Validation of instruments on the headmaster's technology leadership model by using confirmatory factor analysis

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ABSTRACT

In 21st-century education, the role of school headmasters in technology leadership is increasingly crucial. This is due to the fact that administrators are the main force behind efforts to integrate technology in classrooms. Some headmasters resist technology use and lack understanding of its role in leadership, refraining from participating in Malaysian Ministry of Education (MoE) initiatives for technology change. To promote teachers' integration of technology into the teaching process, headmasters need a comprehensive understanding of its implementation for both management and leadership purposes. Therefore, this study aims to assess the impact of headmasters' technology leadership and confirm its aspects in primary schools through cross-sectional quantitative analysis. The principal technology leadership assessment (PTLA) instrument, which was given online to 516 teachers using a straight forward random selection method, served as the basis for the headmaster technology leadership questionnaire. Using IBM-SPSS-AMOS software, descriptive statistics, exploratory factor analysis (EFA), and confirmatory factor analysis (CFA) were used to evaluate the data. Six dimensions and 35 items in technology leadership are approved and validated, according to CFA results. This study successfully created an assessment model for headmasters' technology leadership. To enhance benefits, contribute more, and address identified gaps, future researchers are encouraged to conduct larger-scale studies using both qualitative and quantitative methods.

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1. INTRODUCTION

Producing high-caliber human capital through teaching and facilitation. In order to boost the accomplishment of high-level pupils, headmasters as school leaders must be ready to engage in technology leadership in order to set an example for the integration of technology [1]. The government's strategies that were outlined in the Malaysian Education Development 2013–2025 [2] are also being continued by efforts and initiatives to profit from and equip oneself with technology integration abilities. To provide instruction of high quality, the Malaysian Ministry of Education (MoE) has said that technology must be used in the process decision program chart [2]. In light of this, all school administrators and educators must stress the significance of incorporating information and communication technology (ICT) abilities when conducting lesson in the classroom. The phenomena or scenario while employing technology in the Malaysian educational system also revealed that school administrators physically handle technology by making sure that schools have computer facilities [3]. In other words, school administrators just provide computer facilities in their various schools to meet fundamental instructions and procedures from the MoE or the State Education Department (SED).

The effectiveness of a school in forming a stable organization is determined by the principle and school administrators based on the circumstances in the school [4]. Thus, a school's leadership style serves as a "measuring stick" for the achievement and growth of its pupils [5]. Thus, to address the issues associated with the use of headmasters technology leadership in primary schools in Malaysia, this study intends to determine the impact of headmasters technology leadership and confirm its dimension. In fact, for the past 20 years, there has been a lot of discussion about how headmasters should lead in terms of technology both inside and outside of the nation [6]. Some international research findings indicate that the teacher's digital competency and teacher efficacy are not significantly impacted by the headmaster's technology leadership [7]. Additionally, headmasters do not give teachers the chance to develop their professionalism, take into account their unique ICT requirements, or address concerns with technology access and assistance [8].

Because of the lack emphasis on technology components in professional leadership training for school leaders, coupled with the lack of a clear authority or set of rules directing administrators to integrate ICT use in schools, some headmasters are incompetent in managing schools based on technology [9], [10]. To put it another way, administrators are unclear about their responsibilities as the school's technology leader [11]. Consequently, if the ICT integration in the school is not fully implemented, the headmaster sees a deficiency and raises concern. The supply of internet networks increased by 4% or 363 schools in 2018 compared to 2017 when it was 9,459 schools, according to statistics from the annual report of the Malaysian Education Development plan [12]. What's alarming is that few headmasters participate in initiatives for technological change and have knowledge and abilities in technology that don't support their utilization [13]. This result shows that MoE's investment returns do not match the amount of ringgit it spent [14].

Headmasters should select the best strategy to modify their leadership style in order to balance technological developments in leadership. Therefore, it is important to emphasize to all students the headmaster's responsibility as a technology leader [15]. However, several headmasters are still unaware of how technology might improve leadership [16]. Headmasters play a key role in guiding technology in schools, however. According to research findings, headmasters are unaware of their responsibilities as technology leaders, which restricts all roles and actions aimed at expanding technology in classrooms [17].

According to Esplin *et al.* [18], the majority of headmasters are still not adequately equipped to manage technology-based enterprises. The truth is that few headmasters have the ability to master ICT. However, doing so leads to a weak and unfocused implementation of ICT in schools [19] there is a lack of clarity in identifying technology-based organizational goals in strategic management planning. However, according to the National Educational Technology Standards for Administrators (NETS-A), headmasters still fall short of the requirements for technology knowledge and ICT skills, including vision-oriented leadership, a culture of digital-age learning, excellent professional practices, systemic improvement, and digital citizenship [20]. Headmasters are worried about how well instructors will be able to incorporate ICT hardware and software into the teaching and learning process. This is due to the fact that one of the main issues being addressed is teachers' capacity to manage ICT in teaching and learning successfully [21]. Additionally, the pupils may only profit to a limited extent from the ICT devices or equipment used if they do not fulfill the requirements or are not appropriate. If this happens, it is obvious that time, effort, and money have been wasted. Therefore, this study aims to identify the influence of school headmasters' technology leadership and to validate the dimensions of technology leadership among national primary schools in Malaysia.

2. METHOD

This study employed a cross-sectional survey research design, where data was collected to describe the procedures conducted by the researchers [22]. In this study, pilot and actual test data were collected from teachers under the management of the MoE in primary schools in Malaysia. Stratified random sampling technique was used to select respondents among teachers based on gender, location and teacher experience. The principal technology leadership assessment (PTLA) questionnaire developed by International Society of Technical Educators (ISTE) [23] served as the measurement tool used to obtain quantitative data for this study, utilizing a 7-point interval likert scale. Through this research, technology leadership is measured based on six dimensions in technology leadership, namely: i) leadership and vision (KV); ii) teaching and learning (PDP); iii) productivity and professional practices (PAP); iv) support, management, and operations (SPO); v) assessment and evaluation (PP); and vi) social, legal and ethical issues (SUE) [20], [24].

Subsequently, a pilot test was conducted on 120 respondent responses that were verified and met the minimum required sample size for this study [25]–[27]. Based on the pilot test, the reliability level of the survey on the practice of technology leadership has high Cronbach alpha values across six dimensions, KV (α=0.88), PDP (α=0.84), PAP (α=0.65), SPO (α=0.85), PP (α=0.84), and SUE (α=0.81). Therefore, this survey is utilized because the components in PTLA demonstrate high reliability [26], with Cronbach alpha values exceeding 0.70, indicating that the survey maintains high precision and data validity [27].

The data from the pilot test were analyzed via exploratory factor analysis (EFA). The actual data were obtained from 540 respondents from the primary school teachers in Malaysia. However, a total of 516 responses from respondents were found to be acceptable after data screening process. Therefore, a pre-test was conducted first to ensure the validity of language and content for the survey questionnaire before the actual research. The content validity of the PTLA survey questionnaire was assessed by five content experts who are academics in the same field for more than ten years. Afterwards, the survey questionnaire was submitted to language experts for back-to-back translation in English to Malay language to ensure language validity. IBM-SPSS-AMOS version 22 software was used to analyze the study data and, ultimately, confirm the measurement model through confirmatory factor analysis (CFA) [28]. The results indicate that all dimensions contribute to all suggested items. As a result, it is found that all six dimensions are significant in measuring the leadership of the principal in technology.

3. RESULTS

3.1. Exploratory factor analysis of technology leadership

The exploratory factor analysis procedure aims to identify the number of dimensions or factors of each study variable as well as identify items that are likely to make improvements before being used in the actual study [28], [29]. Several conditions are considered for the EFA procedure, namely the value of the Kaiser-Mayer-Olkin (KMO) measure of Side Adequacy should reach a value of at least 0.50 to ensure that the amount of samples used to generate EFA is sufficient [29], [30]. While the correlation value between items or variables must be significant ($p<0.05$) using Bartlett's test of sphericity [28].

In this study, there are 35 items in the technology leadership questionnaire that are analyzed using the principal component analysis (PCA) process. Based on EFA, it was found that the value of communalities has exceeded 0.3. While the eigenvalues are all above 1.0 as suggested by Hair *et al.* [30]. The total variance explained for each dimension is between (76.372-86.212) which is above the minimum value of 60% and the KMO value for each dimension of technology leadership is between (0.879-0.928) which is above the value of 0.50 as suggested by Hair *et al.* [30]. Therefore, based on the findings of the EFA analysis, all 35 initial items in PTLA were accepted with all appropriate factor loading (FL) values between (0.794-0.952) as described in Table 1. The results of the study show that no item was dropped because the factor loading exceeded 0.6, which is to meet the conditions to remain in the questionnaire [28], [31].

Table 1. Summary of pilot test results

Dimensions	Item received	KMO (>0.50)	Total variance explained (%)	Factor loading
KV	6	0.918	79.357	0.863-0.917
PDP	6	0.923	83.591	0.888-0.930
PAP	5	0.879	79.126	0.842-0.921
SPO	6	0.905	77.603	0.794-0.927
PP	5	0.900	86.212	0.877-0.952
SUE	7	0.928	76.372	0.793-0.905

3.2. Technology leadership confirmatory factor analysis

Table 2 shows the factor analysis of the technology leadership level of headmasters in primary schools in Malaysia. Several studies [30], [32] suggest that all items, dimensions and variables from the model will be accepted when the regression value for each FL>0.708, composite reliability (CR)>0.708, average variance extracted (AVE)>0.5, and square root AVE (√AVE) for the largest discriminant validation of correlation values between items and dimensions. This study found that all items, dimensions and variables were acceptable.

Based on Table 2, the values of FL, CR, AVE and √AVE for each dimension of technology leadership, namely KV, (FL=0.823-0.911, CR=0.967, AVE=0.846, √AVE=0.920), PDP, (FL=0.862-0.918, CR=0.969, AVE=0.846, √AVE=0.920), PAP, (FL=0.753-0.899, CR=0.973, AVE=0.900, √AVE=0.949), SPO, (FL=0.774-0.909, CR=0.966, AVE=0.846, √AVE=0.920), PP, (FL=0.828-0.955, CR=0.976, AVE=0.900, √AVE=0.949), and SUE, (FL=0.730-0.899, CR=0.948, AVE=0.723, √AVE=0.850). After conducting the CFA, the minimum requirement for accepted items in each dimension is three items [29], [30]. Therefore, all six dimensions and 35 items were accepted and confirmed because they met the minimum required number of items. Thus, all six dimensions in technology leadership, namely KV, PDP, PAP, SPO, PP, and SUE, were accepted and confirmed in the measurement model of headmasters' technology leadership.

Table 2. FL, CR, AVE, and √AVE headmasters' technology leadership in primary school in Malaysia

Dimensions	Item	FL	CR > 0.708	AVE >0.5	√AVE
KV	KV1	0.836	0.967	0.846	0.92
	KV2	0.866			
	KV3	0.823			
	KV4	0.872			
	KV5	0.911			
	KV6	0.891			
PDP	PDP1	0.889	0.969	0.846	0.92
	PDP2	0.9			
	PDP3	0.907			
	PDP4	0.862			
	PDP5	0.918			
	PDP6	0.901			
PAP	PAP1	0.899	0.973	0.900	0.949
	PAP2	0.879			
	PAP3	0.867			
	PAP4	0.874			
	PAP5	0.753			
SPO	SPO1	0.774	0.966	0.846	0.920
	SPO2	0.855			
	SPO3	0.788			
	SPO4	0.908			
	SPO5	0.909			
	SPO6	0.897			
PP	PP1	0.828	0.976	0.900	0.949
	PP2	0.917			
	PP3	0.934			
	PP4	0.955			
	PP5	0.913			
SUE	SUE1	0.88	0.948	0.723	0.850
	SUE2	0.899			
	SUE3	0.815			
	SUE4	0.73			
	SUE5	0.886			
	SUE6	0.886			
	SUE7	0.86			

3.3. Technology leadership measurement model

Figure 1 presents the measurement model of headmasters' technology leadership to determine the suitability of the research data with the developed measurement model. Various goodness-of-fit indices, including: chi-square (CMIN), comparative fit index (CFI), root mean square error of approximation (RMSEA), parsimonious normed fit index (PNFI), and parsimonious comparative fit index (PCFI), were used to assess the goodness of fit between the measurement model and the data from SEM procedure. When the significance level of CMIN is greater than 0.05, the measurement model is considered to fit the data. Similarly, CFI values exceeding 0.90 are considered a good fit, and CFI values between 0.80 and 0.89 are still acceptable. RMSEA values less than 0.08 are considered acceptable [29]. For PCFI and PNFI, values must exceed 0.5 for model fit [29]. The final measurement model is considered a good fit when one of the categories, absolute, relative, and parsimony, reaches the specified values.

Table 3 displays the index matching values for the headmasters' technology leadership measurement model. Table 3 shows that all the index matching values reach the specified values and correspond to the study data. The values of RMSEA=0.080, CFI=0.921, PCFI=0.857 and PNFI=0.837.

3.4. The influence of headmaster technology leadership

To ensure the contribution between the variables, the observed CR value is greater than ±1.96 [30]. The findings of the study show that leadership predictor variables are significant predictors of all dimensions when the respective CR values -each exceeding ±1.96 as shown in Table 4. To ascertain the influence between the variables the value of CR is observed. Next, the analysis was done on the dimensions of technology leadership with CR for the dimensions KV=19.456; p=0.000, PDP=17.607; p=0.000, PAP=19.652; p=0.000, SPO=0.000; p=0.000, PP=19.783; p=0.000 and SUE=20.285; p=0.000. Next, the analysis was done on the dimensions of technology leadership with β value for the dimensions KV=0.942, PDP=0.889, PAP=0.941, SPO=0.953, PP=0.941, and SUE=0.946. Therefore, the findings show that all dimensions contribute to all the proposed items. As a result, it was found that all six dimensions are significant to measure the principals' technology leadership.

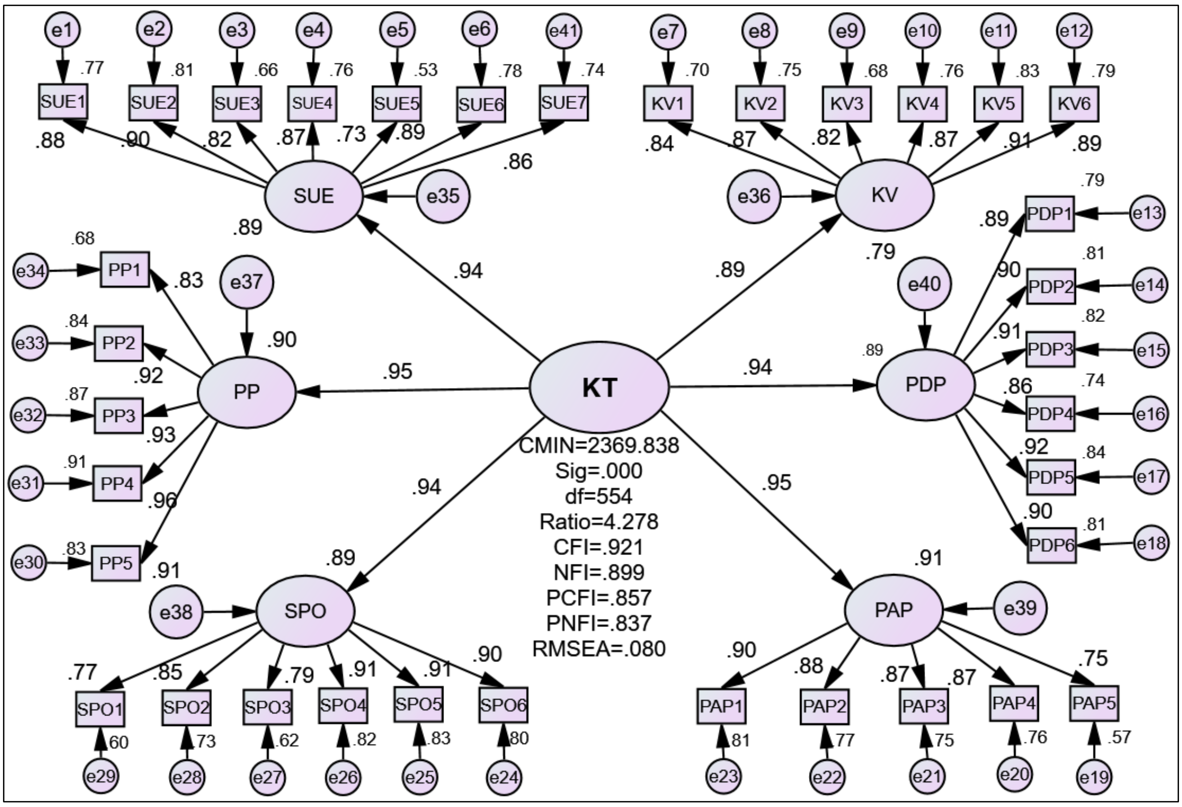

Figure 1. Headmasters' technology leadership measurement model

Table 3. Appropriateness index of the headmasters' technology leadership measurement model

Category	Index	Value	Result
Absolutely	Ratio	4.278	Achieved
	RMSEA	0.080	Achieved
Relative	CFI	0.921	Achieved
Parsimonious	PCFI	0.857	Achieved
	PNFI	0.837	Achieved

Table 4. Regression coefficients between study variables

Variables			Estimate	β	SE	CR	P	Result
KV	<---	KT	1.236	0.942	0.064	19.456	***	Significant
PDP	<---	KT	1.273	0.889	0.072	17.607	***	Significant
PAP	<---	KT	1.37	0.941	0.07	19.652	***	Significant
SPO	<---	KT	1	0.953	0.00	0.000	***	Significant
PP	<---	KT	1.246	0.941	0.063	19.783	***	Significant
SUE	<---	KT	1.26	0.946	0.062	20.285	***	Significant

4. DISCUSSION

The study's conclusions paint a clear picture of how school leaders exhibit qualities associated with technology leadership. This study also adds to earlier research that indicated administrators' leadership in technology is at a moderate level, school leaders are less effective in school management based on a technology learning environment, and the ICT technology knowledge level and skills are lacking, lacking the ability to use data access in the school development process, and lacking the ability to utilize ICT as a channel of managing school organizations especially public school principals [33]. ICT use in the classroom is also not being supported as much as it should be [16]. As a result, school administrators must take the initiative to lead technology, particularly in the areas of information management and human resources [34]. Headmasters should also be prepared to adapt their current leadership styles to include technology leadership. In this digital age, they must be willing to embrace changes in management, leadership, expertise, and attitudes [35]. It has been proven that headmasters who are capable of using technology can enhance the efficiency of procedures and outcomes, consequently leading to ongoing systemic enhancements and the attainment of outstanding or top-notch schools [36]. There are numerous studies have explored the impact of ICT on school leader and teachers' performance or student achievement [37], and the findings from the studies show that school improvement is influenced by the leadership of headmasters [38].

The study's results also support the behaviors of technology leadership established by earlier researchers [39]. However, there is a growing need to highlight the integration of technology inside the classroom environment given the current technologically-driven educational environment. In other words, school administrators and leaders need to be more technologically literate. Additionally, according to Garcia *et al.* [40], all school administrators have technical tools that help them manage their daily work using communication technology (WhatsApp, Telegram, Google Meet, and Facebook) that is designed to send and receive information via internet facilities. Therefore, school leadership should make the most use of digital infrastructure to help their organization share information, data, and learning materials in order to foster a culture where technology is prioritized in the learning environment [41]. Overall, the study was successful in identifying the impact and contribution of school headmasters' technology leadership and in confirming the characteristics of this leadership among Malaysian primary school headmasters. The recognized school leader technology leadership model consists of six aspects and 35 components.

5. CONCLUSION

As a summary, the results of this study give an implication for school leaders to explore the practices of technology leadership in integrating e-learning platforms, leading to the development of a foundational model for quality leadership in technology. This model serves as a point of reference for the practice of leaders in e-learning platforms implementation in schools. The four criteria for the foundational technology leadership model are that leaders can: i) offer robust assistance for the adoption of e-learning platforms; ii) maintain a conducive culture among users; iii) emphasize the needs and readiness of users; and iv) practice effective technology leadership and execute strategies relevant to the constantly dynamic evolution of technology. The study's findings have ramifications for technology leaders and provide light on how school headmasters use technology to guide the development of the next generation. Therefore, future research is advised, and it may be thought to incorporate more variables in the study to better understand technology leadership among school headmasters. This research can be strengthened by looking at the impact of technology leadership among teachers and how it relates to other factors. Moreover, various methodologies for examining the technology leadership practices of school leaders are proposed, including both quantitative and qualitative methods.

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