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A validity and reliability of instrument to evaluate the principal technology leadership: a pilot study

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ABSTRACT

Rapid development of the digital environment nowadays requires a line of educational leadership, especially leaders in schools who are competent in technological leadership. Therefore, this study aims to verify the technology leadership instrument among school principals. Accordingly, a pilot study has been carried out to determine and confirm the level of instruments that have been built to identify the principal's technology leadership practices. This pilot study was conducted on 196 samples consisting of secondary school teachers. This study examines the principal's role as a technology leader involves five specific standards which includes the dimension of supporting digital citizenship, visionary planner, empowering leader, system designer and connected learner. This study has been conducted through three levels of validity namely face validity, content validity, and construct validity. Content validation index (CVI) is used to determine reliability between experts achieved. The construct validity is measured by exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The reliability of the instrument is measured by Cronbach alpha value. The finding of this pilot study shows that the instrument is valid and reliable. Finally, out of 50 items, 49 items are retained.

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1. INTRODUCTION

Technology leadership is a blending of methods and strategies that are typical to leadership with special attention to technology, especially pertaining to material accessibility, technical advancements, as well as the recognition that career progress are constantly changing in accordance with the era. In conclusion, technology leadership plays an important role in relation to the integration of information and communication technology to know the strategies used by the principal in developing the school he leads. Due to the modern era's sophisticated technology and prompt development of the digital environment, there is a need for educational leadership, especially leaders in schools who are competent in technology management. Therefore, the technology leadership practices of school leaders must also be in line with the latest technological developments as they are responsible for overseeing technology and the school environment's use of technology effectively.

Even so, the principal's ICT knowledge and skills still fall short of the standard as suggested by the National Educational Technology Standards for Administrators (NETS-A) [1]–[3]. This phenomenon illustrates that the principal's technology leadership level is still performing at an underachieving and inadequate level [4]–[6]. The study of Esplin *et al.* [7] also claim that school principals are ill-equipped to lead with regard to technology. This finding proves that there is still a gap that should be investigated to determine

the degree of technology leadership in the context of various other responses. In the context of Malaysian education leaders, the literature review also shows that most leaders in schools have low and moderate levels of knowledge and skills in technology leadership [5].

The International Society of Technology on Educational (ISTE) is an organization entrusted with developing educational technology standards. It started with the development of the initial technology leadership standard for administrators and school leaders called the National Educational Technology Standard for Public School Administrators (NETS-A) in 2002. NETS-A 2002 was introduced as a result of merging with the Technology Standards for School Administrators (TSSA) which had introduced in 2001 by the TSSA Collaborative to determine the needs of administrators in supporting the use of appropriate technology in the education system. In order to balance the quick developments in technology and education and to keep pace with the updating of both standards, ISTE further led the discussion to improve NETS-A to ISTE-A in 2009. In 2018, ISTE again conducted a study again against the standard which was later known as ISTE Standards for Education Leaders (ISTE-EL) [8]. ISTE-EL 2018 is a guideline for transformative leadership practices by emphasizing systematic improvement. The principal's position as a leader in technology at schools according to ISTE-EL 2018 involves five specific standards that include the dimensions of equity and citizenship advocate, visionary planner, empowering leader, system designer and connected learner. Equity and citizenship advocate highlights the role of leaders in advancing practices of inclusiveness, equity, and digital citizenship through the use of technology [8]. As for a visionary planner, leaders must involve the others in creating a goal, a strategy, as well as a continuous review cycle. Meanwhile an empowering leader means that the leaders cultivate an environment in which teachers and students are free to employ technology in novel methods to enhance instruction and education. The fourth dimension is systems designer where leaders must create teams and processes to deploy, maintain, and continuously enhance the use of technology to assist learning. Finally, connected learner dimension means that leaders must set an example and encourage people to pursue ongoing professional development.

The results of this study are expected to make school leaders more aware of the value of technology leadership. Additionally, it is anticipated that the findings of this study will provide added value in improving the excellence of school leadership so that the situation of discomfort and uncertainty of the effectiveness of technology leadership especially in the teaching and learning process can be overcome so that school performance can be improved. This study is also expected to provide guidance to school leaders on how to balance their responsibilities in the school with their position in technology leadership. All these guidelines make the leadership of school leaders more effective and make technology leadership among school leaders a new leadership practice in the field of education.

In particular, the Institut Aminuddin Baki (IAB) as the national institute for educational leadership and management in Malaysia will certainly be able to apply the results of this study to improve their module so that school leaders are given sufficient exposure in aspects of management and technology integration to deal with issues of change and the current digital era education system [9]. Additionally, the results of this study may also be used as a source of information for training planners or other courses at the Ministry of Education Malaysia in strengthening and evaluating the effectiveness of leadership training programs in the field of technology for school leaders and teachers, especially in the dimensions that are at the lowest level. The aspect of training and courses in the field of technology is something very important to improve the skills of school leaders in ensuring that schools are managed efficiently as well as the knowledge of teachers in ensuring that teaching and learning achieve maximum results.

Numerous researches have been created in order to evaluate technology leadership using NETS-A and ISTE, but there is still lack of studies using new ISTE-EL 2018. Furthermore, this instrument is self-developed by researchers based on standard statement and guidelines from ISTE. So, it needs to be first assessed before it can be carried out. A pilot study could be used to accomplish this. Indeed, a pilot study must be conducted before the real study may begin. Pilot studies may be time-consuming, but they are crucial to determining the applicability of an instrument. A pilot study was carried out to evaluate the instrument's reliability and validity to ensure the accuracy of the measurements made. Validity means the extent to which a research instrument can accurately measure the construct being studied [10]. The validity of this study involves three steps namely face validity, content validity, and also construct validity.

Face validity determines the questionnaire that has been constructed appropriately in terms of language adjustment, contains sentences that are clear in meaning, easy to understand and uses accurate terms. Questionnaires that can be clearly understood and easily comprehended by respondents, even for individuals who are unfamiliar with its subject matter, are said to have a high face validity value. The instrument may not actually be able to measure the occurrence in the research construct just based on face validity, though. For this reason, the face validity process will be followed by the content validity process to further strengthen the research instrument as an effort to ensure that the constructed items represent the listed constructs. Content validity refers to the extent to which the research instrument measures what should be measured based on the theoretical framework of the study [11], [12] in addition to proving that the content of the item is indeed connected, and the representative of the variable being studied. The process of content validity refers to the

correctness of the content and format of the instrument as well as the consistency of the content and format of the items that respondents will measure and evaluate, the comprehensiveness of the instrument, the applicability of variables, and the accuracy and appropriateness of the items' content. Once more, the expertise of seven management and leadership are utilized. The expert panel will be requested to read the submitted questions or items and provide an evaluation on their level of understandability. Each question in the questionnaire is evaluated in terms of its appropriateness, including the content, the language used, the sequence in which it is presented, the font size used, and the appropriateness of the measurement that must be taken. A 4-point Likert scale from irrelevant to very relevant is used to score each item for the evaluation dimensions. The evaluation results are used to calculate the content validity index (CVI). It is a quantitative method to prove that items and instruments meet content validity specifications. The determination of the content validity index involves item-level validation item content validation index (I-CVI) and validation of the entire instrument scale content validation index (S-CVI) which was originally modified from the Kappa (K*) statistic [13].

The validation process continues by going through procedures that ensure it has construct validity. Construct validity refers to the extent to which the items used in a construct and subconstruct truly represent the construct and subconstruct. In this study, construct validity was conducted using factor analysis techniques. It consists of two, namely exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). EFA was conducted using the Statistical Package for the Social Science (SPSS) software. CFA was tested in the PLS-SEM measurement model using SmartPLS software. This testing covers internal consistency, indicator reliability and construct validity involving convergent validity and discriminant validity. The reliability test of the instrument as a whole has been conducted following the completion of all instrument validity procedures in order to obtain the value of Cronbach's alpha, which can determine the instrument's level of reliability. According to Creswell [14], the accuracy with which a research instrument can measure the variables it is designed to evaluate is referred to as reliability.

2. METHOD

This pilot study was conducted on 196 samples consisting of secondary school teachers around Negeri Sembilan in Peninsular Malaysia. This study uses a questionnaire as an instrument to obtain data or information required from teachers as respondents. The set of questionnaires used in this study contains two main parts, which are parts A and B. Part A in this questionnaire aims to obtain the demographic information of the respondents and the principals of the respondents to ensure that the characteristics of the respondents meet the sample selection criteria that have been set. Part B in the questionnaire is an instrument used to measure the technological leadership dimension shown by the principal. This section covers instruments translated and adapted from ISTE-EL [8]. There are five technology leadership practices of principals that will be evaluated in this section. There are 9 questions in Part A and 50 questions in Part B.

IBM Statistical Package for the Social Sciences version 25.0 and smart partial least squares (SmartPLS) are used for the data analysis. For face validity, three experts in language and linguistic are referred to. After evaluating the items, they are invited to remark on the questionnaire. A few adjustments are done in response to remarks like 'Ensure all students have skilled teachers who actively use technology' is changed to 'Ensuring that all students have skilled teachers who actively use technology to meet students' learning needs. Via I-CVI, one item was removed for failing to meet the suggested value. Then, concept validity is examined using EFA. EFA serves to determine the construct validity of the items found in this research instrument because they have been modified in terms of the original language translation and adapted according to the cultural context and education system in Malaysia. EFA which uses the method of principal component extraction with varimax rotation (variation maximization) is conducted on 49 items that measure the principal technology leadership construct. The eigenvalue or variance that is retrieved by a factor larger than 1 is applied. The next step in the component analysis is CFA, which includes construct validity involving convergent and discriminant validity, as well as internal consistency, and indicator reliability via SmartPLS. All results achieve the established rule of thumb of CFA. An instrument also needs to undergo another procedure which is reliability. According to Creswell [14], reliability refers to the consistency of the code of the research instrument used, whether the instrument can measure what it wants to measure accurately. Based on the Cronbach alpha value determined, it can be concluded that all 49 items in the principal's technology leadership instrument have excellent and consistent reliability.

3. RESULTS AND DISCUSSION

A total of 196 people responded to the 200 questionnaires that were given out to the respondents. Only approximately 9% of respondents are men, compared to nearly 91% of women. Nearly 86% of those surveyed had taught for more than 10 years and the balance 14% experienced between 3 to 10 years. Four sections comprise the study's findings, namely the calculation of the CVI, EFA, CFA, and reliability index values through the Cronbach alpha coefficient.

3.1. Content validation index

The findings of the evaluation of each item's I-CVI value in this research instrument are in the range of 0.86 to 1.00 except for one item (C16) that had an I-CVI value of 0.71. Therefore, the item was removed because the construct still had enough items in its dimensions. The value of S-CVI (AVE) for the principal's technology leadership dimension is 0.969. The recommended S-CVI value is 0.8 to 1.00 for content validity [15], [16]. Therefore, both the I-CVI and S-CVI results have met the specified conditions and all of them are maintained for construct validity. In conclusion, the measurement instruments used have high content validity [16]. Table 1 shows a comparison of the items in the original instrument with the research instrument that has been improved.

3.2. Exploratory factor analysis

According to the EFA procedure, both constructs in the study's instrument have significant Bartlett's Test of Sphericity values (P-value<0.05), Kaiser-Meyer-Olkin (KMO) values exceeding 0.6, Eigenvalue values are greater than 1.0 and each item's factor loading value is larger than 0.6 [17]. According to the findings in Table 2, which are based on Eigenvalue values larger than 1.0, there are five emerging dimensions for the technology leadership construct, and seven for the technology integration construct. Given that the overall total variance is greater than 60%, the number of components and items for each component is appropriate for measuring both constructs [17].

3.3. Confirmatory factor analysis

This testing covers internal consistency, indicator reliability, and construct validity. Cronbach's alpha value and composite reliability can be used to assess internal consistency. Several researchers [18], [19] suggested that the Cronbach alpha value is greater than 0.7. The composite reliability value for each variable should be greater than 0.70 [20]. Based on Table 3, the Cronbach alpha value is in the range of 0.987 to 0.939 while the composite reliability value is in the range of 0.989 to 0.950. The significant level of internal validity and reliability of the construct used in this study is demonstrated by the acceptance of both values.

There are two methods to measure construct validity, namely convergent validity and discriminant validity. Convergent validity is done to assess the extent to which multiple items follow the same concept in one agreement [21]. Three conditions that must be met in convergent validity: i) all individual factor loading values of items (factor loading) must exceed 0.7; ii) composite reliability (CR) values not less than 0.7; and iii) values of average variance extracted (AVE) must be greater than 0.5 [22]. However, factor loading values of 0.4 to 0.7 can be considered if the sample is large or can be considered to be removed from the scale if it can increase the AVE or CR value [20]. Table 4 for the first order construct shows the readings of individual item values (item loading), composite reliability values and AVE values exceeding the value set by Fornell and Larckel [22] which is 0.7. While Table 5 for the second layer constructs shows all the readings of individual item values (item loading), composite reliability values and AVE values exceeding the value set by Fornell and Larckel [22] which is 0.7. This shows that all indicators have passed the set level and have met the converging criteria.

Table 1. Comparisons the number of item before and after the CVI analysis

Section	Number of original item	Number of modified item	Number of dropped item	Number of actual items
Part B: Principal's technology leadership	50	39	1	49

Table 2. Number of components and initial eigenvalues

Construct	Component	Initial Eigenvalues		
		Total	% Variance	Cumulative %
Technology leadership	1	33.069	67.487	67.487
	2	2.815	5.745	73.233
	3	2.217	4.525	77.757
	4	1.987	4.054	81.812
	5	1.356	2.768	84.580

Table 3. Composite reliability and Cronbach's alpha values

Dimensions	Cronbach's alpha	CR	AVE
Equity and citizenship advocate (ECA)	0.962	0.968	0.792
Visionary planner (VP)	0.975	0.977	0.783
Empowering leader (EL)	0.983	0.985	0.856
System designer (SD)	0.986	0.988	0.912
Connected learner (CL)	0.987	0.989	0.899

Table 4. Convergent validity for first order construct

First order constructs	Item	Loadings	CR	AVE
ECA	ECA01	0.872	0.973	0.82
	ECA02	0.886		
	ECA03	0.910		
	ECA04	0.905		
	ECA05	0.919		
	ECA06	0.903		
	ECA07	0.926		
	ECA08	0.924		
VP	VP09	0.896	0.986	0.858
	VP10	0.921		
	VP11	0.913		
	VP12	0.947		
	VP13	0.921		
	VP14	0.942		
	VP15	0.933		
	VP16	0.910		
	VP17	0.938		
	VP18	0.926		
	VP19	0.944		
	VP20	0.924		
EL	EL21	0.913	0.986	0.864
	EL22	0.924		
	EL23	0.930		
	EL24	0.935		
	EL25	0.952		
	EL26	0.928		
	EL27	0.921		
	EL28	0.932		
	EL29	0.927		
	EL30	0.929		
	EL31	0.933		
SD	SD32	0.906	0.982	0.871
	SD33	0.928		
	SD34	0.930		
	SD35	0.932		
	SD36	0.937		
	SD37	0.945		
	SD38	0.947		
	SD39	0.943		
CL	CL40	0.920	0.987	0.885
	CL41	0.935		
	CL42	0.944		
	CL43	0.943		
	CL44	0.930		
	CL45	0.952		
	CL46	0.946		
	CL47	0.950		
	CL48	0.940		
	CL49	0.947		

As for HTMT, a value level of less than 0.85 is advised [23], [24], or less than 0.90 [25], [26]. Given that it has a high rate of discriminant validity, the ideal HTMT value level is less than 0.85 and can be distinguished across items. It is permissible to have a value level of less than 0.9 [27]. Table 6 shows that the HTMT value for each dimension is less than 0.85. This situation shows that all study variables have reached the discriminant validity standards that have been set at the best level.

Table 5. Convergent validity for second order construct

Second order constructs	First order constructs	Loading	CR	AVE
Technology leadership	ECA	0.898	0.960	0.829
	VP	0.932		
	EL	0.917		
	SD	0.894		
	CL	0.912		

Table 6. Discriminant validity

	ECA	VP	EL	SD	CL
ECA					
VP	0.838				
EL	0.796	0.828			
SD	0.782	0.788	0.794		
CL	0.795	0.806	0.788	0.817	

3.4. Reliability index

The reliability test of the instrument was conducted using data obtained from a pilot study through the SPSS software. According to Chua [28], items that are in the range of 0.65 to 0.79 can be used, while

items that are in the range of 0.80 to 0.95 have high and reliability. Lay and Khoo [29], who claimed that items with a Cronbach alpha value of 0.61–1.00 are highly dependable, concur with this. Hair *et al.* [10] determined that the acceptable Cronbach alpha reliability value is 0.7 or more. The closer the Cronbach alpha value is to the number 1, the higher the level of reliability of a research instrument [30].

Table 7 shows the reliability test report of the principal's technological leadership instrument for the pilot study that has been conducted. The equity and citizenship advocate dimension consisting of 8 items has a Cronbach alpha coefficient, α=0.942, the visionary planner dimension comprises of 12 items has α=0.960, the empowering leader dimension which contains of 11 items has a Cronbach alpha coefficient, α=0.972, the system designer dimension which includes of 8 items has α=0.965 and lastly the connected learner dimension which carries of 10 items has α=0.984. Based on the Cronbach alpha value and the correlation value of the scores of each item obtained, it can be concluded that all 49 items in the principal's technology leadership instrument have excellent and consistent reliability, which is α=0.985. This shows that the value of the Cronbach alpha coefficient obtained for each dimension is above 0.70 as set in this study.

Table 7. Values of Cronbach's alpha if item deleted and overall Cronbach's alpha for the principal's technological leadership instrument

Dimension	Total item	Item	Cronbach alpha (α) if item deleted	Cronbach alpha (α) value
Equity and citizenship advocate	8	ECA01	0.925	0.943
		ECA02	0.943	
		ECA03	0.933	
		ECA04	0.938	
		ECA05	0.934	
		ECA06	0.934	
		ECA07	0.932	
		ECA08	0.932	
Visionary planner	12	VP09	0.957	0.960
		VP10	0.957	
		VP11	0.958	
		VP12	0.954	
		VP13	0.954	
		VP14	0.956	
		VP15	0.957	
		VP16	0.957	
		VP17	0.956	
		VP18	0.955	
		VP19	0.956	
		VP20	0.956	
Empowering leader	11	EL21	0.970	0.972
		EL22	0.967	
		EL23	0.967	
		EL24	0.968	
		EL25	0.972	
		EL26	0.969	
		EL27	0.968	
		EL28	0.970	
		EL29	0.967	
		EL30	0.969	
		EL31	0.971	
System designer	8	SD32	0.961	0.965
		SD33	0.963	
		SD34	0.961	
		SD35	0.959	
		SD36	0.959	
		SD37	0.958	
		SD38	0.962	
		SD39	0.963	
Connected learner	10	CL40	0.982	0.984
		CL41	0.984	
		CL42	0.982	
		CL43	0.981	
		CL44	0.981	
		CL45	0.983	
		CL46	0.982	
		CL47	0.981	
		CL48	0.984	
		CL49	0.981	
Overall	49			0.985

Referring to Table 7, the following conclusions have been made: i) Equity and citizenship advocate, as first dimension, all the 8 items, ECA01 until ECA08 are preserved at 0.943 for the Cronbach alpha value; ii) Visionary planner, as second dimension, all the 12 items, VP09 until VP20 are preserved at 0.960 for the Cronbach alpha value; iii) Empowering leaders, as third dimension, all the 11 items, EL21 until EL31 are preserved at 0.972 for the Cronbach alpha value; iv) System designer, as fourth dimension, all the 8 items, SD32 until SD39 are preserved at 0.965 for the Cronbach alpha value; v) Connected learner, as fifth dimension, all the 10 items, CL40 until CL49 are preserved at 0.984 for the Cronbach alpha value.

An assessment is an essential part of education. To ensure that our leadership is on the correct road for new era education, this type of study is crucial. Many studies have been conducted to evaluate the principal technology leadership using ISTE standards [1]–[6], although use of the new ISTE-EL 2018 is still sparse. The researcher had to create this instrument because ISTE-EL is still rather new and there is not a validated instrument that fits the study's goals. This instrument is created based on literature reviews on previous NETS-A and ISTE-A, and also standard statements and guidelines from ISTE [8]. Therefore, in order for future researchers to feel confident in the quality of the data obtained, it is crucial to demonstrate the reliability and validity of a questionnaire.

Based on the pilot study carried out through the validity and reliability procedures that have been explained, the findings show that the questionnaire instrument for this pilot study is suitable for use in the real study. The I-CVI value of each item in the instrument is in the range of 0.86 to 1.00 making all items maintainable [16]. While the overall value of S-CVI (AVE) for the instrument is high at a value of 0.98. The results of the EFA analysis show that the factor loading value for each item is above 0.6 [17]. The analysis' findings also demonstrate a high level of reliability and are suitable for use based on the Cronbach alpha value that exceeds 0.9 [19].

4. CONCLUSION

Implementing this pilot study marks the start of the researcher's true exposure to the study as it moves forward to the actual research stage. The implementation process specifies a number of requirements that must be met in order to ensure results that adhere to the standards of high and good validity and dependability. The implementation of the pilot study for this study resulted in findings in the form of instruments that may guarantee the measurement of the technology leadership practices used by school principals. For that, the instrument can be applied to actual studies.

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