International Journal of Evaluation and Research in Education (IJERE)
Vol. 12, No. 1, March 2023, pp. 412~420
ISSN: 2252-8822, DOI: 10.11591/ijere.v12i1.22376

The sustainability of technology-aided leadership adoption among school leaders: If it could ever be this real forever

Mat Rahimi Yusof[1], Hapini Awang[2], Mohd Faiz Mohd Yaakob[1], Mohd Fairuz Jaafar[1], Mohd Yusri Ibrahim[3], Pang Lai Chaw[4]
[1]School of Education, Universiti Utara Malaysia, Kedah, Malaysia
[2]School of Computing, Universiti Utara Malaysia, Kedah, Malaysia
[3]Faculty of Business, Economic and Social Developments, Universiti Malaysia Terengganu, Kuala Terengganu, Malaysia
[4]Jabatan Pendidikan Terengganu, Sekolah Kebangsaan Tengku Mahmud 2, Kuala Terengganu, Malaysia

Article Info

Article history:

Received Sep 30, 2021
Revised Oct 25, 2022
Accepted Nov 19, 2022

Keywords:

Technology leadership
Technology-aided
Virtual communication

ABSTRACT

The 21st century has become a challenging moment for all sectors including education. The rapid advancement of technology has brought a huge impact to leadership style among school leaders in Malaysia. Hence, this quantitative identified the level of technology-aided leadership and analyze the behavioral constructs that contribute to technology-aided leadership. A total of 365 questionnaires adapted from the national educational technology standards for administrators (NETS-A) were answered by respondents. statistical packages for social sciences (SPSS) version 26 and Smart PLS 3 were used to analyze the data. Interestingly, the results revealed that the level of technology-aided leadership is high and the six constructs of technology-aided leadership among principals are valid. The constructs are i) Productivity and professional practice; ii) Teaching and learning; iii) Social, legal, and ethics; iv) Leadership and vision; v) management support and operations; and vi) Assessment and evaluation. In general, school leaders should take the opportunity to develop themselves to become high-tech leaders. Meanwhile, the 31 indicators that are verified in this study can be used to evaluate the behavior of technological leadership. Finally, further research is strongly encouraged to enlarge the scope by collecting the data from all Malaysian states to obtain more accurate and generalizable results.

Corresponding Author:

Mat Rahimi Yusof
School of Education, Universiti Utara Malaysia
06010, UUM Sintok, Kedah, Malaysia
Email: rahimi@gurumalaysia.edu.my

1. INTRODUCTION

Industry revolution 4.0 (IR4.0) has a huge impact on all sectors including education. The rapid development of technology has generally brought changes to the nation's education system. Indeed, the emphasis on technology integration is clearly stated in the seventh shift of the Malaysian education development plan (PPPM, 2013-2025) and National Education Technology Plan, 2016. This emphasis is to realize the government's aspiration to position Malaysia as a center of educational excellence in line with other developed countries.

The Malaysian Ministry of Education (MOE) has encouraged all educators and students to apply virtual learning through the 1BestariNet program [1]–[3]. When the country affected by the COVID-19 pandemic, the use of technology has suddenly become common among educators. Virtual learning platforms, such as Google Meet, Google Classroom and Zoom are among the alternatives that have been widely adopted to compensate for the unavailability of face-to-face teaching and learning [4], [5].

At the school level, principals should always be sensitive and prepared for technological change [6]–[8]. Principals should be technological leaders who provide knowledge, skills and facilities to realize 21st century education [9], [10]. Moreover, they are also responsible to ensure that teachers integrate technology in their teaching and learning [11], [12]. Principals need to be proactive leaders and always eager towards new technologies such as by acting as a facilitator, equipping computer labs, as well as providing trainings on effective technology integration [10].

2. PROBLEM STATEMENT

Past studies shown that technology leadership has long been practiced in schools [2], [13], [14]. Therefore, principals should be actively practicing their role as technological savvy leaders, as set out in NETS-A [2], [15], [16]. The roles of technological leaders in the 21st century are crucial in technology integration, especially for teaching and learning as well as administration [15]. Principals should design a technology-friendly organizational structure, in accordance with the country's technology agenda [15], [17].

Hence, by assuming their responsibility as technological leaders, principals need to showcase an example in the integration of technology and developing young generations who are technically competent. Principals should offer a more attractive education by enhancing or maintaining the culture of digital learning and good technology practices among students [14]. Principals should make sure that teaching and learning innovations are available and technology-based learning resources are properly used [13]. To practice a higher level of technology leadership, they need to find initiatives or activities that can evoke innovations [18]. Therefore, it becomes vital for principals to encourage teachers to integrate technology into education. As a school leader, their role of technological leadership should be widely implemented [6].

However, in realizing the role of principals as technology-aided leaders, there are several issues have been identified. Due to the lack of emphasis on technology elements in the professional leadership training of school leaders, some principals are incompetent in the aspect of managing schools based on technology [19]. Due to the lack of emphasis given in professional training courses, they faced problems organizing technology-based school planning. This is because technology is a technical trait and requires skills to be integrated effectively. Thus, it is necessary for principals [19] to establish themself as technological leaders to maximize the application of technology in schools [20], [21].

In this case, there were studies that evidenced the moderate level of technology leadership practices in administration [22]–[24]. Additionally, information and communications technology (ICT) knowledge and skills are found to be at a low level [6], and some found that principals were lacking skills in using data access for school improvement process [2], [15], [25]. They were also less willing to apply ICT as a school management medium [6], less interested and less encouraging in the use of ICT in the classroom.

Consequently, principals have difficulty in managing organizations based on a technology-based approach [19], [26]. The level of technology leadership among school leaders has yet to meet the standards proposed by the national educational technology standards for administrators (NETS-A) [7]. Whereas, the responsibility of the school leaders is to ensure that each member acquires high ICT knowledge and skills to enhance the quality of holistic learning [27], [28]. Based on these issues and problems, this study is proposed to identify the perception of teachers on the level of technology-aided leadership and analyze the behavioral constructs of the technology-aided leadership in the district of Kota Star, Kedah.

3. LITERATURE REVIEW

However, in the research context, especially in the Malaysian context, there are only a few researchers focused on sustainable development in their research [29]. According to a report from the Department of Environment, the lack of clear information on implementing sustainable development is one of the reasons why sustainable development stalled [30]. Therefore, based on these issues and concerns, it is recommended that local researchers undertake a study on Geo-Education.

Technological leadership referred to the leader's influence in developing the potential of organizational members in line with technological change. In school, technology changes can be seen through innovations that could develop student performance and school effectiveness [15], [31]. Therefore, principals should understand the benefits of technology and by what means it can be integrated into education to develop teacher competencies [32]. As technological leaders, principals also serve as motivators to teachers to enhance their knowledge and skills in integrating educational technology [2].

As highlighted by previous studies, school leaders are the main pillars of technology integration in schools. They are also the most influential individuals in encouraging teachers to integrate the use of technology in schools [33]. Therefore, school leaders should always be sensitive and ready to accept any technological changes in the organization [6], [7].

Several technology leadership models can be used as a guide for school leaders. For instance, Anderson and Dexter model comprises three main elements, namely infrastructure, principal technology leadership and technology outcomes. This model focuses on the effectiveness of integrating ICT in teaching and learning as well as school management [34]. Additionally, the International Society for Technology in Education (ISTE) introduced the National Technology Education Standard (NETS) in 2000 as a guide to the implementation of technology in education. In 2002, this standard was enhanced, whereby the NETS-A was introduced which emphasizes the role of administrators in ICT integration in schools [13].

4. RESEARCH METHOD

This quantitative study use a cross-sectional because it has been widely used in other fields including healthcare, psychology, marketing, banking, and tourism management [35]. A total of 370 respondents were chosen from the total population of teachers in the Kota Star district using the Krejcie and Morgan sampling table. As a result, 370 questionnaires were disseminated online via Google Forms in order to collect study data. As a result, 365 were completely answered. The questionnaire was adapted from the NETS-A. It is rated based on a five-point Likert Scale ranging from strongly agree (1) to strongly disagree (5). To analyze the collected data, the SPSS and partial least squares structural equation modelling (PLS-SEM) were used. To identify the level of data technology-aided leadership was analyzed using SPSS. While for confirmatory factor analysis, PLS SEM was used. Prior to that, the normality tests were conducted to detect outliers. The value of Mahalanobis Distance was used to seek outliers [36], [37]. Tabachnick and Fidell suggested the Chi-squares distribution table value on the degree of freedom, the number of build items at the significant level of p 0.001, and the Mahalanobis Distance value greater than 143.3.44 as parameters, whereas the outlier data were removed from the study. Finally, a total of 341 sets of questionnaires are accepted for data analysis.

5. RESULTS

This section discusses the result of the quantitative analysis. First, the level of technology-aided leadership is examined. The following section will elaborate on the technological aided leadership model's internal consistency, reliability of indicators based on external loading values, convergence validity, and discriminant validity.

5.1. Descriptive analysis

There were 370 questionnaire sets distributed. However, only 365 were returned to the researcher. While the rest are not answered the questionnaire. After data cleaning, 341 sets of questionnaires were accepted for analysis, which consists of the responses from 143 males (41.9%) and 198 females (58.1%) respondents. Most of the respondents have teaching experience ranging from six to 15 years (156 respondents or 45.7%) followed by 16 to 25 years (122 respondents or 35.8%). The rest are below five years, and above 26 years of teaching experience.

5.2. The level of headmaster technology-aided leadership

This study refers to the mean classification by MOE, which suggested the range from 1.00-1.80 (lowest), 1.81-2.60 (low), 2.61-3.40 (moderate), 3.41-4.20 (high), 4.21-5.00 (highest). The level of technology-aided leadership among headmasters in Kota Setar is high (mean=3.95). The mean score for productivity and professional practice is highest (mean=3.56) followed by teaching and learning (min=3.51), social, legal, and ethical (mean=3.46), and leadership and vision (mean=3.42). On the other hand, the rest are moderate. They are support management and operations (mean=3.31) as well as assessment and evaluation (mean=3.30).

5.3. Technology-aided leadership model analysis

Figure 1 shows a measurement model of the study. The measurement model is an important part before analyzing the structural model. The measurement model explains the validity and reliability of each element in the study. There are two types of validity measured based on measurement model analysis namely convergent validity and discriminant validity. In the context of convergent validity, the factor loading, Cronbach's alpha value, composite reliability average variance extracted (AVE) were reported. Then, the Fornell-Lacker criterion analysis and heterotrait-monotrait criteria (HTMT) used to test the discriminant validity.

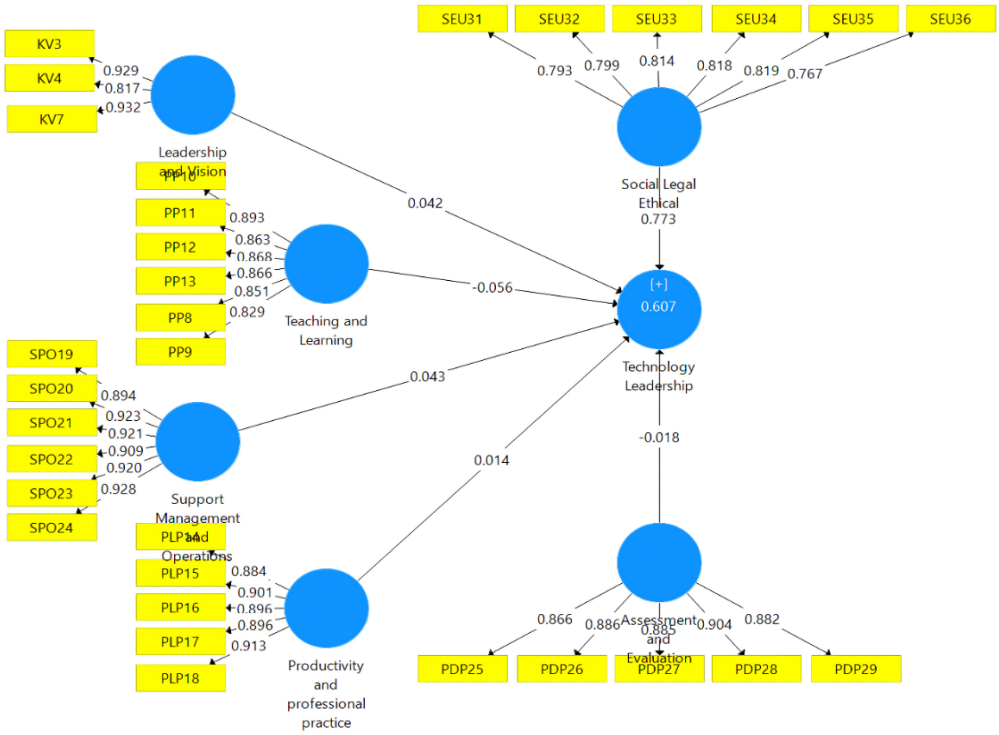

Figure 1. Measurement model of technology-aided leadership

5.4. Internal consistency

A closer inspection of Table 1 shows an overview of Cronbach's alpha, composite reliability, and AVE values for measuring the internal consistency. One of the interesting findings is the internal consistency of leadership and vision, teaching and learning, productivity and professional practice, management support and operations, assessment, and evaluation, and social, legal, and ethical were archived and accepted. To examine the correlation between the internal consistency based on composite reliability coefficient, the rule of thumb proposed by Bagozzi and Yi [38] as well as Hair *et al*. [39] were used. They agreed that the recommended value must be at least 0.70 and the value of AVE shall be higher than 0.5 [40].

It can be seen that the threshold of the composite reliability is achieved with values ranging from 0.915 to 0.969. The Cronbach's alpha coefficient values for Leadership and vision (α.951), teaching and learning (α.962), productivity and professional practice (α.980), support management and operations (α.983), assessment and evaluation (α.94) and social, legal, and ethical (α.966). Next, the outer loading of each construct was examined according to an individual item for reliability analysis. This analysis has been proved to be accurate based on previous studies that suggested item loading above 0.50 [41], [42]. As of the loadings in this study exceed 0.50.

Table 1. Summary of Cronbach's alpha analysis and composite reliability analysis

	Cronbach's alpha (>0.7)	Composite reliability (>0.7)	AVE (>0.5)	Results
Assessment and evaluation	0.931	0.947	0.782	Archives
Social, legal, and ethical	0.889	0.915	0.643	Archives
Support management and operations	0.962	0.969	0.839	Archives
Teaching and learning	0.932	0.945	0.743	Archives
Productivity and professional practice	0.94	0.954	0.806	Archives
Leadership and vision	0.896	0.923	0.8	Archives

5.5. Discriminant validity

For the determination of discriminant validity, Fornell-Larker criterion was used [40]. This was accomplished by comparing the correlations between the latent constructs with the square roots of AVE [41]. Fornell and Larcker [40] suggested that the square root of the AVE be greater than the relationships between latent constructions to attain an adequate discriminant validity. As indicated in Table 2, the correlations between the latent components and the AVE square root were compared. The AVE square roots were all

higher than the correlations between latent constructs, which is considered as appropriate discriminant validity. Table 3 shows the results of the heterotrait-monotrait criteria (HTMT). The correlation value between constructs is less than 1.00. This shows that all constructs differ from each other Hair *et al*.

Table 2. Fornell-Larcker criteria

	AE	SLE	SMO	TL	PPP	LV
Assessment, and evaluation	0.885					
Social, legal, and ethical	0.522	0.802				
Support management and operations	0.661	0.343	0.916			
Teaching and learning	0.257	0.1	0.521	0.862		
Productivity and professional practice	0.358	0.174	0.602	0.859	0.898	
Leadership and vision	0.242	0.079	0.475	0.882	0.793	0.894

Note: AE=Assessment and evaluation; SLE=Social, legal, and ethical; SMO=Social, legal, and ethical; TL=Teaching and learning; PPP=Productivity and professional practice; LV=Leadership and vision

Table 3. Heterotrait-monotrait

	AE	SLE	SMO	TL	PPP	LV
Assessment, and evaluation	0.494					
Social, legal, and ethical	0.951	0.575				
Support management and operations	0.346	0.699	0.371			
Teaching and learning	0.096	0.28	0.121	0.55		
Productivity and professional practice	0.179	0.379	0.187	0.634	0.926	
Leadership and vision	0.076	0.288	0.093	0.511	0.971	0.867

Note: AE=Assessment and evaluation; SLE=Social, legal, and ethical; SMO=Social, legal, and ethical; TL=Teaching and learning; PPP=Productivity and professional practice; LV=Leadership and vision

5.6. Validation of structural models

Figure 2 illustrates the finding of the structural model analysis. This is established to achieve the measurement model assessment requirements, which are based on the PLS-SEM analytic technique. As shown in Figure 2, the research model explained 60% of the total variance in technology-aided leadership. This suggests that the four sets of exogenous latent variables have collectively explained 60% of the variance in technology-aided leadership. Falk and Miller proposed an R-squared value of 0.10 as a minimum acceptable level [43]. Following Falk and Miller's recommendation, it can be said that the endogenous latent variable had an acceptable level of R-squared value.

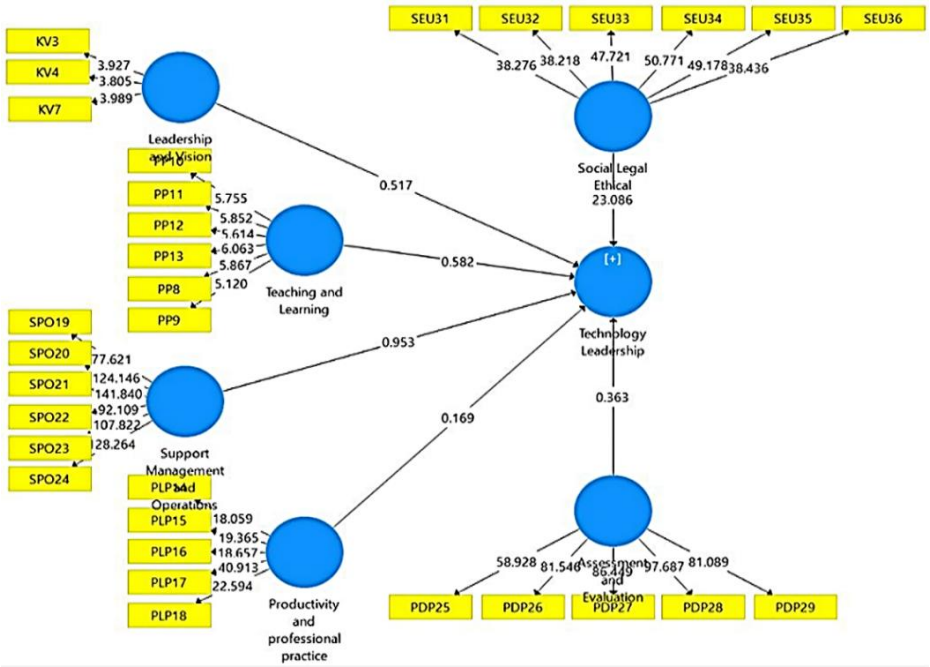

Figure 2. Analysis of the model of technology-aided leadership

Furthermore, through path analysis as can be seen from Table 4, there is a significant influence between the constructs of social, legal and ethics towards technology-aided leadership (β=23.653, p<0.05) at the significance level of 0.05 with a two-tailed test, p<0.05 and T>1.96 as suggested by Hair *et al*. [44]. However, the relationships from other dimensions to technology-aided leadership are not significant: Assessment, and evaluation (β=0.356, p<0.05); Support management and operations (β=0.925, p<0.05); Teaching and learning (β=0.165, p<0.05); Productivity and professional practice (β=0.165, p>0.05) and Leadership and vision (β=0.527, p>0.05).

Table 4. Assessment of significant relationships

	Beta β	p-values	Result
Assessment and evaluation->technology-aided leadership	0.356	0.722	Not significant
Social, legal, and ethical->technology-aided leadership	23.653	0.000	Significant
Support management and operations->technology-aided leadership	0.925	0.355	Not significant
Teaching and Learning->technology-aided leadership	0.592	0.554	Not significant
Productivity and professional practice->technology-aided leadership	0.165	0.869	Not significant
Leadership and vision->technology-aided leadership	0.527	0.598	Not significant

6. DISCUSSION

This study has raised important questions about the nature of technology-aided leadership among school leaders. As mentioned in the literature, 21st century technological leaders play an important role in integrating technology into teaching and learning as well as administration. However, several issues were identified by past researchers. Some of the issues are the level of leadership of administrator technology is at a moderate level [15], [45], low level of ICT knowledge and skills, lack of skills of using data access in school improvement process [46], [47], less willingness to apply ICT as a medium for school management [6], and less interested to use ICT in the classroom [15], [47], [48].

The comparison between the finding of this study with those has confirmed that the level of technology-aided leadership among headmasters in Kota Setar is high with four out of six dimensions are at the highest level. The dimensions are productivity and professional practice, teaching and learning, social, legal, and ethical, and leadership and vision. On the contrary, the rest are rather moderate. They are support management and operations and, assessment and evaluation. These results reflect those who also found that the level of technology leadership is at a high level among principals. Principals can also set organizational goals for technology integration, communication, and information dissemination in schools [49].

Despite some similarities, this finding also has different aspects compared to the others. Most researchers found that the level of technology leadership among principals is high and moderate according to the NETS-A standard [48], [50]. School leaders are also found as not efficient in educational technology and need more training in all dimensions of NETS-A. In terms of quantity and quality, the degree of ICT use at schools remains unsatisfactory. Due to overburdened tasks and other responsibilities, most teachers have little time to integrate ICT [48].

On the other hand, another interesting finding is the four sets of exogenous latent variables have collectively explained 60% of the variance in technology leadership. Six dimensions are accepted which are leadership and vision, teaching and learning, productivity and professional practice, management support and operations, assessment and evaluation, and social, legal, and ethic. In line with this study, in the 21st century, school leaders should not take for granted to integrate technology in administration as well as in teaching and learning [1], [12]. In line with the country's technology agenda, principals should design an organizational structure that promotes the use of technology, particularly in organizational management and teaching and learning [17], [31].

In other words, principals should always be responsible to play their role as technological leaders as set out in NETS-A [2], [15], [16]. Principals should nurture and sustain a culture of digital learning and technology usage among students to provide a more appealing education [14]. Principals should ensure that technology is used as a learning resource to support teaching and learning innovations. To ensure a higher-level technological leader, initiatives must be taken to plan activities that will trigger innovation [18]. Consequently, teachers need to be encouraged to integrate technology into education. The role of technological leaders should be proactively played by school leaders [6].

7. CONCLUSION

Technology-aided leadership has recently emerged as an essential leadership approach. This research reveals a high degree of technology-aided leadership among school leaders in Kota Star, Kedah. In line with Malaysia Education Blueprint (2013-2025) to ensure that every school has high-performing school leaders,

principals are strongly advised to integrate modern technologies into their administration routines. Based on the findings of this study, school leaders should engage in self-development to become technological leaders. To make 21st-century education realistic, teachers must be innovative in integrating technology in the classrooms and continue to keep up with the demands of students of the digital age generation.

As a result, to increase school leaders' and teachers' confidence in employing technology-assisted learning, the Ministry of Education should provide specific courses or in-service training in the fields such as digital technology, virtual communication, information, communication and technology. Aside from that, the technology-aided leadership model developed in this study could be utilized to help school leaders in their leadership practices. Furthermore, 31 indicators revealed in this study could be used to evaluate the behavior of technology leaders. This study, however, has several limitations. This study was only done in one of the districts in Kedah; thus, we urge that future researcher do similar studies in other districts or provinces to acquire more accurate results.

ACKNOWLEDGMENTS

This research was funded by Research and Innovation Management Centre (RIMC), Universiti Utara Malaysia.

REFERENCES

[1] A. Raman and S. B. Shariff, "Relationship between technology leadership, ICT facility, competency, commitments and teachers practices on implementations with effective teacher's management tasks in schoo," *Scholedge International Journal of Multidisciplinary & Allied Studies*, vol. 4, no. 9, p. 88, 2017, doi: 10.19085/journal.sijmas040901.

[2] M. W. Leong, S. Kannan, and S. A. Maulod, "Principal technology leadership practices and teacher acceptance of school management system," *Educational Leader (Pemimpin Pendidikan)*, vol. 4, no. October 2016, pp. 89–103, 2016, [Online]. Available: https://ejournal.um.edu.my/index.php/PEMIMPIN/article/view/20717.

[3] W. A. Yieng and K. B. Daud, "Technology leadership in malaysia's high performance school," *Journal of Education and e-Learning Research*, vol. 4, no. 1, pp. 8–14, 2017, doi: 10.20448/journal.509/2017.4.1/509.1.8.14.

[4] M. Y. Mai and G. R. Muruges, "Primary school science teachers' attitude towards using virtual learning environment (VLE) in teaching science," *European Journal of Education*, vol. 1, no. 3, p. 155, 2018, doi: 10.26417/ejed.v1i3.p155-162.

[5] S. Iftakhar, "Google Calssroom: What works and how?" *Journal of Education and Social Sciences*, vol. 3, pp. 12–18, 2016, [Online]. Available: https://www.jesoc.com/wp-content/uploads/2016/03/KC3_35.pdf.

[6] N. L. Esplin, C. Stewart, and T. N. Thurston, "Technology leadership perceptions of Utah elementary school principals," *Journal of Research on Technology in Education*, vol. 50, no. 4, pp. 305–317, 2018, doi: 10.1080/15391523.2018.1487351.

[7] T. Özkan, A. Tokel, M. Çelik, and B. Öznacar, "Evaluation of technology leadership in the context of vocational school administrators," *CSEDU 2017 - Proceedings of the 9th International Conference on Computer Supported Education*, vol. 1, pp. 727–731, 2017, doi: 10.5220/0006384107270731.

[8] R. Yasnain and M. K. Mohamad Nasir, "Amalan kepimpinan teknologi pengetua sekolah berasrama penuh berstatus sekolah berprestasi tinggi dari perspektif guru," in *Persidangan Antrabangsa Sains Sosial dan Kemanusiaan*, 2019, pp. 62–70.

[9] M. Roblyer and A. Doering, *Integrating Educational Technology into Teaching*. Pearson, 2013.

[10] J. L. Hero, "Exploring the principal's technology leadership: its influence on teachers' technological proficiency," *International Journal of Academic Pedagogical Research*, vol. 4, no. 6, pp. 4–10, 2020.

[11] C. Yu and D. L. Prince, "Aspiring school administrators' perceived ability to meet technology standards and technological needs for professional development," *Journal of Research on Technology in Education*, vol. 48, no. 4, pp. 239–257, 2016, doi: 10.1080/15391523.2016.1215168.

[12] U. Akcil, Z. Altinay, F. Altinay, G. Dagli, and M. Altinay, "The Role of E-transformational Leadership in Intergenerational Cooperation for School Culture," in *Open and Equal Access for Learning in School Management*, IntechOpen, 2018, p. 29. doi: 10.5772/intechopen.73494.

[13] R. Thannimalai and A. Raman, "The influence of principals' technology leadership and professional development on teachers' technology integration in secondary schools," *Malaysian Journal of Learning and Instruction*, vol. 15, no. 1, pp. 203–228, 2018, doi: 10.32890/mjli2018.15.1.8.

[14] A. Yorulmaz and S. Can, "The technology leadership competencies of elementary and secondary school directors," *Educational Policy Analysis and Strategic Research*, vol. 11, no. 1, pp. 47–61, 2016.

[15] M. I. M. Hamzah, F. Juraime, and A. N. Mansor, "Malaysian principals' technology leadership practices and curriculum management," *Creative Education*, vol. 07, no. 07, pp. 922–930, 2016, doi: 10.4236/ce.2016.77096.

[16] Ü. Çakıroğlu, S. Gökoğlu, and M. Öztürk, "Pre-service computer teachers' tendencies towards the use of mobile technologies: a technology acceptance model perspective," *European Journal of Open, Distance and E-Learning*, vol. 20, no. 1, pp. 176–191, 2017, doi: 10.1515/eurodl-2017-0011.

[17] A. Raman, Y. Don, and A. L. Kasim, "The relationship between principals' technology leadership and teachers' technology use in Malaysian secondary schools," *Asian Social Science*, vol. 10, no. 18, pp. 30–36, 2014, doi: 10.5539/ass.v10n18p30.

[18] M. N. Omar and S. N. Ismail, "Mobile technology integration in the 2020s: The impact of technology leadership in the Malaysian context," *Universal Journal of Educational Research*, vol. 8, no. 5, pp. 1874–1884, 2020, doi: 10.13189/ujer.2020.080524.

[19] M. J. Gallego-Arrufat, E. Gutiérrez-Santiuste, and R. L. Campaña-Jiménez, "School technology leadership in a Spanish secondary school: The TEI model," *Improving Schools*, vol. 20, no. 3, pp. 247–263, 2017, doi: 10.1177/1365480217732232.

[20] M. A. Moreira, V. M. H. Rivero, and J. J. Sosa Alonso, "Leadership and school integration of ICT. Teachers perceptions in Spain," *Education and Information Technologies*, vol. 24, no. 1, pp. 549–565, 2019, doi: 10.1007/s10639-018-9789-0.

[21] C. M. S. Bin Che Cob and N. S. Zainal Abidin, "The Relationship between Leadership Styles and Leader's Talent Management Ability Among administrator in Selected Malaysian Public Universities," *Journal of Sultan Alauddin Sulaiman Shah (JSASS)*, vol. 7, no. 1, pp. 64–70, 2020.

[22] M. I. Mohd Hamzah, N. Nordin, K. Jusoff, R. Abd. Karim, and Y. Yusof, "A quantitative analysis of Malaysian secondary school technology leadership," *Management Science and Engineering*, vol. 4, no. 2, pp. 124–130, 2010, doi: 10.3968/j.mse.1913035X20100402.012.
[23] M. Y. Ibrahim, M. R. Yusof, M. M. Morni, I. Kasawani, A. M. Sinin, and M. Z. Mahadi, "The Measurement Model of Virtual Instructional Leadership: Confirmatory Factor Analysis Approach," *The Journal of Social Sciences Research*, vol. 5, no. 51, pp. 153–158, 2019, doi: 10.32861/jssr.51.153.158.
[24] J. Cabero-Almenara, J. J. Gutiérrez-Castillo, A. Palacios-Rodríguez, and J. Barroso-Osuna, "Development of the teacher digital competence validation of DigCompEdu check-in questionnaire in the University context of Andalusia (Spain)," *Sustainability (Switzerland)*, vol. 12, no. 15, 2020, doi: 10.3390/su12156094.
[25] F. Juraime and M. I. Mohd Hamzah, "Kepimpinan teknologi pengetua dan hubungannya dengan prestasi akademik sekolah di Malaysia," *International Journal of Education, Psychology and Counseling*, vol. 2, no. 5, pp. 215–230, 2017, [Online]. Available: http://www.ijepc.com/PDF/IJEPC-2017-05-09-17.pdf.
[26] M.-J. Gallego-Arrufat and E. Gutiérrez-Santiuste, "Instructional and distributed leadership in virtual communication spaces in post-compulsory secondary education," *Revista Electronica de Investigacion Educativa*, vol. 16, no. 2, pp. 97–118, 2014.
[27] H. Kör, H. Erbay, and M. Engin, "Technology leadership of education administers and innovative technologies in education: A case study of Çorum City," *Universal Journal of Educational Research*, vol. 4, no. 12A, pp. 140–150, 2016, doi: 10.13189/ujer.2016.041318.
[28] L. N. Abraham, A. Lois, P. E. Dzakpasu, and K. D. Amenyedzi, "Principals' ICT proficiency level and tutors' willingness to adopt modern technological devices in teaching in the Volta and Greater Accra Regions, Ghana," *American Journal of Information Systems*, vol. 7, no. 1, pp. 1–6, 2019, doi: 10.12691/ajis-7-1-1.
[29] H. Mahat, S. Ahmad, M. Suhaily, Y. Che, and N. Ali, "Pendidikan pembangunan lestari-hubungan kesedaran antara ibu bapa dengan pelajar," *Geografia: Malaysian Journal of Society and Space*, vol. 10, no. 5, pp. 71–84, 2014.
[30] M. F. M. Yaakob *et al.*, "A quest for experts' consensus on the geo-education module using fuzzy delphi analysis," *Universal Journal of Educational Research*, vol. 8, no. 7, pp. 3189–3203, 2020, doi: 10.13189/ujer.2020.080748.
[31] F. Juraime and M. I. M. Hamzah, "Kepimpinan Teknologi Pengetua Dalam Pengurusan Sekolah," *Prosiding 3rd Regional Conference on Educational Leadership and Management*, 2017, pp. 324–334.
[32] F. B. Osman, "High school administrators perceptions of their technology leadership preparedness," *Educational Research and Reviews*, vol. 9, no. 14, pp. 441–446, 2014, doi: 10.5897/err2014.1858.
[33] L. Metcalf and S. Benn, "Leadership for sustainability: An evolution of leadership ability," *Journal of Business Ethics*, vol. 112, no. 3, pp. 369–384, 2013, doi: 10.1007/s10551-012-1278-6.
[34] R. E. Anderson and S. Dexter, "School technology leadership: An empirical investigation of prevalence and effect," *Educational Administration Quarterly*, vol. 41, no. 1, pp. 49–82, 2005, doi: 10.1177/0013161X04269517.
[35] D. Liu, W. Lu, and Y. Niu, "Extended technology-acceptance model to make smart construction systems successful," *Journal of Construction Engineering and Management*, vol. 144, no. 6, p. 04018035, 2018, doi: 10.1061/(asce)co.1943-7862.0001487.
[36] M. Z. Mustafa, Y. Buntat, M. A. Omar, A. R. A. Razzaq, and R. Ahad, "Organizational commitment survey: A confirmatory factorial analysis based on vocational colleges teachers sample," *International Journal of Engineering and Advanced Technology*, vol. 8, no. 5C, pp. 279–288, 2019, doi: 10.35940/ijeat.E1041.0585C19.
[37] W. L. Hays, "Review of Using Multivariate Statistics," *PsycCRITIQUES*, vol. 28, no. 8. 1983, doi: 10.1037/022267.
[38] R. P. Bagozzi and Y. Yi, "On the evaluation of structural equation models," *Journal of the Academy of Marketing Science*, vol. 16, no. 1, pp. 74–94, 1988, doi: 10.1007/BF02723327.
[39] J. F. Hair Jr., W. C. Black, B. J. Babin, and R. E. Anderson, *Multivariate Data Analysis*, 7th Ed. Pearson Prentice Hall, 2009.
[40] C. Fornell and D. F. Larcker, "Evaluating structural equation models with unobservable variables and measurement error," *Journal of Marketing Research*, vol. 18, no. 1, pp. 39–50, Feb. 1981, doi: 10.1177/002224378101800104.
[41] A. Leguina, "A primer on partial least squares structural equation modeling (PLS-SEM)," *International Journal of Research & Method in Education*, vol. 38, no. 2, pp. 220–221, 2015, doi: 10.1080/1743727x.2015.1005806.
[42] D. Barclay, R. Thompson, and C. Higgins, "The partial least squares (PLS) approach to causal modeling: personal computer adoption and use an illustration," *Technology Studies*, vol. 2, no. 2, pp. 285–309, 1995.
[43] R. F. Falk and N. B. Miller, *A primer for soft modeling*. The University of Akron Press, 1992.
[44] J. F. Hair, M. Sarstedt, T. M. Pieper, and C. M. Ringle, "The use of partial least squares structural equation modeling in strategic management research: A review of past practices and recommendations for future applications," *Long Range Planning*, vol. 45, no. 5–6, pp. 320–340, 2012, doi: 10.1016/j.lrp.2012.09.008.
[45] M. R. Yusof, M. F. M. Yaakob, and M. Y. Ibrahim, "Digital leadership among school leaders in Malaysia," *International Journal of Innovative Technology and Exploring Engineering*, vol. 8, no. 9, pp. 1481–1485, 2019, doi: 10.35940/ijitee.I8221.078919.
[46] A. Raman, R. Thannimalai, and S. N. Ismail, "Principals' Technology Leadership and its effect on teachers' technology integration in 21st century classrooms," *International Journal of Instruction*, vol. 12, no. 4, pp. 423–442, 2019, doi: 10.29333/iji.2019.12428a.
[47] M. Alkrdem, "Technological leadership behavior of high school headteachers in Asir Region, Saudi Arabia," *Journal of International Education Research (JIER)*, vol. 10, no. 2, pp. 95–100, 2014, doi: 10.19030/jier.v10i2.8510.
[48] R. Subramaniam and M. I. Mohd Hamzah, "Amalan kepimpinan teknologi guru besar serta cabaran dan cadangan penambahbaikan di sekolah," in *Prosiding Seminar Nasional FIP 2020*, 2020, pp. 281–294.
[49] T. Tiop and R. Talip, "Hubungan Kepimpinan Teknologi Pengetua dalam Pengurusan Kurikulum dan Efikasi Kendiri Guru," *Malaysian Journal of Social Sciences and Humanities (MJSSH)*, vol. 5, no. 4, pp. 71–83, 2020, doi: 10.47405/mjssh.v5i4.383.
[50] C. Yu and V. A. Durrington, "Technology Standards for School Administrators: An Analysis of Practicing and Aspiring Administrators' Perceived Ability to Perform the Standards," *NASSP Bulletin*, vol. 90, no. 4, pp. 301–317, 2006, doi: 10.1177/0192636506295392.

BIOGRAPHIES OF AUTHORS

Mat Rahimi Yusof is a Ph.D on Communication from Universiti Malaysia Terengganu, Malaysia. Currently, he is a senior lecturer at School of Education Universiti Utara Malaysia. His research interests such as educational leadership, leadership communication, teachers' education, and digital technologies in leadership. He can be contacted at email: mrahimiy@uum.edu.my.

Mohd Faiz Mohd Yaakob is a Senior Lecturer (Educational Management and Administration) in the School of Education, Universiti Utara Malaysia, Malaysia. His research interests include educational policy, educational planning, educational law, school culture, professional learning community, teachers' competencies, Islamic administration, teacher education, and professional development. He can be contacted at email: mohd.faiz@uum.edu.my.

Hapini Awang has more than 10 years of experience serving in various education fields, including as a schoolteacher and an education officer in Pejabat Pendidikan Daerah (PPD). Currently, his area of research is Information Systems (IS), with the main interest in E-Learning, M-Learning, Virtual Learning Environment, ICT in Education, Educational Technology, Instructional Technology, and other related areas. He received his Ph.D. (Information Systems) from Universiti Utara Malaysia in 2019. He can be contacted at email: hapini.awang@uum.edu.my.

Mohd Fairuz Jafar is a senior lecturer at School of Education, Universiti Utara Malaysia. He is an alumnus of UUM. He got his PhD which specialization in Educational Psychology in 2019 from USM. His research interest is in the area of educational psychology, teacher's education, adolescent psychology, psychological well-being, deep learning and quantitative research. He can be contacted at email: mohd.fairuz.jaafar@uum.edu.my.

Mohd Yusri Ibrahim is an associate professor of policy study at Faculty of Business, Economic and Social Development. On education area, he is focusing research on educational leadership, management and administration. He had widely experienced on those matters for more than 15 years including research, teaching, and publication. He can be contacted at email: yusri@umt.edu.my.

Pang Lai Chaw is a teacher from SK Tengku Mahmud 2, Besut, Terengganu. She got master in Master of Science Educational Management form Universiti Utara Malaysia. Experienced as a teacher for more than 14 years in the primary school. Her research interests are in the field of educational management and communication. She can be contacted at email: chriszer@gmail.com.