RES MILITARIS
REVUE EUROPEENNE D ETUDES EUROPEAN JOURNAL OF MILITARY STUDIES
Social Science Journal

Principal's Leadership and Technology Leadership Practices and Its Relationship with Integration of Technology in Teachers' Teaching at School: Evidence Through PLS-SEM and IPMA Analysis

By

Wirda Nawawi
Faculty of Education, Universiti Kebangsaan Malaysia, Bangi, Selangor, Malaysia
Email: wirda@iab.edu.my

Mohamed Yusoff Mohd Nor
Faculty of Education, Universiti Kebangsaan Malaysia, Bangi, Selangor, Malaysia

Bity Salwana Alias
Faculty of Education, Universiti Kebangsaan Malaysia, Bangi, Selangor, Malaysia

Abstract

The purpose of this study was to identify the level of principal's leadership and technological leadership practices, and level of the integration of technology in teachers' teaching at schools. In addition, the relationship between principal's leadership and technological leadership practices with the integration of technology in teachers' teaching at schools was also investigated. This study is a quantitative study using a survey method on 492 teachers from Selangor, the Federal Territory of Kuala Lumpur, and the Federal Territory of Putrajaya in Peninsular Malaysia's central region. Data was collected using a set of questionnaires as instruments and analyzed using the Statistical Package for Social Science (SPSS) and Partial Least Squares Structural Equation Modelling (PLS-SEM) programs. Descriptive analysis shows that the principal's leadership, the principal's technological leadership and the integration of technology in teachers' teaching at schools are practiced at a very high level. The structural model test shows that there is a significant relationship between the principal's leadership practices and the principal's technological leadership with the integration of technology in the teacher's teaching at school. IPMA analysis was also utilised in this study to discern the total effect which represents the importance of the dimension of leadership practices and principal's leadership in predicting the integration of technology in teachers' teaching in schools. The study's findings can provide input to the Malaysian Ministry of Education in providing various initiatives to support principals in enhancing both their level of leadership personal and technology leadership.

Keywords: leadership; technology leadership; technology integration

Introduction

The explosion of information and communication technology (ICT) is a phenomenon that occurs all over the world. A new medium in virtual communication is beginning to gain a place in society. In addition, with the situation of the Corona Virus Disease (COVID-19) pandemic that hit the world at the end of 2019, it seemed to further accelerate this explosion. It turned out to disrupt the teaching and learning process of millions of educators and students following the closure of schools and other educational institutions (MyREF, 2022). Accordingly, the world witnessed the dependence of students solely on their own resources to continue learning. Meanwhile, teachers must adapt to new pedagogic concepts and teaching delivery methods. Teachers and school leaders are the main driving force in school's student success (KPM, 2013). School leaders are not just leading the administration, but they are also instructional leaders who need to focus on improving the quality of teaching and learning in their respective schools. Strong school leadership proved to be very necessary to increase student achievement significantly.

2. Leadership, Technology Leadership and Technology Integration Practices In School

Leadership is a critical component of the collaborative process between people and organisations working to achieve their goals (Robbins, 1996). While Lipham and Hoeh (1974) stated that leadership is an effort using relevant procedural and structural elements towards the completion of organizational objectives and goals. In conclusion, leadership is a person's ability to motivate their team to achieve a goal or organisational milestone. Even though this definition pertains to the fields of organisational training and development, it is appropriate to use it for explaining the concept of leadership in schools because schools are also organisations. In this regard, school leadership plays a very important role for the effectiveness of educational institutions starting from setting goals to achieving goals. The school is led by a principal and the person led consists of teachers and students. School teachers need leaders who can inspire, support, encourage and motivate them to be more effective in teaching and learning while students are very dependent on teachers to acquire knowledge and skills. According to the results of Margeret and Chua (2021), the leadership practices of school principals have an impact on teachers and in turn have an impact on student performance. Therefore, the success and failure of a school are very upsetting to the school leader's ability to lead all school members (Shantini et al.2018).

Technology leadership is a combination of strategies and approaches used in general leadership but with a focus on technology, particularly in relation to equipment availability, technological advancement, and the understanding that professional advancement and the use of technology are ever evolving in line with the passage of time and eras (Tisebio & Roslee, 2020). In conclusion, technology leadership is crucial for the integration of information and communication technology to understand the principal's development objectives for the school

he leads. Due to the speed at which digital technology is developing and the sophistication of technology today, schools must have pedagogical leadership that is digitally proficient. Because this group of school leaders oversees properly managing technology and the digital environment in schools, their technology leadership techniques must also be in step with the most recent technical advancements.

The establishment of a teaching technology environment, the utilisation of technology applications, and general frequency and pattern of technology use are all included in organisational technology integration (Texas Education Agency, 2010). When teachers utilise technology to introduce, reiterate, expand, enrich, evaluate, and restore understanding of curricular objectives, this is known as technology integration (Hamilton, 2015). In this regard, the backing of the leader will also foster a setting that is favourable for technological integration. The more support provided by the leader, the more resources the organization may devote to the implementation of technological integration, which will ultimately result in the success of innovation (Lawrence & Tar, 2018). The degree of all-encompassing support that can be offered by the institution's management is referred to as leader support because it is uncommon for teachers to use and integrate technology in teaching and learning on their own. To encourage or discourage the use of technology, the leader can do so in a variety of ways, such as openly through mandates (Moore & Benbasat, 1991) or implicitly through reward and incentive systems (Leonard-Barton, 1988).

2.1 Problem statement

Student achievement and school excellence are positively correlated with effective principal leadership, according to research (Dutta & Sahney, 2016). The findings of Margeret and Chua (2021) demonstrate that principal leadership practices influence teachers, who in turn influence students' academic performance. Studies on principal leadership and school success are growing more and more significant in Malaysia, according to the literature. However, there is still little evidence that school administrators' leadership techniques have an impact on teachers' motivation and self-efficacy in this nation (Margeret & Chua, 2021).

Leaders in the fourth industrial revolution must simultaneously be extremely proactive in utilising technology and developing knowledge and information about it (Mat et al., 2019). In comparison, the principal still falls short of the ICT knowledge and proficiency requirements of the National Educational Technology Standards for Administrators (NETS-A) (Osman 2014; Banolu et al., 2016; Ozkan et al., 2017). According to this occurrence (Kor et al., 2016; Uur & Koç, 2019), the principal's level of technology leadership is still insufficient and performing poorly. How effectively teachers use ICT is significantly influenced by technology leaders (Mohd Norakmar et al., 2020). Because school principals are one of the major influences influencing how successfully teachers integrate ICT, this finding is rather alarming (Nor Asiah et al., 2019).

2.2 Objectives

This study was conducted with several specific objectives as follows:

i. Identifying the level of principal leadership, principal technology leadership and the integration of technology in teachers' teaching practices at school.

ii. Testing the relationship between the principal's leadership practices and the integration of technology in teachers' teaching at school.
iii. Testing the relationship between the principal's technology leadership practices and the integration of technology in teachers' teaching at school.
iv. Testing which dimensions in the principal's leadership practices is a dominant predictor of the integration of technology in teachers' teaching at schools.
v. Testing which dimensions in principals' technology leadership practices is a dominant predictor of the integration of technology in teachers' teaching at schools.

2.3 Hypothesis

This study employs the following two null hypotheses:

Ho1: There is no significant relationship between the principal's leadership practices and the integration of technology in teachers' teaching at school.
Ho2: There is no significant relationship between the principal's technology leadership practices and the integration of technology in teachers' teaching at school.
Ho3: Dimension in the principal's leadership practices is not a predictor in encouraging the integration of technology in teachers' teaching at school.
Ho4: Dimension in principal's technology leadership practices is not a predictor in encouraging the integration of technology in teachers' teaching at school.

2.4 Conceptual Framework

Based on the idea of the theories and previous findings, the research framework for this study is exhibited in Figure 1.

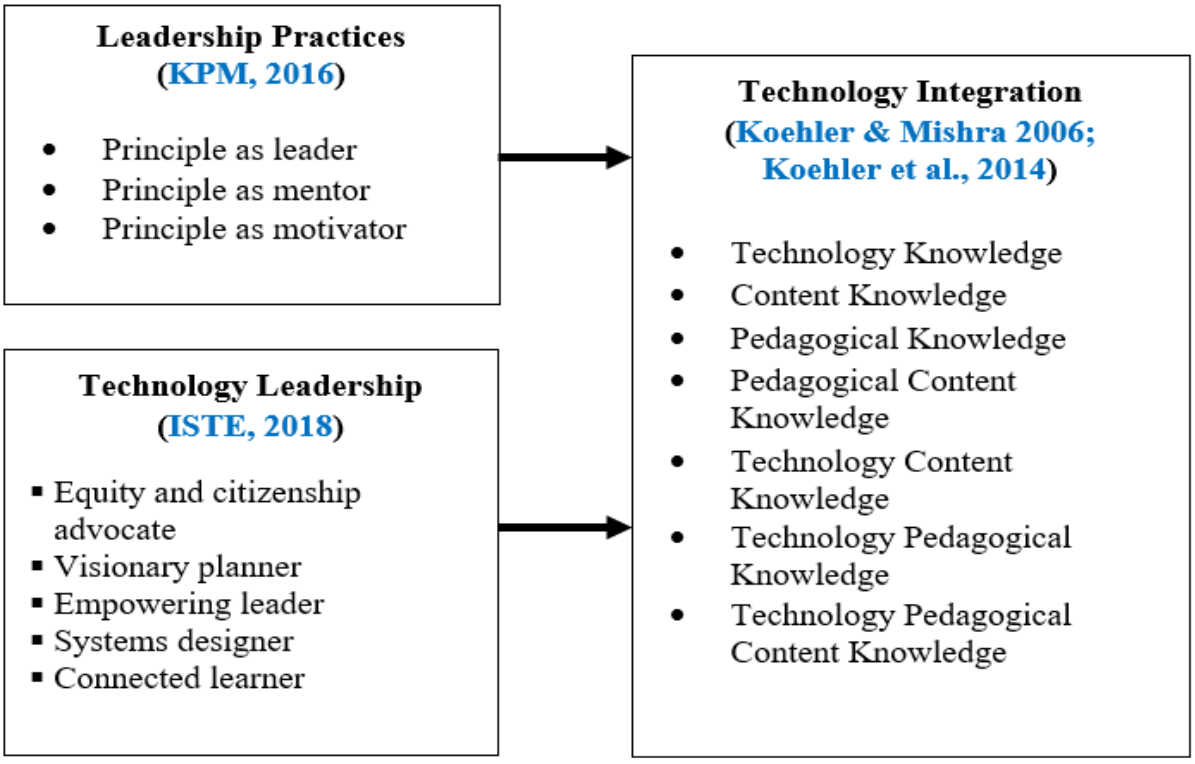

Figure 1. *Conceptual framework*

3. Methodology

This study is quantitative and use a survey method to gather data from a subset of the population about the study variables. With a research population of 29,987 teachers from Selangor, Putrajaya, and Kuala Lumpur in the central region of Peninsular Malaysia, this study used a multi-level random selection technique. However, only 492 people from the entire sample were chosen at random for this study's purposes. The second version of Malaysian Education Quality Standard Model (SKPMg2) introduced by the Ministry of Education (KPM, 2016) and the ISTE for Education Leader (ISTE-EL) by the International Society of Technology in Education (ISTE, 2018) are the two instruments used to assess principals' leadership and technological leadership practices. Each question contains a response choice in the form of a Likert scale with a range of 1 to 5. (Strongly disagree – Strongly agree). Scale 1 indicates that the teacher strongly disagrees with the principal's reported practices, whereas scale 5 indicates that the teacher strongly agrees with the principal's reported practices. While the level of integration of technology in in teachers' teaching at school was assessed using the TPACK model created by Schmidt et al. (2009), Chai et al. (2011) and Schmid et al. (2020). Additionally, this part includes a Likert scale with five possible responses, ranging from 1 to 5. (Strongly disagree – Strongly agree). Scale 1 indicates that the teacher strongly disagrees with displaying the conduct as it is mentioned in the questionnaire, whereas scale 5 indicates that the teacher strongly agrees with displaying the conduct as it is stated. The COVID-19 epidemic, which is currently impacting the entire planet, serves as justification for the distribution of this questionnaire, which is only made available online and is granted a two-week window using Google Form.

Table 1. *Respondents Profile*

Profile		Frequency (n)	Percentage (%)
Gender	Male	70	14.2
	Female	422	85.8
Location	Selangor	340	69.1
	Wilayah Persekutuan Kuala Lumpur	87	17.7
	Wilayah Persekutuan Putrajaya	65	13.2
Teaching Experience	1 – 3 years	49	10.0
	3 – 5 years	36	7.3
	6 – 10 years	72	14.6
	11 – 15 years	108	22.0
	16 – 20 years	62	12.6
	More than 20 years	165	33.5
Period of Service at Current School	1 – 2 years	151	30.7
	3 – 4 years	81	16.5
	5 years and above	260	52.8
Number of ICT Related Courses Attended	Never	51	10.4
	1 – 2 times	198	40.2
	3 – 4 times	115	23.4
	5 times and above	128	26.0

4. Results and Analysis

The data were collected from a total of 492 teachers. Table 1 shows the summary results. It consisted of 70 males (14.2%) and 422 females (85.8%). Majority of the respondent's locality are from Selangor (69.1%). In terms of the seniority, teachers with more than 20 years' experience in teaching was the most common (33.5%) and more than 50% of them were already in recent school for more than 5 years. In the aspect of ICT courses that have been participated by the respondents, more than 80% of them at least attended the course once.

4.1 Level of the principal's leadership practices, principal's technological leadership practices, and integration of technology in teachers' teaching at school

The level of the principal's leadership practices, principal's technological leadership practices, and technology integration in teachers' teaching were all determined using descriptive analysis or mean and standard deviation. The interval scale for each average score was calculated, as shown in Table 2, since the researcher utilised a five-point Likert scale to interpret the average score to assess the degree of each variable in this study.

Table 2. *Explanation of Five-Point Average Score (Mean) for Level of Principal's Leadership Practices, Level of Principal's Technological Leadership Practices, and Level of Integration of Technology in Classroom*

Average Score	Indication
1.00 – 1.80	Very low
1.81 – 2.60	Low
2.61 – 3.40	Medium
3.41 – 4.20	High
4.21 – 5.00	Very high

Table 3 shows overall findings for level of leadership and technology leadership among principals, and also level of technology integration among teachers, which all of them were at very high level. The highest mean score was leadership variable (M=4.43, SD=0.53), followed by technology leadership variable (M=4.38, SD=0.53) and the lowest variable was the integration of technology in teachers' teaching (M=4.27, SD=0.45).

Table 3. *Level of Principal's Leadership Practices, Principal's Technology Leadership Practices and Level of Integration of Teacher's Teaching Technology*

Constructs	*M*	*SP*	Indicator
Leadership	4.43	.53	Very high
Technology Leadership	4.38	.53	Very high
Teacher's Integration of Technology	4.27	.45	Very high
Overall	4.36	.50	Very high

Ho1, Ho2, Ho3 and Ho4 were analyzed by PLS-SEM, this analysis consists of two approaches, first is measurement model and the second is structural model.

4.2 Assessment of measurement model

For the assessment of measurement model, internal consistency, convergent validity, and discriminant validity was measured. Internal consistency was measured through Cronbach alpha and composite reliability. The analysis shows that both reliability tests (Composite Reliability and Cronbach's Alpha) for each targeted construct were above .70. This situation indicated that all constructs used in this study had high internal consistency (Hair et al., 2018; Sekaran & Bougie, 2016). Convergent validity is the extent to which measures correlates positively with the alterative measures of the same construct. Convergent validity is measured through loading value each item and average variance extracted (AVE) values. All indicators that were used to measure targeted constructs meet the minimum requirement of the loading value above .70. The assessment AVE for each construct was above .50. This indicated that all items and constructs used in this study had met the standard of convergent validity and reliability (Barclay et al., 1995; Hair et al., 2018;Ebrahimi et al., 2022; Henseler et al., 2009). Table 4 shows the summary results of the internal consistency and convergent validity assessment for the measurement model.

Table 4. *Reliability and Validity Analysis for Measurement Model*

Second Layer Constructs	First Layer Constructs	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Leadership	Principal as Leader	0.983	0.984	0.708
	Principal as Mentor	0.966	0.972	0.853
	Principal as Motivator	0.979	0.981	0.815
Technology Leadership	Equity and Citizenship Advocate	0.969	0.973	0.82
	Visionary Planner	0.985	0.986	0.858
	Empowering Leader	0.984	0.986	0.864
	Systems Designer	0.979	0.982	0.871
	Connected Learner	0.986	0.987	0.885
Technology Integration	Technology Knowledge	0.96	0.965	0.735
	Content Knowledge	0.947	0.957	0.759
	Pedagogical Knowledge	0.98	0.982	0.809
	Pedagogical Content Knowledge	0.95	0.962	0.835
	Technological Content Knowledge	0.953	0.961	0.78
	Technological Pedagogical Knowledge	0.963	0.97	0.82
	Technological Pedagogical Content Knowledge	0.955	0.965	0.847

The discriminant validity is measured through Heterotrait-Monotriat (HTMT) analysis. The analysis confirms that each latent variable was totally discriminate to each other since the HTMT ratio values were less than .90. Therefore, the indicators that were used to measure targeted construct were totally used for the respectively construct (Barclay et al., 1995; Hair et al., 2018; Henseler et al., 2009). Table 5 shows the result of HTMT ratio.

Table 5. *HTMT Discriminant Analysis for Measurement Model*

Constructs	Leadership	Technology Leadership	Technology Integration
Leadership			
Technology Leadership	0.596		
Technology Integration	0.563	0.844	

4.3 Assessment of structural model

After completing the measurement model assessment by establishing reliability and validity, the next step is to assess the structural model. For assessing structural model, a few steps assessment was measured: collinearity analysis, hypothesis testing and R^2 test. Collinearity is checked before moving to another step. For checking collinearity, Variance Inflation Factor (VIF) was calculated for all items of each variable. The results indicated that there are no collinearity issues exits, all the VIF values are below 5 (Hair et al., 2018), the results are shown in the Table 6.

Table 6. *VIF Values*

Model	Collinearity Statistics	
	Tolerance	VIF
Integration	.644	1.552
Technology Leadership	.279	3.582
Leadership	.295	3.384

4.4 Result of testing hypothesis 1 and 2

The result that can be seen in Table 7 indicated that leadership had a positive and significant effect on technology integration ($\beta = 0.207$; $t = 2.990$), therefore hypothesis 1 was rejected. Technology leadership also had a positive and significant effect on technology integration ($\beta = 0.413$; $t = 5.761$), therefore hypothesis 2 was also rejected. Values of R^2 0.02, 0.15,0.26 are defined as weak, medium, and strong respectively (Cohen, 1988). The R^2 in Table 6 indicated that the existence of leadership and technology leadership were able to explain the contribution to technology integration was about 35.6% ($R^2 = .356$).

Table 7. *Hypothesis Testing*

Hypothesis	Path	Standardized Beta (ß)	t Values	p Values	Decision	R^2	Level
Ho1	Leadership -> Integration	0.207	2.990	0.003	Significant	0.356	Strong
Ho2	Technology leadership -> Integration	0.413	5.761	0	Significant	0.356	Strong

Importance - Performance Map Analysis (IPMA)

As the advancement of the PLS-SEM analysis procedure, Importance-Performance Map Analysis (IPMA) was employed in this study. The objective of this analysis is to access the importance key areas for increasing the level of technology integration in teachers' teaching. IPMA also considers the performance of the construct.

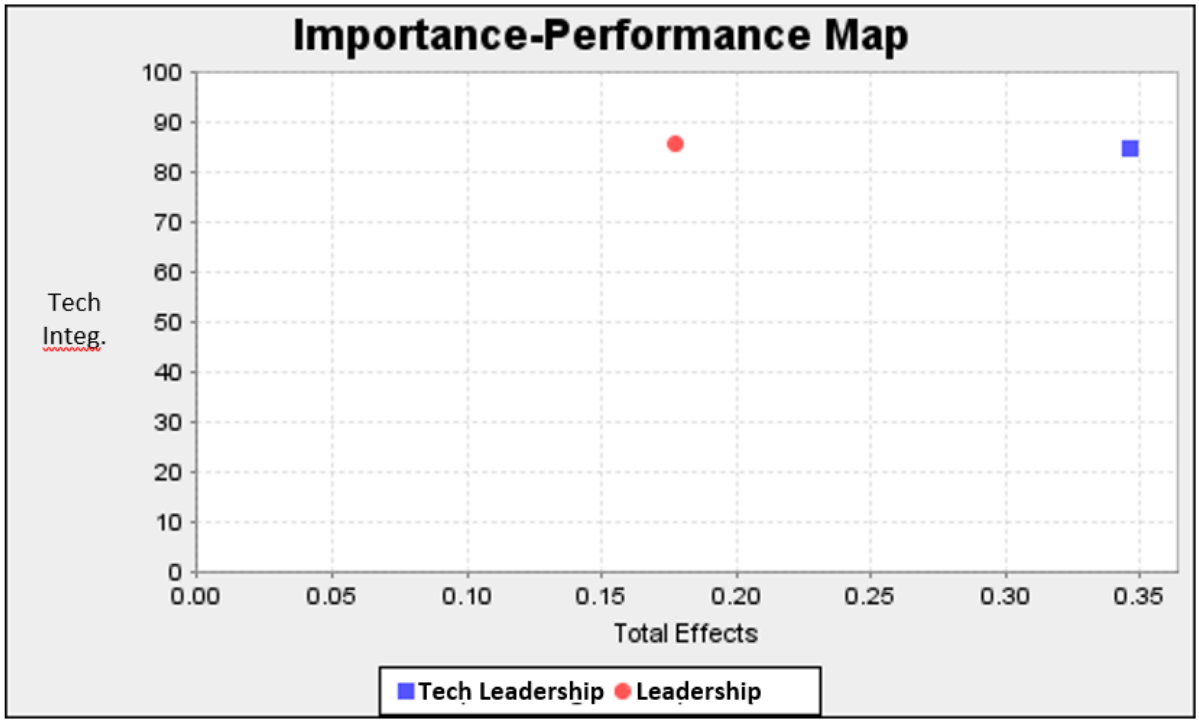

Figure 1. *Importance-Performance Map Analysis*

Figure 1 shows the assessment of IPMA analysis. The analysis indicated that technology leadership is the very important factor for increasing the level of technology integration in teachers' teaching since this factor having the highest value of the total effect (refer to X-axis reading) followed by leadership factor. As for performance aspect (refer to Y-axis reading), the analysis indicated that leadership having a highest performance value as compared to technology leadership factor. Therefore, by suggestion from the IPMA analysis, technology leadership play the importance factor for increasing the level of technology integration in teachers' teaching, whereas leadership give an additional forces factor to increase technology integration in teachers' teaching due it's having a good performance level.

4.5 Result of testing hypothesis 3 and 4

The analysis of each dimension of the principal's leadership construct are presented in Table 8. According to the analysis, the principal as motivator is the most important predictor (1.045), followed by the principal as mentor (1.017) and the principal as leader (0.974), in terms of encouraging the use of technology in teachers' teaching. From the perspective of performance, it is also evident that the principal as motivator has the greatest value (86.193), followed by the principal as leader (85.413) and the principal as mentor (85.400). Overall, IPMA's analysis reveals that, in addition to having a very strong level of performance in encouraging the integration of technology in teachers' teaching in schools, the principal's role as a motivator plays the most significant role. Those results proved that hypothesis 3 was rejected because all the dimensions in the principal's leadership practices is a predictor in encouraging the integration of technology in teachers' teaching at school.

Table 8. *IPMA Analysis for Leadership*

Leadership	**Technology Integration**	
	Total Effect (Importance)	Index Value (Performance)
Principal as Leader	0.974	85.413
Principal as Mentor	1.017	85.400
Principal as Motivator	1.045	86.193

The outcomes of the IPMA analysis of each dimension of the principal's technology leadership practices construct are presented in Table 9. The results showed that the most important predictor was the connected learner dimension (1.031), which was followed by the visionary planner dimension (1.028), the systems designer dimension (0.992), the empowering leader (0.985), and finally the equity and citizenship advocate dimension (0.948). According to the performance aspect, the systems designer dimension comes in last with a score of 83.768, followed by the connected learner dimension (83.84), the visionary planner dimension (84.172), the equity and citizenship advocate dimension (84.695) and the empowering leader dimension (86.708) comes the most performance aspects. Overall, the IPMA analysis suggests that the connected learner dimension plays the most significant role in promoting the integration of technology in teachers' teaching at schools, while the empowering leader dimension provides an additional factor because it performs at a very high level.

Table 9. *IPMA Analysis for Technology Leadership*

Technology Leadership	**Technology Integration**	
	Total Effect (Importance)	Index Value (Performance)
Equity **a**nd Citizenship Advocate	0.948	84.695
Visionary Planner	1.028	84.172
Empowering Leader	0.985	86.708
Systems Designer	0.992	83.768
Connected Learner	1.031	83.84

5. Discussion

From the result, it shows that the level of leadership and technology leadership among principals were at a high level. The research by Hero (2020), Faridah et al. (2020), Melvin and Bity (2020), Shantini et al. (2018), Evonne and Crispina (2018) that found principals have a high level of leadership agree with this finding. As for technology leadership, this result is consistent with research by Rafidah and Muhammad (2022), Nur Hanisah and Mohamed Yusoff (2021), Faridah and Azlin (2020), Tisebio and Roslee (2020), Thannimalai and Raman (2018a), Mohd Norakmar et al. (2020), Leong et al. (2016), Alkrdem (2014), Fisher and Waller (2013), Noraini (2017), Faridah and Mohd Izham (2017).

The result also shows that the level of technology integration among teachers were at a high level. This study supports the findings of Arumugam et al. (2019), which indicated that teachers were integrating technology at a high level. The level of teacher technology integration was also shown to be high in various research by Mohammed Yousef and Mahizer (2016), Arumugam (2014), Khor and Lim (2014). Al-Jaraideh (2009), Almekhlafi and Almeqdadi (2010), Hero (2020) and other international research also revealed a high level of technology integration.

The findings of the overall analysis of the relationship's strength between the principal's leadership and the use of technology in the classroom indicate that the relationship is strongly interpreted. The results of this study were found to be consistent with those of Syamsul et al. (2021), Zuheir Khlaif (2018), Anugamini and Yatish (2018), Rabah (2015) and Tondeur et al. (2008) who identified the principal's leadership as one of the key factors impacting teachers' adoption of ICT. Additionally, studies demonstrate a favourable correlation between the principal-teacher relationship and the degree of teacher involvement (Price et al., 2012).

The study's analysis's findings also indicate a strong correlation between the principal's technology leadership and the level of technology integration in teachers' lessons at the firm level. According to studies by Mohd Norakmar (2022), Mohd Norakmar et al. (2019), Ugur and Koc (2019), Thannimalai and Raman (2018a), Anugamini and Yatish (2018), Fisher and Waller (2013), Tan (2010) and Alenezi (2016), there is a significant correlation between the level of leadership provided by the principal's technology and the level of integration provided by the teacher's technology.

This study also discovered that the principal's technological leadership and all leadership variable characteristics are significant predictors of how much technology will be used in classroom instruction.

6. Conclusion

The population of this study, which consists solely of national secondary school teachers in Peninsular Malaysia's middle zone, is constrained. As a result, the study's conclusions may only be applied generally to all SMK principals and teachers employed by the

Ministry of Education. It is advised that future responses include other groups such as elementary schools, government-aided schools, private schools, and others. Additionally, information was gathered regarding teachers' perceptions of principals as survey participants. As a result, it is possible that teachers' perceptions of their principals are either too high or too low when used to gauge their level of technical leadership and leadership practices.

This study still helps policy makers in their planning and provision of suitable programmes for principals' professional development, nonetheless. To improve and hasten the use of technology in teaching and learning more successfully, it involves training and programmes that should highlight 21st century leadership styles such as technology leadership.

References

Alenezi, A. 2016. Technology leadership in Saudi schools. *Education and Information Technologies* 22(3): 1121–1132. doi:10.1007/s10639-016-9477-x.

Al-Jaraideh, Y. A. 2009. Factors affecting information and communication technology (ICT) integration in Jordanian secondary schools. PhD thesis, Universiti Utara Malaysia.

Alkrdem, M. 2014. Technological leadership behavior of high school headteachers in Asir Region, Saudi Arabia. *Journal of International Education Research (JIER)* 10(2): 95-100. https://doi.org/10.19030/jier.v10i2.8510

Almekhlafi, A. G. & Almeqdadi, F. 2010. Teachers' perceptions of technology integration in the United Arab Emirates school classrooms. *Journal of Educational Technology & Society* 13(1): 165-175.

Anugamini, P. S. & Yatish, J. 2018. Examining the role of technology leadership on knowledge sharing behaviour. *International Journal of Knowledge Management.* 14(4): 13-29.

Aruguman, R. 2014. TPACK Confidence of Pre-service Teachers in Universiti Utara Malaysia. *Mediterranean Journal of Social Sciences* 5(22): 167–175.

Aruguman, R., Raamani, T. & Siti Noor, I. 2019. Principals' technology leadership and its effect on teachers' technology integration in 21st century classrooms. *International Journal of Instruction* 12(4): 423–442.

Banoğlu, K., Vanderlinde, R. & Çetin, M. 2016. Investigation of principals' technology leadership profiles in the context of schools' learning organization culture and ICT infrastructure: F@tih project schools vs. the others. *Egitim ve Bilim* 41(188): 83–98.

Barclay, D., Higgins, C. & Thompson, R. 1995. The Partial Least Squares (PLS) approach to causal modeling: Personal computer adoption and use as an illustration. *Technology Study, 2*(2), 285–309.

Chai, C. S., Ling Koh, J. H., Tsai, C.C., & Wee Tan, L. 2011. Modeling primary school pre-service teachers' Technological Pedagogical Content Knowledge (TPACK) for meaningful learning with information and communication technology (ICT). *Computers & Education* 57(1): 1184–1193.

Cohen, J. 1988. *Statistical power analysis (2nd ed.)*. Hillsdale NJ: Erlbaum.

Ebrahimi E, HadaviZade A. The Effect of Computer-Based Concept Mapping Learning Strategy on Iranian Intermediate EFL Learners' Writing Accuracy and Fluency. kurmanj 2022; 4 (1) :1-7

Evonne, L. E. F. & Crispina, G. K. H. 2018. Hubungan kepimpinan pengetua dan iklim sekolah dengan motivasi guru. *Malaysian Journal of Social Sciences and Humanities (MJSSH)* 3(2): 1-16.

Faridah, A, K. & Azlin, TN. M. 2020. Amalan kepimpinan teknologi pengetua sekolah menengah daerah Tawau. *Proceeding of the International Conference of Future Education and Advance, pp.* 575-581.

Faridah, J. & Mohd Izham, M. H. 2017. Kepimpinan teknologi pengetua dan hubungannya dengan prestasi akademik sekolah di Malaysia. *International Journal of Education, Psychology and Counseling* 2(5): 215–230. http://www.ijepc.com/PDF/IJEPC-2017-05-09-17.pdf.

Faridah, J. 2016. Kepimpinan teknologi dan standard kompetensi pengurusan kurikulum dalam kalangan pengetua sekolah menengah harian di Malaysia. PhD thesis, Universiti Kebangsaan Malaysia.

Faridah, S. A., Ruslin, A. & Azmi, A. 2020. Kepimpinan pengetua dan kesannya terhadap motivasi murid. *Proceeding of the International Conference of Future Education and Advance (ICOFEA) 2020.* 205-212.

Fisher, D. M. & Waller, L. R. 2013. The 21st century principal: A study of technology leadership and technology in Texas K-12 schools. *The Global ELearning Journal* 2(4): 1-44.

Hair, J. F., Sarstedt, M., Ringle, C. M. & Gudergan, S. P. 2018. *Advanced Issues in Partial Least Squares Structural Equation Modeling*. Los Angeles: SAGE Publishing.

Hamilton, B. 2015. *Integrating Technology in the Classroom: Tools to Meet the Needs of Every Student*. Oregon: International Society for Technology in Education.

Henseler, J., Ringle, C. M., & Sinkovics, R. 2009. The use of partial least squares path modeling in international marketing. *Advances in International Marketing 20*: 277–319.

International Society for Technology in Education (ISTE). 2018. *ISTE Standards for Educational Leaders*. Oregon: ISTE.

Kementerian Pendidikan Malaysia (KPM). 2013. *Pelan Pembangunan Pendidikan Malaysia 2013-2025: Pendidikan Prasekolah hingga Lepas Menengah*. Putrajaya: KPM.

Khor, M. T. & Lim, H. L. 2014. Pengetahuan Teknologi Pedagogi Kandungan (PTPK) dalam Kalangan Guru Matematik Sekolah Rendah. *Jurnal Pendidikan Sains & Matematik Malaysia* 4(1): 29-43.

Kör, H., Erbay, H. & Engin, M. 2016. Technology leadership of education administers and innovative technologies in education: A case study of Çorum City. *Universal Journal of Educational Research* 4(12A): 140–150.

Lawrence, J. E. & Tar, U. A. 2018. Factors that influence teachers' adoption and integration of ICT in teaching/ learning process. *Educational Media International* 55(1): 79–105. https://doi.org/10.1080/09523987.2018.1439712.

Leonard-Barton, D. 1988. Implementation as mutual adaptation of technology and organization. *Research Policy* 17(5), 251–267. doi:10.1016/0048-7333(88)90006-6

Leong, M. W., Chua, Y. P. & Kannan, S. 2016. Relationship between principal technology leadership practices and teacher ICT competency. *Malaysian Online Journal of Educational Management (MOJEM)* 4: 13- 36. 10.22452/mojem.vol4no3.2.

Lipham, J. M. & Hoeh, J. A. 1974. *The principalship: Foundations and Functions*. London: Harper & Row.

Malaysian Research and Education Foundation (MyREF). 2022. Laporan Kajian Kaedah Kesinambungan Pengajaran dan Pembelajaran (PdP) Sebagai Pelan Pemulihan Sistem Pendidikan Negara: Inisiatif Pelbagai Negara.

Margeret, L. P. T. & Chua, Y. P. 2021. Kesan amalan kepemimpinan pengetua sekolah ke atas motivasi dan efikasi kendiri guru terhadap pencapaian aktiviti kokurikulum pelajar. Jurnal Kepimpinan Pendidikan 8(3): 1-17

Mat, R. Y., Mohd Faiz, M. Y. & Mohd Yusri, I. 2019. Digital leadership among school leaders in Malaysia. *International Journal of Innovative Technology and Exploring Engineering* 8(9): 1481–1485.

Melvin, S. E. & Bity, S. A. 2020. Gaya kepimpinan pengetua dan motivasi guru di sekolah menengah harian di daerah Miri. *Proceeding of the International Conference of Future Education and Advance (ICOFEA) 2020.* 555-559.

Mohammed Yousef, M. & Mahizer, H. 2016. Primary Science Teachers' Perceptions of Technological Pedagogical and Content Knowledge (TPACK) in Malaysia. *European Journal of Social Sciences, Education and Research* 6(2): 167- 179.

Mohd Norakmar, O., Siti Noor, I. & Abd Latif, K. 2020. Karakter kepimpinan teknologi pengetua dalam pengintegrasian ICT di sekolah menengah. *Jurnal Kepimpinan Pendidikan* 7(1): 28–46. https://jupidi.um.edu.my/article/view/22122.

Moore, G. C. & Benbasat, I. 1991. Development of an Instrument to Measure the Perceptions of Adopting an Information Technology Innovation. *Information Systems Research* 2(3): 192-222.

Nor Asiah, R., Habibah, A. J. & Ismi Arif, I. 2019. Challenges in ICT integration among Malaysian public primary education teachers: The roles of leaders and stakeholders. *International Journal of Emerging Technologies in Learning* 14(24): 184–205.

Noraini, A. 2017. Amalan kepimpinan teknologi pengetua sekolah menengah di Malaysia. PhD thesis, Universiti Kebangsaan Malaysia.

Nur Hanisah, M. A. & Mohamed Yusoff, M. N. 2021. Amalan kepimpinan teknologi pengetua dalam pengintegrasian ICT di sekolah menengah daerah Pekan, Pahang. *Jurnal Dunia Pendidikan* 3(3): 1-12.

Osman, F. B. 2014. High school administrators' perceptions of their technology leadership preparedness. *Educational Research and Reviews* 9(14): 441–446.

Ozkan, T., Tokel, A., Celik, M., & Oznacar, B. (2017). Evaluation of technology leadership in the context of vocational school administrators. *Proceedings of the 9th International Conference on Computer Supported Education* (Vol. 1, pp. 727–731).

Price, A., Mansfield, C. & McConney, A. 2012. Considering teacher resilience from critical discourse and labour process theory perspectives. *British Journal of Sociology of Education* 33(1): 81-95.

Rabah, J. 2015. Benefits and challenges of information and communication technologies (ICT) integration in Québec English schools. *Turkish Online Journal of Educational Technology* 14(2): 24–31.

Rafidah, S. & Muhammad, H. 2022. Kepimpinan teknologi pengetua dan pelaksanaan kemahiran abad ke 21 dalam kalangan guru sekolah. *International Conference On Global Education* 355-363.

Robbins, S. P. 1996. *Organizational Behavior: Concepts, Controversies, Applications.* Englewood Cliffs, New Jersey: Prentice-Hall International.

Schmid, M., Brianza, E., & Petko, D. 2020. Efficient self-report measures for technological pedagogical content knowledge (TPACK): Constructing a reliable and valid short-scale among pre-service teachers. *Computers & Education* 103967. doi:10.1016/j.compedu.2020.103967

Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Koehler, M. J., & Shin, T. S. 2009. Technological Pedagogical Content Knowledge (TPCK): The development and validation of an assessment instrument for preservice teachers. *Journal of Research on Technology in Education* 42(2): 27.

Sekaran, U. & Bougie, R. 2016. *Research Methods for Business: A Skill-Building Approach*. United Kingdom: John Wiley & Sons.

Shantini, A. R., Muhammad Faizal, A. G. & Norfariza, M. R. 2018. Tahap kompetensi pemimpin sekolah di sekolah jenis kebangsaan tamil dalam daerah terpilih di Selangor. *Jurnal Kepimpinan Pendidikan* 3(1): 32–46.

Shantini, A. R., Muhammad Faizal A. G. & Norfariza, M. R. 2018. Tahap kompetensi pemimpin sekolah di sekolah jenis kebangsaan Tamil dalam daerah terpilih di Selangor. *Jurnal Kepimpinan Pendidikan* 3(1): 32–46.

Syamsul, A. H., Aziah, I. & Rozniza, Z. 2021. Kepimpinan teknologi guru besar sekolah rendah harian: Satu kajian rintis di Kedah. *Jurnal Kepimpinan Pendidikan* 8(3): 38-54.

Tan, S.bC. 2010. School technology leadership: Lessons from empirical research. In C. H. Steel, M. J. Keppell, P. Gerbic & S. Housego (eds.) *Curriculum, technology & transformation for an unknown future*. Proceedings Ascilite Sydney 2010. pp. 896-906.

Texas Education Agency (TEA). 2010. *The 2006 - 2020 Texas Campus STaR Chart*. Instructional Materials and Educational Technology Division.

Thannimalai, R. & Raman, A. 2018a. The influence of principals' technology leadership and professional development on teachers' technology integration in secondary schools. *Malaysian Journal of Learning and Instruction* 15(1): 203–228.

Tisebio, T. & Roslee, T. 2020. Hubungan kepimpinan teknologi pengetua dalam pengurusan kurikulum dan efikasi kendiri guru. *Malaysian Journal of Social Sciences and Humanities* 5(4): 71- 83.

Tondeur, J., van Keer, H., van Braak, J. & Valcke, M. 2008. ICT integration in the classroom: Challenging the potential of a school policy. *Computers and Education* 51(1): 212–223.

Uğur, N.G. & Koç, T. 2019. Leading and teaching with technology: School principals' perspective. *International Journal of Educational Leadership and Management* 7(1): 42.

Zuheir, K. 2018. Teachers' perceptions of factors affecting their adoption and acceptance of mobile technology in k-12 settings. *Computers in the Schools* 35(1): 49–67.