cope with technological developments, perform daily tasks in technology-rich environments, and demonstrate awareness of ethical and responsible ICT use in their professional duties (Aslan & Zhu, 2018; Ruuhina, 2018).

However, interestingly, the current findings are contrary to the study by Talua et al. (2016), who examined a similar context in the Philippines. They found that the majority of primary school teachers were still incompetent in ICT-related knowledge, pedagogy, organization and administration, teacher professional de-

velopment, social, ethical, and humanitarian issues, as well as assessment and evaluation of ICT competencies. It is predicted that primary school teachers need further guidance and knowledge in optimizing technology and maximizing teaching activities via technology-driven methods in the classroom (Bordbar, 2010; Talua et al., 2016; Varol, 2013).

Knowledge is the first dimension being measured in determining teachers' ICT competency. Leveraging and demonstrating ICT knowledge and skills is a powerful tool to assess and evaluate students' performance (Ruuhina, 2018). Learning analytics, as an assistive technology, encourages personalisation in understanding student learning needs and capturing student performance (Sharef et al., 2020). In addition, the use of teaching tools and multimedia applications in teaching and learning processes will increase engagement and interaction in the classroom (Cansoy & Parlar, 2018; Lawrence & Tar, 2018; López-Vargas et al., 2017; Ruuhina, 2018). Regarding the skills dimension, the respondents reported a high level of ICT skills. They can identify and evaluate ICT equipment and applications for learning activities as well as develop curricula for subjects (Ruuhina, 2018). The findings of this study are corroborated by the study of Rahman et al. (2018), who stated that primary school teachers are capable of conducting classrooms and managing student learning activities with existing ICT equipment, such as LCDs, computers, software, and multimedia applications for teaching and learning in the classroom.

It has been suggested that the lack of ICT integration in pedagogical practice was due to a lack of ICT training among teachers (Rahman et al., 2018). Past studies have also agreed that lack of training is one of the repeated barriers faced by teachers, especially those who serve in rural school areas (Raman et al., 2019b). Furthermore, it was reported that training focused insufficiently on practical know-how for solving software- and hardware-related technical problems. The ICT facilities and accommodation have been provided, including computers and multimedia tools. Numerous problems arose, such as maintenance issues and limited funding for purchasing and updating software. Indeed, relevant ICT-based training should be based on current practices, technological development, and specific applications and software to enhance ICT competency, which later boosts the confidence of primary school teachers in integrating technology in instruction (Syahid & Nugraha, 2019; Wambiri & Ndani, 2016).

The positive attitude of teachers towards the integration of ICT at a high level has been a major factor in determining the desire of primary school teachers in rural areas to use ICT in pedagogical practice. If teachers do not have the necessary competencies in ICT integration, then such teachers will realize that a lack of ICT knowledge and skills causes them not to integrate ICT in pedagogical practice (Kreijns et al., 2013; Ruuhina, 2018). With this, a positive attitude towards ICT integration can push teachers towards the integration of ICT in learning and facilitation to the maximum in the classroom (Drossel et al., 2017; Raman et al., 2019a; Teo, 2011). Primary school teachers also believe that the quality of teaching

can be improved through the integration of ICT in learning and facilitation in the classroom (Rahman et al., 2018; Talua et al., 2016).

A school teacher who has the right mindset regarding the use of technology is an integral part in empowering ICT integration in the classroom (Mulenga & Marbán Prieto, 2018). The eminent role of teachers who have positive attitudes will ensure the success of the optimization of ICT tools in teaching and learning procedures (Rahman et al., 2018; Semerci & Aydin, 2018). Based on the above argument, Ruuhina (2018) espoused that those teachers who were mindful of the importance of ICT integration proved to improve their job performance, learn ethics, and comply with laws and regulations of ICT usage as well as policies related to integrating ICT in the educational milieu. Modern use of technology and sharing data via online platforms often result in discrimination and misuse of information. This condition misuse of information. Such misuse may dampen stakeholders' willingness to adopt technology in beneficial ways (Gagrčin et al., 2026; Hsu et al., 2022).

Numerous studies have attempted to explain the importance of ICT competency among school teachers at primary and secondary school levels (Briones, 2018; Buabeng-Andoh, 2019; Daling, 2017; Drossel et al., 2017; Leong et al., 2016). Building on this body of work, Anderson & Dexter (2005), European Commission (2013), and Tzafilkou et al. (2023) examined teacher ICT competency specifically within educational settings Preparing teachers with ICT knowledge and skills, and fostering positive attitudes toward ICT integration, are essential to fulfilling the seventh shift of the Malaysian Education Blueprint 2013-2025, using ICT to improve the quality of learning (Ministry of Education Malaysia, 2013).

The respondents implored the school administrator to promulgate the technology leadership practice due to the requirement for ICT integration as stated in the Malaysian Education Blueprint. On top of that, the leadership role of the teacher is empowered by the fifth shift in the blueprint, which aims to demonstrate a high-performance leadership role in every school in Malaysia. Past literature mentioned that the school's ecosystem suffers from the ineffectiveness of technology leadership practices among school leaders (Abu-Tineh et al., 2025). In other words, school administrators who serve in secondary or primary schools demonstrate a limited role in instilling technological leadership in school leaders. Although some prior studies report ineffective technology leadership, the findings of this study are consistent with those of Omar et al. (2020), Tiop & Talip (2020), Leong et al. (2016), and Ünal et al. (2015), who reported that school stakeholders appreciate the technology leadership values at school demonstrated by school leaders.

A school teacher supports the initiative on ICT integration at school because it stipulates new pedagogical approaches at school. Systematic improvement in school performance requires school leaders to strengthen the school ecosystem through the effective use of ICT. Systematic improvement is indeed a crucial agenda in the school ICT transformation. As a result, the school leaders should strategize on improving ICT integration, especially in utilizing ICT tools to ana-

lyze staff job performance and student academic achievement (Omar & Ismail, 2019). With the help of technology, school stakeholders can manage workloads and unnecessary tasks in their daily routine. This condition simultaneously increases productivity and societal well-being among school members. Esplin et al. (2018), on the other hand, argued that there is still insufficient preparation to forge relationships beyond the school context, such as community support for effective ICT integration.

The school administrators were reported to still encounter a lack of knowledge and skills in the concept of technological learning due to a lack of professional development training (Esplin et al., 2018; Gallego-Arrufat et al., 2017). This condition contributed as a major reason for the failure of ICT integration to be implemented effectively at schools. Accordingly, the knowledge and skills of the school leaders can be strengthened by implementing a series of courses and training to promote educational transformation for the digital age (Omar et al., 2020). School leaders are not only required to attend courses and training related to ICT; they are also required to relearn and reskill in the concept of technological leadership practices. After undergoing training, school leaders are expected to act as role models and provide support to teachers to integrate ICT in instructional processes (Moreira et al., 2019).

6. Conclusion

Overall, this study reported high levels of ICT competency and technology leadership practices among the participating rural primary school teachers in the Klang district, Selangor, Malaysia. The five dimensions of technology leadership practices were positively associated with teachers' ICT competency in this exploratory sample. These findings suggest that technology leadership practices may be relevant to teachers' ICT competency, although the results should be interpreted cautiously because of the achieved sample size, the absence of a calculable response rate, and the lack of cluster-adjusted analysis. To summarize, technological readiness will be seen as a premise in teaching, assessment, and the delivery of the knowledge process. Reflecting on the impact of COVID-19, it is essential to sustain educational stakeholders' motivation to acquire and deliver knowledge and educators can sustain their commitment to supporting learners. Instead, through technology, educators continue to deliver knowledge in online classrooms. School leaders, in turn, need to deepen their knowledge of new technologies to embed ICT integration in schools. Thus, the role of technology leaders among school leaders is vital to improving the ICT competencies among school teachers.

7. Limitations and Future Research

Several limitations should be considered when interpreting these findings. First, the achieved sample (n = 121) was below the minimum sample size of 320 suggested by Krejcie & Morgan (1970) for the target population of 1877 teachers. This reduced the statistical power and precision of the estimates; therefore, the findings

should be regarded as exploratory. Future studies should secure a larger and more systematically documented sample.

Second, the exact number of teachers who received the questionnaire link was not recorded, so a precise response rate could not be calculated. Future studies should document the number of invited teachers, the number of distributed questionnaire links, and the number of valid responses to improve reproducibility and transparency.

Third, the cross-sectional correlational design identifies associations but cannot establish causal relationships between technology leadership practices and teachers' ICT competency. Longitudinal or quasi-experimental designs are needed to clarify the direction and causality of this relationship.

Fourth, all data were obtained through teachers' self-reports on a single questionnaire, which may introduce common method bias and social desirability effects. Future research could triangulate self-reports with other sources—such as administrators' perspectives, classroom observations, or objective indicators of ICT use—and adopt a mixed-methods approach to obtain a more comprehensive picture.

Fifth, teachers were nested within 35 schools, but the present analysis did not apply multilevel or cluster-adjusted models. This may affect the precision of significance tests for leadership-related associations. Future studies should retain school-level identifiers, obtain sufficient responses within each school, and consider multilevel modeling or cluster-robust analysis.

Sixth, the original analysis records did not include reproducible diagnostics for Pearson correlation assumptions, such as normality, linearity, and outlier checks. Future research should report these diagnostics explicitly when applying Pearson correlation.

Finally, all data were obtained through teachers' self-reports on a single questionnaire, which may introduce common method bias and social desirability effects. Future research could triangulate self-reports with other sources, such as administrators' perspectives, classroom observations, or objective indicators of ICT use, and adopt a mixed-methods approach to obtain a more comprehensive picture.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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