JIRSEA
JOURNAL OF INSTITUTIONAL RESEARCH SOUTH EAST ASIA

JIRSEA Issue: Vol. 22 No. 1
JIRSEA/UPM Special Issue
April 2024
ISSN 1675-6061
http://www.seaairweb.info/journal/index.aspx

Submission Timeline

Received: 30/10/2023

Revised as per Preliminary Review: 15/01/2024

Final Revision & Acceptance: 15/03/2024

Influences Of Technology And Data Use On The Professional Self-Efficacy Of Malaysian Teachers

Samsu Hilmy Abdullah, Mohd Hazwan Mohd Puad*, Masrah Azrifah Azmi Murad, Erzam Marlisah

CITE ARTICLE: Abdullah, S.H., Puad, M.H.M., Murad, M. A. Z. & Marlisah, E. (2024). Influences Of Technology And Data Use On The Professional Self-Efficacy Of Malaysian Teachers, *Journal of Institutional Research South East Asia*, 22(1), 275-301

Publisher: SEAAIR Secretariat

C/O Suan Dusit Rajaphat University
295 Nakhon Ratchasima Rd, Dusit, Dusit District, Bangkok 10300, THAILAND
email:seaair.info@gmail.com
http://www.seaairweb.info/

INFLUENCES OF TECHNOLOGY AND DATA USE ON THE PROFESSIONAL SELF-EFFICACY OF MALAYSIAN TEACHERS

Samsu Hilmy Abdullah, Mohd Hazwan Mohd Puad*, Masrah Azrifah Azmi Murad and Erzam Marlisah

Faculty of Educational Studies, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

*Corresponding email: hazwan@upm.edu.my

ABSTRACT

The trend of early retirement among teachers is worrisome as it results in the loss of experienced teachers and contributes to the expanding teacher shortage. This condition is thought to have been caused by the workload and strain connected with technology and data use. Early retirement signifies teachers' burnout, stress, and lack of job satisfaction, and multiple studies have suggested that they significantly affect professional self-efficacy. This article explores the influence of technology and data use on a teacher's self-efficacy in relation to their profession. A total of 525 school teachers in Malaysia have participated in a research study by completing a questionnaire. The results indicated that teacher professional self-efficacy, technology use, and data use are at a moderate level. The findings demonstrate a favorable correlation among these constructs. However, the connections are not influenced by factors such as age, gender, or school location. The study's implications for the higher education setting are also addressed, suggesting the implementation of enhancement of professional development opportunities, mentorship and peer support, and recognition to teachers. These suggestions aim to better equip teachers with the indispensable skills required in the swiftly evolving realm of data and technology.

Keywords: technology use, data use, professional self-efficacy, higher education, learning analytics

1. Introduction

In today's dynamic educational landscape shaped by the volatility, uncertainty, complexity, and ambiguity (VUCA) of 21st-century learning and Industrial Revolution 4.0 (IR4.0) technologies, educational institutions must remain vigilant and adaptable. This environment poses challenges that can unpredictably impact education stakeholders, particularly teachers, affecting their engagement, performance, and persistence. In recent decades, transformations in the education system have profoundly influenced teaching practices and the work patterns of teachers, who now rely on internet-based technologies and advanced tools as integral components of teaching and learning. It is advocated that teachers possess adequate ICT competencies and skills to facilitate learning and meet the demands of IR4.0 effectively. They should be trained to proficiently utilize technology and adeptly handle data, enabling them to interpret and utilize it for interventions aimed at enhancing teaching and learning outcomes (Aleksic et al., 2019). Such readiness ensures that teachers remain aligned with the requirements of 21st-century education, thus ensuring they thrive in the IR4.0 era (Ismail et al., 2020).

In Malaysia, digital education is being actively promoted through the adoption of various online educational technologies, such as Google Classroom, for online learning management and the use of centralized student management systems to handle student data. The introduction of the Digital Educational Learning Initiative Malaysia (DELIMA) in 2020 has further facilitated this shift by providing a centralized platform offering diverse educational resources and tools for teachers, students, parents, and stakeholders. Malaysia aims to fully integrate digital solutions into all schools by 2025, with DELIMA serving as a crucial catalyst in this transformation by continually updating its content and expanding its reach for optimal effectiveness (PMD, 2021a). Efforts are also underway to enhance digital access and awareness within the Malaysian education system, enabling better utilization of technology for teaching and learning purposes (Ebrahimi & Yeo, 2018).

The utilization of education technologies and digitalization in education is associated with a significant factor contributing to early retirement among teachers in Malaysia (Bernama, 2024). The trend of early teacher retirements exacerbates this issue, signaling a worrying annual increase in experienced teacher loss (Bernama, 2022; Nasbah, 2022; Parkaran, 2022). By 2030, an estimated 69 million teachers will be needed worldwide to meet the demands of education, yet teacher shortages persist due to high attrition rates and retirement, particularly during the early years of teaching (UNESCO Institute for Statistics, 2016; Vincent Dupriez et al., 2016). This shortfall poses a significant challenge in accommodating the growing student population and educational institutions globally (UNESCO, 2015). Similarly, Malaysia is grappling with a shortage of teachers both in urban and rural areas

(Mutalib, 2019; Bestari, 2022).

2. Literature Review

Malaysia has made significant efforts in integrating technology into its education system. Since 1998, the Malaysian government has been investing in computer technology for education, with a focus on e-learning programs offered through the Ministry of Education. Particularly during the Covid-19 epidemic, there has been a dramatic change in the use of educational technology in schools. Online teaching and learning have ensured the school system's survival and mitigated the impacts of the Covid-19 epidemic (Yunus, 2018).

2.1. Technology and Data Use Challenges in Education

Described as the process of determining which tools and implementation strategies are most effective in enriching classroom teaching and learning environments (M. D. Roblyer, 2010), technology use encompasses the utilization of devices such as computers, laptops, and smartphones that are accessible to both teachers and students (Johnson et al., 2016). This integration of technology has significantly transformed traditional classroom instruction, rendering education more engaging and efficient (Pazilah et al., 2019). Given the proficiency of present-generation students, commonly referred to as digital natives, in technology use, it is undeniable that technology plays a crucial role in enhancing educational outcomes (Ahmadi, 2018). In this regard, it is advocated that teachers utilize technology as a tool for communication and idea exchange within the classroom setting (Ahmed & Nasser, 2015).

Furthermore, the rapid advancement of IR 4.0 technology corresponds with swift strides in digitalizing the education sector, with extensive data use emerging as a fundamental aspect of this digitalization endeavor. Data use in education entails a series of data-driven activities ranging from collection to analysis, interpretation, presentation, and intervention, all aimed at extracting pertinent information and informing decision-making in educational practices (Coburn & Turner, 2011). Educational data collection provides insights into institutional operations, teaching methodologies, and student learning, encompassing various metrics such as assessment values, exam scores, observations, and student backgrounds (Schildkamp & Kuiper, 2010). Studies have also observed a growing emphasis on adopting a data-driven approach in education for purposes of accountability, enhancement, and educational advancement globally (Bolhuis, 2019a).

Adopting new technology and embracing digitalization in educational settings pose significant challenges for teachers, particularly those accustomed to traditional teaching approaches. Many teachers encounter hurdles in adjusting to novel methodologies, including the integration of technology into their teaching practices

(Boonmoh et al., 2021). While some teachers recognize the benefits and efficacy of digital technology in education, not all are motivated to incorporate and adapt to it. A considerable number of teachers feel uneasy about technology use, citing insufficient competence due to the time and effort required to acquire the necessary technological skills for effectively utilizing classroom technology (Singh, 2021). Moreover, inadequate classroom facilities further impede teaching processes and activities, and the lack of technological resources leads to frustration among teachers (Kelly, 2015).

The extensive use of data provides an opportunity to educate teachers on its effective use within educational contexts (Mandinach & Gummer, 2016). Nevertheless, current studies reveal limited engagement with data among teachers, primarily focusing on accountability rather than school development or instructional improvement (Mandinach & Gummer, 2016). Despite acknowledging the necessity for teachers to work with data, there has been minimal effort to enhance teachers' data literacy through professional development programs or explicit recruitment criteria (Mandinach & Jimerson, 2016). Many teachers lack confidence in using data to inform teaching and learning decisions, highlighting low self-efficacy in data utilization (Sun et al., 2016).

The pandemic's impact on the teachers' practices following school closures is explored, revealing a correlation between positive teaching experiences and increased technology and data use (Paetsch et al., 2023). Effective implementation of educational activities hinges on teachers' capacity to organize, develop, and deploy such activities, underscoring the importance of their ability to integrate technology and utilize data in teaching and learning contexts (Abunowara, 2014). There is a critical need to emphasize teachers' use of technology and data within the classroom (Boonmoh et al., 2021). As expressed by Roy (2019), while technology cannot replace exceptional teachers, it has the potential to bring about transformative educational outcomes when used by skilled teachers.

2.2. Teachers' Professional Self-efficacy

Research has shown that teacher efficacy is an important variable in teacher effectiveness and is consistently related to teacher behaviors (Bray-Clark, N & Bates, 2003). Self-efficacy, regarded as a pivotal measure of teacher effectiveness and instructional quality, refers to individuals' belief in their capacity to execute various aspects of their job (Tschannen-Moran et al., 1998). This belief system significantly impacts human functioning through cognitive, motivational, affective, and decision-making processes. Teachers with heightened levels of professional self-efficacy exhibit confidence in executing job tasks proficiently, adeptly planning, organizing, and executing required actions (Bandura, 1977). Research indicates that self-efficacy tends to remain consistent across various factors such as gender, professional

identity, salary, relationship satisfaction, experience, educational levels, and tenure (Burić & Kim, 2020).

Professional self-efficacy, extensively studied as a key motivator for teachers, strongly correlates with retention intentions, job satisfaction, and commitment (Burić & Kim, 2021). Unlike a fixed personality trait or job quality, it represents a belief in one's capacity to complete tasks with specific qualities (Peng et al., 2021). Teachers with high professional self-efficacy demonstrate increased preparation time, superior organizational skills, receptiveness to innovative approaches, enthusiasm for teaching, and dedication to assisting struggling students (Tschannen-Moran & Hoy, 2001). This attribute is essential for teachers to enact transformative changes in facilitating effective student learning, ensuring they possess up-to-date knowledge, competencies in curriculum and pedagogy, and proficiency in utilizing various technologies to enhance teaching and learning performance. Moreover, teachers' professional self-efficacy significantly influences their satisfaction and engagement in their profession, thereby fostering greater loyalty to the teaching profession.

Professional self-efficacy has been identified to mediate the relationship between professional factors such as job satisfaction and career calling, between in-role performance and career calling (Peng et al., 2021), work performance and work motivation (Cetin & Celik, 2018), and job insecurity and job-related learning (Hootegem et al., 2021). As a result, several countries are attempting to solve teacher shortages and early retirement by implementing support and enhanced policies and services to boost teachers' professional self-efficacy. As teacher retirement contributes considerably to teacher shortages in educational institutions, it is anticipated that professional self-efficacy influences increasing early retirement.

2.3. Technology and Data Use Influence On Professional Self-Efficacy

Kuh and Hu (2001) illustrated that technology stimulates greater student engagement and enhances learning outcomes. Active involvement of students in knowledge creation, collaboration, and reflection facilitated by technology, including computers and various educational applications, has been shown to improve learning effectiveness (Rosická & Hošková-Mayerová, 2014). Furthermore, research indicates that leveraging data can improve teaching practices (Gelderblom et al., 2016).

Nonetheless, as noted by Alnoor et al. (2020), teachers' self-efficacy plays a crucial role in determining their positive perception of organizational readiness for change, particularly as new technologies often demand a high level of self-efficacy. Enhanced self-efficacy contributes to teachers' well-being and satisfaction, reducing negative feelings or a sense of helplessness when adopting new technology. Abror et al. (2020) identified a link between self-efficacy, employee engagement, satisfaction, and loyalty in the workplace, underscoring the significance of

investigating self-efficacy in the current study.

In a higher education setting, Velu et al.'s (2011) study revealed that factors predicting higher education teachers' self-efficacy towards research include expertise, interest, motivation, positive environment, and personal strength, with stronger self-efficacy increasing their engagement in research activities (Velu et al., 2011). This suggests that positive self-efficacy among teachers contributes towards the overall improvement in work tasks and performance.

In pursuit of enhancing both quality and performance, educational systems frequently institute modifications that entail the incorporation of advanced technologies, such as the digitalization of educational processes. Nevertheless, the introduction of novel technologies can present significant challenges for teachers, potentially resulting in diminished performance and a less favorable perception of their profession. Research indicates that meaningful integration of technology into the classroom remains a paramount challenge confronting teachers today (Gomez et al., 2021). However, the use of technology and data has been reported to contribute to teachers' low professional self-efficacy. Existing literature reveals a correlation between teacher self-efficacy and job satisfaction (Kasalak & Dağyar, 2020; Matos et al., 2022), stress management (Galindo-Domínguez & Bezanilla, 2021), burnout (Kim & Burić, 2020), and technology acceptance (Fearnley & Amora, 2020).

The stress and exhaustion stemming from data and technology use have been cited as primary reasons for early retirement trends (Nasbah, 2022). Retired teachers have expressed dissatisfaction with the demands of technology use, reporting feelings of demotivation and burnout (Nasbah, 2022). Furthermore, the overwhelming workload associated with technology use has been consistently identified as a source of pressure and burden for many teachers (Parkaran, 2022; Bestari, 2022).

A study conducted by McDonald and Siegall (1992) demonstrated a positive correlation between technology use and various indicators of job satisfaction, commitment, work quality, and quantity, as well as a negative correlation with absenteeism and tardiness. Additionally, Medici et al. (2022) discerned that technology employment was linked to reduced intentions of occupational mobility, suggesting its pivotal role in fostering professional commitment and mitigating turnover intentions. Conversely, Weibenfels et al. (2022) proposed that technology use positively impacts changes in classroom management.

Further research has elucidated a notable negative relationship between teachers' professional self-efficacy and job stress and burnout (Smetackova, 2017; Hassan and Ibourk, 2021). Studies have revealed that the perceived loyalty to one's career in light of technological advancements anticipates feelings of job insecurity (Nam, 2019), which subsequently influences job satisfaction, organizational commitment, and turnover intentions (Staufenbiel & König, 2010). Technology integration in

classroom settings thus may pose challenges for teachers as they are expected to make active adjustments, which can have an impact on their professional self-efficacy. It is also apparent from the literature that only a restricted number of studies had constructed statistical models to investigate the relationship between gender and computer teaching efficacy and student teachers' intentions to use technology (Wong et al., 2012). It is a logical argument that teachers' social background moderates technology use and its link to self-efficacy. Thus, this study investigates the influence of technology and data use on teachers' professional self-efficacy, with the possibility of gender, age, and school location moderating the relationships.

2.4. Research Objectives

This study aims to understand teachers' professional self-efficacy in school empirically. It seeks to confirm several assumptions by achieving the research objectives. These objectives are:

i. To determine the level of teachers' technology use, data use, and professional self-efficacy.

ii. To examine the influence of teachers' technology use and data use on their professional self-efficacy.

iii. To examine the roles of gender, age, and school location as moderators between teacher's technology use, data use, and professional self-efficacy.

3. Methodology

3.1. Population and Sampling

This study employed the correlational quantitative design, specifically the survey approach, to collect data. A set of questionnaires has been formulated based on a 5-point Likert scale and distributed using an online survey tool. The population for the study consisted of teachers from public national schools in Malaysia. The population was estimated at 416743 (Ministry of Education Malaysia, 2021). Using Raosoft's sample size calculator, 384 or more respondents are needed to reach a confidence level of 95% that the value is within ± 5% of the surveyed value. Raosoft's sample size calculator is an online tool used to determine the appropriate sample size for a survey or research study. The calculator takes into account factors such as population size, confidence level, margin of error, and expected response rate to generate an estimate of the sample size needed for the study.

The sampling of respondents was done using a random sampling technique by utilizing Furey's online random number generator. 300 randomly chosen schools have received emails containing links to questionnaires and questionnaire guidelines. Each school administrator has designated one male and one female teacher as respondents to these inquiries. The responses to the teachers' questionnaire were

automatically documented and forwarded to the researcher using the Google Forms application. The survey consists of three sections:

Section A: Schoolteacher's Demographic Information

Section B: Teacher Professional Self-Efficacy

Section C: Technology Use, Data Use

A total of 525 teachers participated and submitted their responses to the questionnaire. The representation of female (62%) is higher than male (38%) respondents, and the majority of teachers are aged between 30 – 49 (77.9%). Most respondents were serving in primary (62.5%) and rural schools (62.5%).

3.2. Measures and Instrumentatio

The research framework is shown in Figure 1. The study statistically measured three constructs: technology use, data use, and professional self-efficacy using structural equation modeling (SEM) statistical analysis. The study also measured the moderating effects of gender, age, and location using multigroup analysis (MGA).

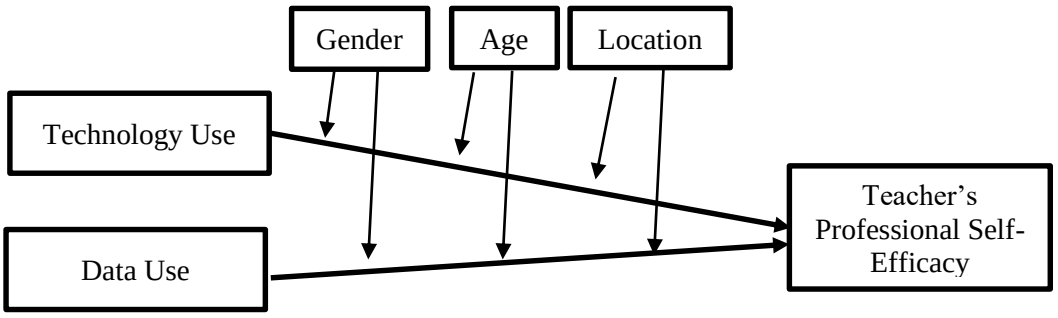

Figure 1: Research Framework

As illustrated in Table 1, professional self-efficacy consists of 4 items adapted from the sense of self-efficacy instrument by Geijsel et al. (2009). The instrument measures the extent to which teachers feel a sense of self-efficacy regarding their profession. Technology use consists of 6 items adapted and modified from the Teacher Use of Technology in Instructional Practices (T-STEM) instrument (Innovation, 2012). The instrument measures the use of technology in the classroom. The instrument reveals how frequently teachers use technology during teaching and learning sessions. Data use self-efficacy consists of 8 items adapted from the data-based decision-making efficacy instrument (Dunn et al., 2013), which measures the use of data in the classroom. The instrument reveals how frequently teachers use data during teaching and learning sessions. Specifically, the T-STEM instrument is designed to assess changes in teachers' confidence and self-efficacy pertaining to STEM subject content and teaching, use of technology in educational settings, proficiency in 21st-century learning skills, leadership attitudes, and awareness of

STEM career prospects. However, for this study, only the items related to the integration of technology in classroom settings were adjusted to gauge teachers' technology utilization within the Malaysian educational framework. These items underwent modifications and expert review to ensure their relevance and applicability within the context of the Malaysian education system.

Table 1: Research Instrument

Variable	Statements
Professional SE	"I can work effectively." "I am satisfied with the quality of my work." "I feel that I am being successful in my work." "I have sufficient self-confidence to defend my points of view about the work."
Technology Use	"Use various technologies for teaching and learning, e.g., productivity, data visualization, research, and communication tools." "Use technology to communicate and collaborate with others beyond the classroom." "Use technology to access online resources and information." "Use technology to help solve problems." "Use technology to support higher-order thinking, e.g., analysis, synthesis, and evaluation of ideas and information." "Use technology to create new ideas and representations of information."
Data Use	"Identify learning needs of students." "Discuss student progress or instructional strategies with other teachers." "Tailor instruction to individual student needs." "Identify instructional content to use in class." "Set learning goals for individual students" "Assign or reassign students to classes or groups." "Discuss data with a parent or student." "Interact with your principal about data use."

For the reliability analysis, Cronbach's Alpha was used to obtain the reliability index of each construct in the research instrument. As shown in Table 2, the Cronbach's alpha coefficient for the questionnaire ranges from 0.838 to 0.898. Therefore, the instrument was considered suitable for subsequent use in the study as all the constructs with Cronbach's Alpha values are higher than 0.70 (Nunnally & Bernstein, 1994). Furthermore, the inter-item correlation mean value above 0.25 indicates that the construct is valid for research (Nunnally & Bernstein, 1994). The reported item correlation mean ranges from 0.530 to 0.564, confirming that the research instrument is valid and can measure constructs well. To check whether a data set is distributed normally, two statistical numerical measures of shape – skewness and excess kurtosis – are used. Data is assumed to be expected if the skewness value is between -2 to +2 and kurtosis is between -7 to +7 (Hair et al., 2010).

Table 2: Constructs' Validity, Reliability, and Normality

Variables	Cronbach's Alpha	Inter-Item Correlation Mean	Skewness	Kurtosis
Professional SE	0.838	0.564	-0.250	0.850
Technology Use	0.864	0.527	-0.397	-0.239
Data Use	0.898	0.530	-0.279	0.202

3.3. Analysis

The descriptive analysis, reliability, validity, and normality tests were conducted in this study using SPSS 26.0. SEM consists of 3 levels of analysis: confirmatory factor analysis (CFA), measurement model analysis, and structural model analysis. SEM was run and measured using AMOS 26.0. P < 0.05 was considered to be statistically significant. According to (Hair et al., 2010), the SEM analysis model was considered to have a reasonable goodness fit if relative chi-square (χ^2) <= 5.0, root mean square error of approximation (RMSEA) < 0.08, and one or two of fit indices (GFI/AGFI/IFI/CFI/NFI/TLI) > 0.90. Moreover, the MGA was tested to explore the moderating role of gender, age, and school location in the relationship between technology use, data use, and professional self-efficacy. The analysis involves splitting the data into groups based on the moderator.

4. Findings

4.1. Descriptive Analysis

Table 3 shows the result of descriptive analysis for the analytics used in mean in descending order. Based on the result, teachers' most frequent agreement of a sense of professional self-efficacy in school is being able to work effectively (Item 1). The second most frequent agreement of professional self-efficacy is feeling confident about the work (Item 4). The third frequent agreement of professional self-efficacy is feeling satisfied with the quality of work (Item 2). The least frequent agreement of professional self-efficacy is feeling successful in work (Item 3). Overall, the mean value ranges from 3.00 (Undecided) to 4.00 (Agree). As a result, Malaysian teachers have a moderate sense of self-efficacy in the teaching profession.

Table 3: Analytics Use Descriptive Analysis

Item	N	Minimum	Maximum	Mean	Standard Deviation
1	525	1.00	5.00	4.20	0.62
4	525	2.00	5.00	4.09	0.64
2	525	2.00	5.00	3.98	0.61
3	525	1.00	5.00	3.89	0.64
			Total	4.04	0.63

Table 4 shows the result of descriptive analysis for the analytics used in descending order. Based on the result, teachers' most frequent use of technology in school is to access online resources and information (Item 3), followed by solving problems (Item 4). The least frequent use of technology is for communication and collaboration (Item 3) and teaching and learning (Item 1). Overall, the mean score varies from 3.00 (Sometimes) to 4.00 (Frequent), indicating that teachers' frequency of technology use in school is moderate.

Table 4: Technology Use Descriptive Analysis

Item	N	Minimum	Maximum	Mean	Standard Deviation
3	525	2.00	5.00	4.30	0.75
4	525	1.00	5.00	4.13	0.78
6	525	1.00	5.00	3.90	0.84
5	525	1.00	5.00	3.79	0.83
2	525	1.00	5.00	3.66	0.99
1	525	1.00	5.00	3.39	0.90
			Total	3.86	0.85

Table 5 shows the result of descriptive analysis for the data used in descending order. Based on the result, the most frequent data used by teachers in school is to identify instructional content to be taught in the class (Item 4), to set learning goals for individual students (Item 5), and to tailor instruction for individual student needs (Item 3). The least frequent data use is to assign students to groups (Item 6), to discuss with the school principal (Item 8), and to discuss with parents or students (Item 7). Overall, the mean value varies from 3.00 (Occasionally) to 4.00 (Frequently), indicating a moderate frequency of data use by teachers in the classroom.

Table 5: Data Use Descriptive Analysis

Item	N	Minimum	Maximum	Mean	Standard Deviation
4	525	2.00	5.00	4.06	0.73
5	525	2.00	5.00	3.91	0.74
3	525	2.00	5.00	3.89	0.74
1	525	1.00	5.00	3.87	0.75
2	525	1.00	5.00	3.84	0.77
6	525	1.00	5.00	3.82	0.75
8	525	1.00	5.00	3.70	0.82
7	525	1.00	5.00	3.30	0.87
			Total	3.80	0.77

4.2. Confirmatory Factor Analysis (CFA)

The results of the CFA analyses in Figures 2, 3, 4, and Table 6 show how well the model fits each variable. Based on the data collected, the fit values of the model were

found to be acceptable without modification, except for Technology Use, where items 3, 4, and 6 were discarded, and Data Use, where item 7 was removed from the model. All factor loadings for other items' was observed at >= 0.5. To ensure the goodness of fit, all standardized factor loadings must be i) more than 0.5, ii) positive, and iii) not more than 1.0. (Byrne, 2010). Notably, convergent validity refers to a set of indicators that are presumed to measure a construct (Kline, 2016), and the Average Variance Extracted (AVE) values > 0.5 indicate high convergent validity. Meanwhile, construct reliability (CR) is comparable to Cronbach alpha, and an instrument with CR > 0.70 is considered reliable (Hair et al., 2010)

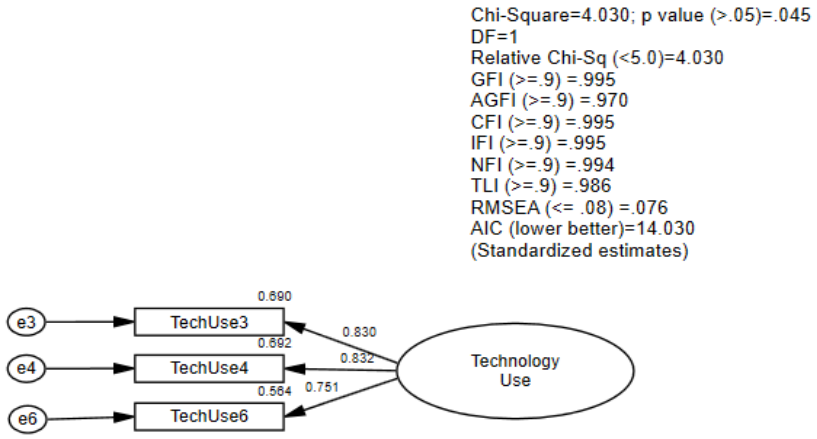

Figure 2: Confirmatory Factor Analysis for Technology Use

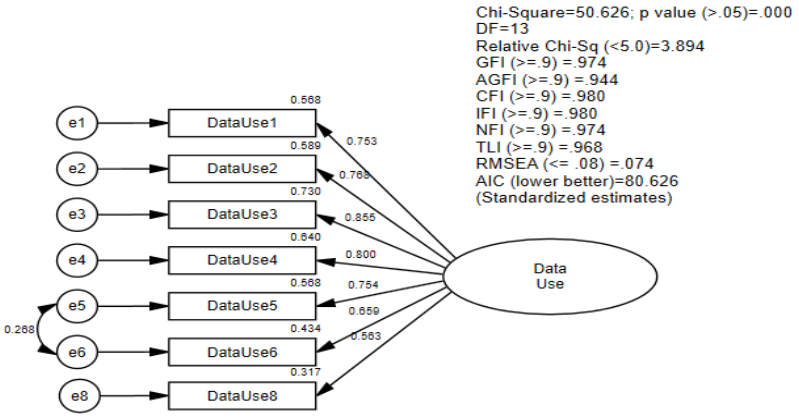

Figure 3: Confirmatory Factor Analysis for Data Use

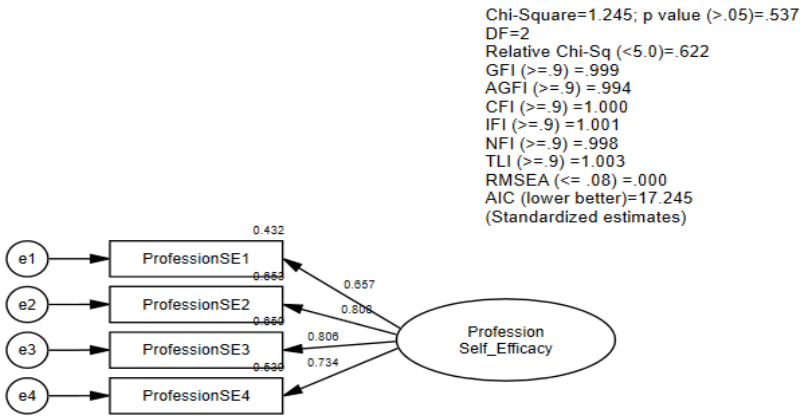

Figure 4: Confirmatory Factor Analysis for Professional Self-Efficacy

Table 6: Fit Indices, AVE, and CR

Variables	Relative χ^2	RMSEA	GFI/AGFI/IFI/CFI/NFI/TLI	AVE	CR
Professional SE	0.662	0.000	All > 0.9	0.568	0.839
Technology Use	4.030	0.076	All > 0.9	0.652	0.848
Data Use	3.894	0.074	All > 0.9	0.550	0.894

4.3 Measurement Model

All individual variables should be correlated to each other to build a measurement model. Based on the result of the analysis, it was observed that all items have a loading factor of>0.5. Relative chi-square (χ^2) = 3.546, root mean square error of approximation (RMSEA) < 0.070, and one or more (GFI/AGFI/CFI/NFI/TLI) > 0.90. The goodness of fit of the model was deemed acceptable without modification. Subsequently, a discriminant validity test was performed to confirm how much a variable discriminates from other constructs. Discriminant validity involves an association between a specific latent construct and other constructs of a similar nature (Brown, 2006), where all constructs are assumed to be genuinely distinct from others. In this regard, the AVEs for the two interrelated variables must be greater than their r^2 (Byrne, 2010). Based on Figure 5 and Table 7, it can be concluded that all constructs exhibit sufficient discriminant validity.

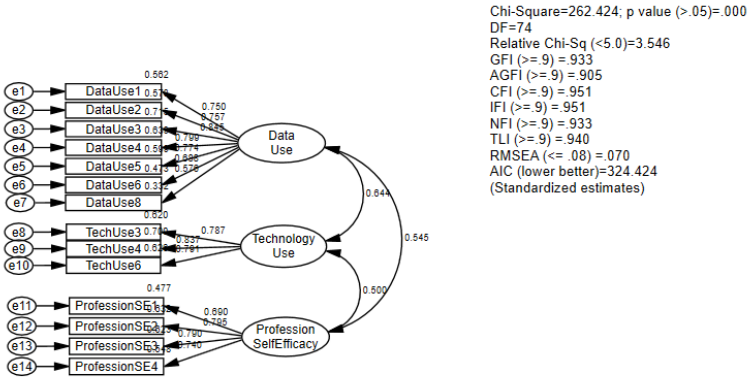

Figure 5: Measurement Model

Table 7: Discriminant Validity

Variables	CR	Professional SE	Technology Use	Data Use
Professional SE	0.841	0.570*		
Technology Use	0.897	*0.297***	0.556*	
Data Use	0.847	*0.250***	*0.415***	0.649*

***** AVE, ** correlation squared (r^2)

4.4. Structural Model

The measurement model has identified exogenous and endogenous variables based on the study's conceptual framework to build the structural model (Figure 6). A structural model represents a set of one or more dependence relationships linking the hypothesized model's variables. The model is significantly helpful in representing the interconnections between exogenous and endogenous constructs. It was observed that all items factor loading > 0.5. Relative chi-square (χ^2) = 3.546, root mean square error of approximation (RMSEA) < 0.070, and one or more (GFI/AGFI/CFI/NFI/TLI) > 0.90. The goodness of fit of the structural model was found acceptable without modification.

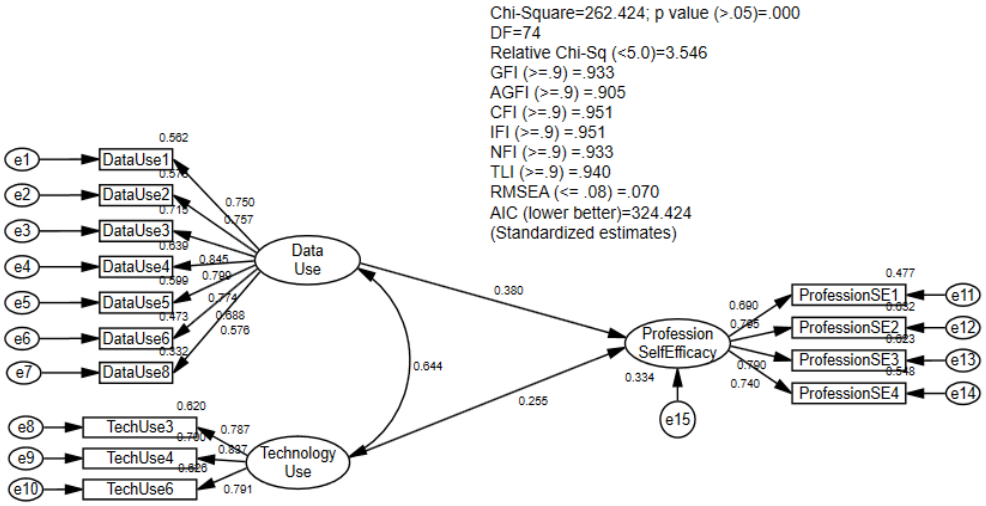

Figure 6: Structural Model

The structural model analysis is employed to fulfill the secondary objective of this study, namely, to investigate the impact of teachers' utilization of technology and data on their professional self-efficacy. The causal path shown in Table 8 shows that technology use positively affects professional self-efficacy (β=0.255; $p < 0.05$) and data use positively affects professional self-efficacy (β=0.380; $p < 0.05$). There are moderate positive correlations between professional self-efficacy, data use, and technology. Therefore, according to the results of the structural model analysis, both technology use and data utilization have exhibited a positive influence on the professional self-efficacy of teachers. It can be observed that data use and technology use explain 33.4% variance in professional self-efficacy.

Table 8: Causal Path for Professional SE and Analytics Use

Causal Path	b	Beta	CR	p
Technology Use – Professional SE	0.184	0.255	3.955	0.000
Data Use – Professional SE	0.287	0.380	5.832	0.000

Professional Self-Efficacy (R= 0.578 $R^2 = 0.334$)

4.5. Multigroup Analysis for Moderating Effects

The MGA involves the following two stages: The overall model test for the moderation effect in the model is shown in Table 9. The individual path test moderation effect for the individual path is shown in Table 10. Hair criteria were used to determine the moderating effect. According to (Hair et al., 2010), the moderation effect for a two-group moderator can be established if:

- The beta for one group is significant, while the beta for the other group is non-significant or
- Both Betas for both groups are significant. However, the beta for one group is

positive, while the beta for the other group is negative.

Table 9: CMIN (χ^2) Model Fit Summaries

	Gender		Age		Location	
	CMIN	p	CMIN	p	CMIN	p
Unconstrained	339.765	.000	320.841	.000	358.091	.000
Measurement Residuals	396.495	.000	346.458	.000	377.530	.000
Model Fit Comparison	56.495	.003	25.617	.739	19.439	.947

Table 10: Individual Path of Gender Moderating Effect

Individual Paths	B	Beta	CR	p
Technology Use – Profession Self-Efficacy				
Male	.272	.359	3.526	.000
Female	.131	.187	.2.272	.023
Data Use – Profession Self-Efficacy				.
Male	.270	.367	3.750	.000
Female	.320	.410	4.775	.000

Based on the moderator effect test in Table 9, it was found that gender has a moderator effect on the relationship between technology use, data use, and professional self-efficacy. Meanwhile, the moderation effects of teachers' age and school location in the relationship between technology use, data use, and professional self-efficacy are insignificant. However, based on individual path analysis for male and female teachers, as shown in Table 10 gender have no significant effects on both technology and data use. Therefore, the study inferred that gender, age, and school location did not moderate the relationship between technology use, data use, and professional self-efficacy of teachers.

5. Discussions

It is intriguing to examine professional self-efficacy among teachers employing data and technology in the classroom. Teachers report and believe that the workload associated with the use of data and technology makes them feel burdened, burnout, and stress (Parkaran, 2022; Bestari, 2022; Fernández-Batanero et al., 2021). Burnout and stress are said to have contributed to the early retirement decision, directly impacting the school teacher shortage.

As the use of technology and data in education is crucial to developing 21st-century education and delivering IR4.0 standards, teachers must not only accept and adapt technology or data use in their practices. They also must possess a reasonable sense of self-efficacy to ensure the effectiveness and sustainability of current educational needs and responsibilities.

It can be concluded from the analysis that most teachers have a moderate sense of professional self-efficacy. In this regard, teachers with moderate self-efficacy may be less likely to participate in professional activities as they may feel less confident in their ability to teach efficiently and effectively (Alibakhshi et al., 2020). Even while teachers believed they could teach well in the classroom, they felt less secure at work and were less pleased with the quality of their teaching. They also did not feel successful in their profession.

Nevertheless, it can be deduced that teachers' use of technology and data in the classroom is minimal. Such low level of use is influenced by many factors including time limitations, insufficient training, distrust of data, and a lack of proficiency in data literacy (Herodotou et al., 2019). Teachers may not have attained proficiency in utilizing technology and may lack a thorough understanding and expertise in its applications (Fasiah et al., 2023). It is found that teachers primarily use technology and data to access online resources and information and determine the most effective instructional content for classroom instruction. However, teachers utilize technology and data for discussion and cooperation with other stakeholders, such as management, parents, and students, regarding the results of teaching and learning analysis very infrequently.

Thus, examining the relationships between professional self-efficacy, technology use, and data use provides nuanced details, which is significantly helpful in proposing practical solutions to the issue of early retirement and teacher shortage in school. The findings manifest that technology use and data use have moderate positive relationships with the professional self-efficacy of teachers. Moreover, these relationships are not moderated by gender (male and female), age (younger and older), and school location (urban and rural). The findings are in line with Burić & Kim (2020) and Wong et al (2012). Positive relationships between the variables seem reliable and valid across different personal and contextual conditions. Therefore, education stakeholders and policymakers should pay great attention to teachers' technology use and data use to improve their sense of self-efficacy toward the teaching profession.

6. Conclusions

In conclusion, this study demonstrates a significant correlation between the use of technology and data and the level of professional self-efficacy among teachers. This suggests that teachers who effectively employ technology and data are more likely to possess a heightened feeling of professional self-efficacy. Most importantly, this association is unaffected by variables such as gender, age, or school location, underscoring the universal importance of technology and data use in developing teachers' confidence in their profession.

This study's findings have substantial implications for educational institutions. The

study highlights the significance of teachers' use of technology and their proficiency in interpreting data as factors that impact their confidence in their professional abilities and their choice to retire. Furthermore, the study emphasizes the importance of education stakeholders and policymakers giving significant consideration to teachers' utilization of technology and their proficiency in interpreting data. This is crucial for enhancing their confidence and effectiveness in the field of teaching. Institutions can contribute to reducing early retirement decisions and addressing teacher shortages by taking this action.

Enhancing the utilization of data and technology in education can greatly bolster teachers' self-efficacy. In order to accomplish this, educational institutions should emphasize equipping teachers with essential tools, training, and assistance to improve their proficiency in utilizing technology and understanding data. This objective can be achieved by means of professional development initiatives that specifically target the integration of technology into teaching methodologies and the improvement of data literacy competencies. Furthermore, it is imperative to engage in partnership with stakeholders, researchers, and policymakers to guarantee that teachers are provided with suitable working environments and conditions that facilitate their retention in the profession.

Investigations into the roles and responsibilities of teachers in integrating technology and data use in the teaching and learning process are well-established. Consequently, it is unsurprising that the outcomes of this research align closely with those of prior studies. Educational institutions, leaders, and stakeholders, particularly teachers, should recognize the significance of technology and data use in education. Notably, teachers and other stakeholders must acknowledge and understand the roles they play in this context. Substantial investments and initiatives aimed at integrating technology and data into education will be futile if these roles are overlooked or underestimated.

7. Implications to Higher Education Institutions

The current study reported an improvement in teachers' professional self-efficacy, which is linked with positive technology and data use, necessitating efforts to support and encourage teachers to integrate digital use into classroom activities. In this case, the Higher Education Institutions (HEI) must assume responsibility for preparing teachers in Malaysia with relevant skills and resources. Supporting teachers' life-long learning is a critical mission of HEI. To enhance teachers' self-efficacy regarding technology and data in education, HEI should prioritize the implementation of comprehensive training programs tailored to teachers' varying proficiency levels. These programs should offer practical workshops, online courses, and seminars led by experienced educators and technology experts, providing teachers with the necessary skills and strategies for effective technology integration

and data utilization.

Additionally, HEI mentorship programs and peer support networks can offer invaluable guidance, encouragement, and collaborative opportunities, fostering a sense of community and empowerment among teachers as they navigate the complexities of technology integration and data-driven teaching practices. Instituting incentives and recognition programs for innovative practices can further motivate teachers to invest in enhancing their technological skills and leveraging data effectively, ultimately contributing to a culture of continuous improvement and innovation in education. Given the interpersonal nature of the teaching profession, it is reasonable that the HEIs implement and maintain a system that could provide effective feedback and recognition to teachers. Constructive feedback, both from administrators and peers, can help teachers identify areas for growth and improvement while also affirming their strengths and accomplishments. Recognizing teachers' efforts and achievements through awards, public acknowledgment, or professional development opportunities can reinforce their sense of competence and efficacy in their profession.

Moreover, reflective practices should be promoted among teachers during their teacher training by encouraging regular self-reflection and self-assessment. Suggested measures include journaling about their teaching experiences, setting goals for professional growth, and engaging in critical self-evaluation. It is also imperative to facilitate opportunities for teachers to engage in peer observations and feedback sessions, where they can reflect on their teaching practices and receive constructive input from colleagues. Reflective practices can help teachers develop a deeper understanding of their strengths and areas for improvement, ultimately enhancing their self-efficacy in their profession. These initiatives will be useful to instill lifelong learning in teachers by maximizing the resources available and the HEI's capacity for graduating and deploying teachers into the workforce.

8. Limitations and Suggestions for Future Studies

Some limitations of the study should be noted. Firstly, the discussion regarding the use of technology and data by teachers in Malaysian public schools specifically addresses the systems and applications that have been officially provided by the Malaysian Ministry of Education (MOE). Any other forms of technology or data that teachers might use beyond those officially provided by the Ministry of Education are not within the focus of this study. Therefore, the study's scope is limited to the technology and data frameworks endorsed and supported by the MOE, with any other variations lying outside its investigative scope.

Secondly, the professional self-efficacy of school teachers and university educators differs due to variations in their roles and contexts. School teachers primarily focus on teaching specific subjects, managing classrooms, and fostering student

engagement and success in school settings. Their self-efficacy often revolves around their confidence in these areas. Conversely, university educators are typically engaged in teaching undergraduate or graduate courses, conducting research, and contributing to academic leadership roles. Their self-efficacy encompasses designing rigorous academic programs, engaging students in critical thinking, mentoring graduate students, conducting research, and contributing to the scholarly community. Despite both groups' commitment to promoting student learning, their professional self-efficacy is shaped by distinct factors related to their roles, experiences, and environments. Future studies investigating university educators' professional self-efficacy regarding technology and data use are warranted towards improving the learning process at both school and higher education settings.

Based on the results of the present investigation, several suggestions for future research have been put forth to address identified gaps and overcome the limitations of the study's findings. A common characteristic of the failure to implement educational innovations in real-world settings and ensure their continued adoption is the lack of understanding of teachers' barriers and the limitations they encounter (Scanlon et al., 2013). While teachers generally recognize the potential benefits of educational technologies, they frequently experience difficulties and feel overwhelmed when it comes to adopting and implementing new educational technologies. Therefore, it is suggested that future studies investigate both facilitators and barriers concerning teachers' perspectives on technology and data use to promote successful implementation at the micro-level.

Moreover, teachers' knowledge and competency level in using the technology and data for learning improvement is still unknown. To what extent and how teachers use technology and data in schools needs to be studied more deeply. As concluded by Bolhuis et al. (2019), teachers mainly use technology and data only for accountability and less for school development or to improve instruction. Therefore, it is recommended that the purpose of teachers' use of technology and data be investigated in more detail. Additionally, it is recommended that further investigation be undertaken into teachers' roles in utilizing technology and data for education purposes to tackle their sense of self-efficacy in the field.

Acknowledgments

This study was self-funded by the authors. The authors value the anonymous participants from the Faculty of Educational Studies, Universiti Putra Malaysia, for their cooperation and time in providing the researchers with all the needed information. Special thanks to Ts. Dr. Mohd Hazwan Mohd Puad, Assoc. Prof. Dr. Masrah Azrifah Azmi Murad and Dr. Erzam Marlisah contributed to this paper. The authors thank the reviewers and proofreaders for their valuable time and comment to improve this article.

References

Abunowara, A. M. (2014). Using technology in EFL/ESL classroom. International Journal of Humanities and Cultural Studies (IJHCS), 1(2), 7–23. https://www.academia.edu/8209309/Using_Technology_in_EFL_ESL_Classroom_by_Ahmed_Mohamed_Abunowara_

Abror, A., Patrisia, D., Syahrizal, S., Sarianti, R., & Dastgir, S. (2020). Self-efficacy, employee engagement, remuneration and employee loyalty in higher education: The role of satisfaction and OCB. International Journal of Advanced Science and Technology, 29(3), 5456–5470.

Ahmadi, D. M. R. (2018). The Use of Technology in English Language Learning: A Literature Review. International Journal of Research in English Education, 3(2), 115–125. https://doi.org/10.29252/ijree.3.2.115

Ahmed, K., & Nasser, O. (2015). Incorporating iPad technology: Creating more effective language classrooms. TESOL Journal, 6(4), 751–765. https://doi.org/10.1002/tesj.192

Aleksic, A., Ljepava, N., & Ristic, M. (2019). Learning Analytics: Developing a Data-centric Teaching-Research Skill. Smart Technologies and Innovation for a Sustainable Future, Advances in Science, Technology & Innovation, February 2018, 333–338. https://doi.org/10.1007/978-3-030-01659-3

Alibakhshi, G., Nikdel, F., & Labbafi, A. (2020). Exploring the consequences of teachers' self-efficacy: a case of teachers of English as a foreign language. Asian-Pacific Journal of Second and Foreign Language Education, 5(1), 1–19. https://doi.org/10.1186/s40862-020-00102-1

Alnoor, A. M. R., Al-Abrrow, H., Abdullah, H., & Abbas, S. (2020). The impact of self-efficacy on employees' ability to accept new technology in an Iraqi university. Global Business and Organizational Excellence, 39(2), 41–50. https://doi.org/10.1002/joe.21984

Bandura, A. (1997). Self-Efficacy: The Exercise of Control. W.H. Freeman.

Bernama. (2022). Guru bersara awal punca sekolah mengalami kekurangan guru. Berita Harian. https://www.bharian.com.my/berita/kes/2022/09/1003752/guru-bersara-awal-punca-sekolah-mengalami-kekurangan-guru?fbclid=IwAR3dhZXf-JE_WI7aZUoQRtyMqBb2vXWHFfgWB9hKulqhentPMpLgCxhzOm8&mibextid=YSzJz1

Bernama. (2024). Lebih 6,000 guru bersara pilihan tahun lalu. Berita Harian. https://www.bharian.com.my/berita/nasional/2024/02/1218051/lebih-6000-guru-bersara-pilihan-tahun-lalu

Bestari, S. (2022). Masih kekurangan 10,000 guru, isu signifikan di sekolah bandar. Sinar Harian. https://sinarbestari.sinarharian.com.my/komuniti/masih-kekurangan-10000-guru-isu-signifikan-di-sekolah-bandar/

Bolhuis, E. (2019a). The development of data use, data skills, and positive attitude towards data use in a data team intervention for teacher educators. Studies in Educational Evaluation, 60(April 2018), 99–108. https://doi.org/10.1016/j.stueduc.2018.12.002

Bolhuis, E. (2019b). The development of data use, data skills, and positive attitude towards data use in a data team intervention for teacher educators. Studies in Educational Evaluation, 60(December 2018), 99–108. https://doi.org/10.1016/j.stueduc.2018.12.002

Boonmoh, A., Jumpakate, T., & Karpklon, S. (2021). Teachers' perceptions and experience in using technology for the classroom. Call-Ej, 22(1), 1–24.

Bray-Clark, N & Bates, R. (2003). Self-efficacy beliefs and teacher effectiveness: Implications for professional development. The Professional Educator, XXVI(1), 13–22. http://www.theprofessionaleducator.org/articles/archives/fall2003.pdf#page=17

Brown, T. A. (2006). Confirmatory factor analysis for applied research. The Guilford Press. https://doi.org/10.5860/choice.44-2769

Burić, I., & Kim, L. E. (2020). Teacher self-efficacy, instructional quality, and student motivational beliefs: An multilevel structural equation modeling analysis. Learning and Instruction, 66(January 2019), 101302. https://doi.org/10.1016/j.learninstruc.2019.101302

Burić, I., & Kim, L. E. (2021). Job satisfaction predicts teacher self-efficacy, and the association is invariant: Examinations using TALIS 2018 data and longitudinal Croatian data. Teaching and Teacher Education, 105. https://doi.org/10.1016/j.tate.2021.103406

Byrne, B. M. (2010). Structural Equational Modeling with AMOS blue book.

Cetin, F., & Celik, D. A. (2018). The effect of occupational self-efficacy on work performance through intrinsic work motivation. Management Research Review, March. https://doi.org/10.1108/MRR-03-2017-0062

Coburn, C. E., & Turner, E. O. (2011). Research on Data Use : A Framework and Analysis. 173–206. https://doi.org/10.1080/15366367.2011.626729

Coburn, C. E., & Turner, E. O. (2012). The practice of data use: An introduction. American Journal of Education, 118(2), 99–111. https://doi.org/10.1086/663272

Dunn, K. E., Airola, D. T., Lo, W. J., & Garrison, M. (2013). What teachers think about what they can do with data: Development and validation of the data driven decision-making efficacy and anxiety inventory. Contemporary Educational Psychology, 38(1), 87–98. https://doi.org/10.1016/j.cedpsych.2012.11.002

Ebrahimi, S. S., & Yeo, K. J. (2018). The Use of Technology at Malaysian Public High Schools. Merit Research Journals, 6(3), 54–60. https://www.researchgate.net/publication/324279780_The_Use_of_Technology_at_Malaysian_Public_High_Schools

Fasiah, E. E. M., Ayub, A. F. M., & Zulkifli, N. N. (2023). Teachers ' acceptance of technology as predictors of the use of Google Classroom analytical learning. 12(3), 1383–1389. https://doi.org/10.11591/ijere.v12i3.25021

Fearnley, M. R., & Amora, J. (2020). Learning Management System Adoption in Higher Education Using the Extended Technology Acceptance Model Volume 8 – Issue 2 IAFOR Journal of Education: Technology in Education Volume 8 – Issue 2 IAFOR Journal of Education: Technology in Education Volume. IAFOR Journal of Education: Technology in Education, 8(2), 89–106.

Fernández-Batanero, J. M., Román-Graván, P., Reyes-Rebollo, M. M., & Montenegro-Rueda, M. (2021). Impact of educational technology on teacher stress and anxiety: A literature review. International Journal of Environmental Research and Public Health, 18(2), 1–13. https://doi.org/10.3390/ijerph18020548

Galindo-Domínguez, H., & Bezanilla, M. J. (2021). The importance of personality and self-efficacy for stress management in higher education. International Journal of Educational Psychology, 10(3), 247–270. https://doi.org/10.17583/ijep.7870

Geijsel, F. P., Sleegers, P. J. C., Stoel, R. D., & Krüger, M. L. (2009). The effect of teacher psychological and school organizational and leadership factors on teachers' professional learning in Dutch schools. Elementary School Journal, 109(4), 406–427. https://doi.org/10.1086/593940

Gelderblom, G., Schildkamp, K., Pieters, J., & Ehren, M. (2016). Data-based decision making for instructional improvement in primary education. International Journal of Educational Research, 80, 1–14. https://doi.org/10.1016/j.ijer.2016.07.004

Guzmán-Valenzuela, C., Gómez-González, C., Rojas-Murphy Tagle, A., & Lorca-Vyhmeister, A. (2021). Learning analytics in higher education: a preponderance of analytics but very little learning? International Journal of Educational Technology in Higher Education, 18(1). https://doi.org/10.1186/s41239-021-00258-x

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). Multivariate Data Analysis. In Pearson (7th ed., Vol. 12, Issue 12). Pearson Prentice Hall. https://doi.org/10.3390/polym12123016

Hassan, O., & Ibourk, A. (2021). Burnout, self-efficacy and job satisfaction among primary school teachers in Morocco. Social Sciences and Humanities Open, 4(1), 100148. https://doi.org/10.1016/j.ssaho.2021.100148

Herodotou, C., Rienties, B., Verdin, B., & Boroowa, A. (2019). Predictive learning analytics "at scale": Towards guidelines to successful implementation in higher education based on the case of the open university UK. Journal of Learning Analytics, 6(1), 85–95. https://doi.org/10.18608/jla.2019.61.5

Hootegem, A. Van, Sverke, M., & Witte, hans De. (2021). Does occupational self-efficacy mediate the relationships between job insecurity and work- related learning? A latent growth modelling approach. Work Stress, 4, 1–22.

Ingram, D., Louis, K. S., & R.G, S. (2004). Accountability Policies and Teacher Decision Making: Barriers to the Use of Data to Improve Practice. Teachers College Record.

Innovation, F. I. for E. (2012). Teacher Efficacy and Attitudes Toward STEM (T-STEM) Survey Mathematics Teacher. In Raleigh. https://doi.org/10.1002/sce.3730740605

Ismail, N. A., Wahid, N. A., Yusoff, A. S. M., Wahab, N. A., Rahim, B. H. A., Majid, N. A., Din, N. M. N., Ariffin, R. M., Adnan, W. I. W., & Zakaria, A. R. (2020). The Challenges of Industrial Revolution (IR) 4.0 towards the Teacher's Self-Efficacy. Journal of Physics: Conference Series, 1529(4), 0–6. https://doi.org/10.1088/1742-6596/1529/4/042062

Johnson, M., Riel, R., Germain-Froese, B., Federation, C. T., & (Canada), M. (2016). Connected to Learn: Teachers' Experiences with Networked Technologies in the Classroom. Canadian Teachers' Federation. http://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=ED573421&site=ehost-live&scope=site

Kasalak, G., & Dağyar, M. (2020). The relationship between teacher self-efficacy and teacher job satisfaction: A meta-analysis of the teaching and learning international survey (talis). Educational Sciences: Theory and Practice, 20(3), 16–33. https://doi.org/10.12738/jestp.2020.3.002

Kelly, D. P. (2015). Overcoming Barriers to Classroom Technology Integration. Educational Technology, January 2015, pp. 40–43. http://www.ncbi.nlm.nih.gov/pubmed/15237199

Kim, L. E., & Burić, I. (2020). Teacher self-efficacy and burnout: Determining the directions of prediction through an autoregressive cross-lagged panel model. Journal of Educational Psychology, 112(8), 1661–1676. https://doi.org/10.1037/edu0000424

Kline, R. B. (2016). Principles and practices of structural equation modelling 4th edition. In Methodology in the social sciences (4th ed.). Guildford Press.

Kuh, G. D., & Hu, S. (2001). The Relationship between Computer and Information Technology Use, Selected Learning and Personal Development Outcomes, and Other College Experiences. Journal of College Student Development, 42(3).

M. D. Roblyer, A. H. D. (2010). Integrating Educational Technology into Teaching. Allyn & Bacon.

Mandinach, E. B., & Gummer, E. S. (2016). What does it mean for teachers to be data literate: Laying out the skills, knowledge, and dispositions. Teaching and Teacher Education, 60, 366–376. https://doi.org/10.1016/j.tate.2016.07.011

Mandinach, E. B., & Jimerson, J. B. (2016). Teachers learning how to use data: A synthesis of the issues and what is known. Teaching and Teacher Education, pp. 60, 452–457. https://doi.org/10.1016/j.tate.2016.07.009

Matos, M. da M., Sharp, J. G., & Iaochite, R. T. (2022). Self-efficacy beliefs as a predictor of quality of life and burnout among university lecturers. Frontiers in Education, 7(July), 1–15. https://doi.org/10.3389/feduc.2022.887435

McDonald, T., & Siegall, M. (1992). The effects of technological self-efficacy and job focus on job performance, attitudes, and withdrawal behaviors. Journal of Psychology: Interdisciplinary and Applied, 126(5), 465–475. https://doi.org/10.1080/00223980.1992.10543380

Medici, G., Grote, G., Igic, I., & Hirschi, A. (2023). Technological self-efficacy and occupational mobility intentions in the face of technological advancement: a moderated mediation model. European Journal of Work and Organizational Psychology, 32(4), 538–548. https://doi.org/10.1080/1359432X.2023.2197215

Mokhtar, S., Alshboul, J. A. Q., & Shahin, G. O. A. (2019). Towards Data-driven Education with Learning Analytics for Educator 4.0. Journal of Physics: Conference Series, 1339(1), 0–7. https://doi.org/10.1088/1742-6596/1339/1/012079

Mutalib, Z. A. (2019). Kekurangan guru dalam masa lima tahun. Berita Harian. https://www.bharian.com.my/berita/nasional/2019/11/623714/kekurangan-guru-dalam-masa-lima-tahun

Nam, T. (2019). Technology usage, expected job sustainability, and perceived job insecurity. Technological Forecasting and Social Change, 138(July 2018), 155–165. https://doi.org/10.1016/j.techfore.2018.08.017

Nasbah, N. N. (2022). Tekanan pengurusan punca guru bersara awal. Berita Harian. https://www.bharian.com.my/berita/pendidikan/2022/06/970661/tekanan-pengurusan-punca-guru-bersara-awal

Nunnally, J. C., & Bernstein, Ir. H. (1994). Psychometric Theory. In McGraw-Hill (3rd ed., Vol. 5, Issue 3). McGraw Hill. https://doi.org/10.2307/1161962

Paetsch, J., Franz, S., & Wolter, I. (2023). Changes in early career teachers' technology use for teaching: The roles of teacher self-efficacy, ICT literacy, and experience during COVID-19 school closure. Teaching and Teacher Education, 135(February), 104318. https://doi.org/10.1016/j.tate.2023.104318

Parkaran, K. (2022). 'Trend mengejut' guru bersara awal membimbangkan, kata NUTP. Free Malaysia Today. https://www.freemalaysiatoday.com/category/bahasa/tempatan/2022/04/18/trend-mengejut-guru-bersara-awal-membimbangkan-kata-nutp/

Pazilah, F. N. P., Hashim, H., & Yunus, M. M. (2019). Using Technology in ESL Classroom: Highlights and Challenges. Creative Education, 10(12), 3205–3212. https://doi.org/10.4236/ce.2019.1012244

Peng, J., Zhang, J., Zhou, X., Wan, Z., Yuan, W., Gui, J., & Zhu, X. (2021). Validation of the Occupational Self-Efficacy Scale in a Sample of Chinese Employees. Frontiers in Psychology, 12(November), pp. 1–9. https://doi.org/10.3389/fpsyg.2021.755134

PMD, M. P. M. D. (2021). National Fourth Industrial Revolution (4IR) Policy. Economoic Planning Unit, Prime Minister's Department.

Rosická, Z., & Hošková-Mayerová, Š. (2014). Motivation to Study and Work with Talented Students. Procedia - Social and Behavioral Sciences, 114(February), 234–238. https://doi.org/10.1016/j.sbspro.2013.12.691

Roy, A. (2019). Using technology in teaching and learning. International Journal of Innovation Education and Research, 7(4), 414–422. https://doi.org/10.5860/crln.68.2.7752

Schildkamp, K., Karbautzki, L., & Vanhoof, J. (2014). Exploring data use practices around Europe: Identifying enablers and barriers. Studies in Educational Evaluation, 42, 15–24. https://doi.org/10.1016/j.stueduc.2013.10.007

Schildkamp, K., & Kuiper, W. (2010). Data-informed curriculum reform: What data, purposes, and promoting and hindering factors. Teaching and Teacher Education, 26(3), 482–496. https://doi.org/10.1016/j.tate.2009.06.007

Singh, M. N. (2021). Inroad of Digital Technology in Education: Age of Digital Classroom. Higher Education for the Future, 8(1), 20–30. https://doi.org/10.1177/2347631120980272

Smetackova, I. (2017). Self-Efficacy and Burnout Syndrome Among Teachers. The European Journal of Social & Behavioural Sciences, 20(3), 228–241. https://doi.org/10.15405/ejsbs.219

Staufenbiel, T. (2010). A Model for the Effects of Job Insecurity on Performance, Turnover Intention, and Absenteeism. Journal of Occupational and Organizational Psychology, 1–37.

Sun, J., Przybylski, R., & Johnson, B. J. (2016). A review of research on teachers' use of student data: from the school leadership perspective. Educational Assessment, Evaluation and Accountability, 28(1), 5–33. https://doi.org/10.1007/s11092-016-9238-9

Tschannen-Moran, M., & Hoy, A. W. (2001). Teachers' Sense of Efficacy Scale 1 (long form). Teaching and Teacher Education, 17(1), 783–805.

Tschannen-moran, M., Hoy, A. W., & Hoy, W. K. (1998). Teacher Efficacy: It is Meaning and Measure. June. https://doi.org/10.3102/00346543068002202

UNESCO. (2015). The challenge of teacher shortage and quality: Have we succeeded in getting enough quality teachers into classrooms? https://unesdoc.unesco.org/ark:/48223/pf0000232721

UNESCO Institute for Statistics. (2016). The World Needs Almost 69 Million New Teachers To Reach The 2030 Education Goals. https://unesdoc.unesco.org/ark:/48223/pf0000246124

Velu, J., Ahmad, I. S., & Rahman, Z. A. (2011). Lecturers' Perspective Of Self-Efficacy Towards Research: 'Push Or Not To Push.' 1–13.

Vincent Dupriez, Delvaux, B., & Lothaire, S. (2016). Teacher shortage and attrition: Why do they leave? British Educational Research Journal, 42(1).

Weibenfels, M., Klopp, E., & Perels, F. (2022). Changes in Teacher Burnout and Self-Efficacy During the COVID-19 Pandemic: Interrelations and e-Learning Variables Related to Change. Frontiers in Education, 6(January), 1–9. https://doi.org/10.3389/feduc.2021.736992

Wong, K. T., Teo, T., & Russo, S. (2012). Influence of gender and computer teaching efficacy on computer acceptance among Malaysian student teachers: An extended technology acceptance model. Australasian Journal of Educational Technology, 28(7), 1190–1207. https://doi.org/10.14742/ajet.796

Yunus, M. (2018). Innovation In Education and Language Learning in 21st Century Learning. Journal of Sustainable Development Education and Research, 2(1), 33–34.