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Determinants of Physical Teachers' Attitude toward Technology Integration in Shenzhen Schools, China

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Abstract

Background and Aim: This study aimed to identify the factors influencing Physical teachers' attitudes toward technology integration in Shenzhen Schools, China. The variables used in this research framework include Content Knowledge, Pedagogical Knowledge, Technological Knowledge, Technology Pedagogy and Content Knowledge, Technology Integration Self-efficacy, Intention to Integrate Technology, Teaching Style, Contextual Factors, Intention to Integrate Technology and Instructional Technology Outcome Expectation.
Materials and Methods: The research utilized a quantitative survey research method using a questionnaire to investigate the influencing factors. The purposive sampling technique was employed to recruit 359 respondents in Shenzhen City to participate in the study. The Confirmatory Factor Analysis and Structural equation model was utilized to test the hypotheses.
Results: The results revealed that physical education teachers' intention to integrate technology can be influenced by the attitudes of Technological Integration Self-efficacy and Contextual Factors. In addition, the Technology Integration Self-efficacy is influenced by Technological Pedagogical and Content Knowledge. For the instructional technology outcome expectation, this factor can be influenced by the TISE and the IIT. Furthermore, the mediating effects were found for the teachers' intention to integrate technology and the technology integration self-efficacy.
Conclusion: The results showed that for physical education teachers to change their attitude toward technology integration, they need to increase their self-efficacy level. It is also important for the school to provide additional technology knowledge or support for teachers to ensure that the teachers can increase their competency toward technology usage, which could result in the increased utilization of technology in physical education classes.
Keywords: Physical Education; Intention to Integrate Technology; TPACK; Technology Integration Self-Efficacy

Introduction

In the era of the information society, data technology and network technology, which represent information technology, have made significant progress and have profoundly impacted people's lives, work, and studies. Traditional teaching methods have become outdated. However, many educators consciously or unconsciously remain skeptical of new technologies. Even in countries that provide classrooms with excellent educational technology support, such as the United States, only 72% of teachers use projectors, 57% use interactive electronic whiteboards, and 49% use digital cameras. Only 40% of teachers and their students use computers in teaching. The process of integrating information technology into school teaching is not as optimistic as people imagine (Raygan & Moradkhani, 2022).

The integration of technical elements into teaching is an important topic in contemporary teaching theory and educational technology research. Although campuses refuse to give up on technology, pioneers in the reform of educational informationization such as educational technology workers and pedagogical researchers have never stopped their efforts to integrate technology into teaching (Almusawi et al., 2021). People have been considering what kind of technologies teachers need to master and how to obtain these technologies. Furthermore, they are exploring how teachers can appropriately use these technologies to promote efficient and effective teaching and learning.

Educational technology research has long been criticized for lacking its theoretical basis. This not only hinders related research work but also results in the application of technology in teaching practice being limited to simple use and low-level application. The theoretical framework of "Technologically Integrated Subject Pedagogical Knowledge (TPACK)" aims to fill this gap in educational technology research by exploring under the guidance of high-level "integrated thinking." It provides a complete and

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comprehensive framework for integrating technology into teaching while offering action guidelines for the practice of technology integration in teaching and teacher expertise construction (Morales-López et al., 2021).

Objectives of Research

To investigate the influence of content knowledge, pedagogical knowledge, technological knowledge, and technology pedagogy on technology integration self-efficacy.

To investigate the influence of teaching style and contextual factors on intention to integrate technology.

To investigate the influence of technology integration self-efficacy on instructional technology outcome expectation and intention to integrate technology.

Literature review

Technological Pedagogical Content Knowledge Framework (TPACK)

The Technological Pedagocial Content Knowledge Framework known as the TPACK model was developed by Mishra and Koehler (Mishra & Koehler, 2009). This framework shows several aspects that educators should possess to utilize technology in teaching effectively. The framework contains Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Knowledge (TK), Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Technological Pedagogical Content Knowledge (TPCK) (Mishra & Koehler, 2009). TPACK framework promotes pedagogical practices by testing how teachers integrate knowledge with technology and assesses how they incorporate technology into their teaching methodologies. In this research, the TPACK framework and its variables were shown to influence teachers' competency in technology integration. The researcher aims to test some of the variables in the TPACK framework with the physical education instructors' attitudes toward integrating technology in teaching.

Content knowledge influences technology integration self-efficacy

The TPACK model posits that effective technology integration necessitates a profound comprehension of not only technological knowledge and pedagogical knowledge but also content knowledge. Consequently, teachers who possess strong content knowledge are better equipped to identify ways in which technology can be utilized to support student learning in their specific subject area. This, in turn, may increase their confidence in integrating technology into their teaching practices and thereby enhance their technology integration self-efficacy (Schmidt et al., 2009)

Empirical research has also provided evidence for the relationship between content knowledge and technology integration self-efficacy. For instance, Goos and Bennison (2008) discovered that teachers' content knowledge in mathematics and science was positively associated with their self-efficacy in using technology to teach those subjects (Farjon et al., 2019) study found that teachers' content knowledge in science was positively related to their self-efficacy in using technology to teach science.

In conclusion, the TPACK model, Social Cognitive Theory, and empirical research provide a robust theoretical and empirical foundation for the hypothesis that content knowledge influences technology integration self-efficacy.

Pedagogical knowledge influences technology integration self-efficacy

The hypothesis that pedagogical knowledge influences technology integration self-efficacy is supported by several theoretical frameworks and bodies of literature. One theoretical framework that supports this hypothesis is the Technological Pedagogical Content Knowledge (TPACK) model. The TPACK model proposes that effective technology integration requires a deep understanding of technological knowledge, content knowledge, and pedagogical knowledge. Teachers with strong pedagogical knowledge are better equipped to identify ways in which technology can be used to support student learning and may therefore feel more confident in their ability to integrate technology into their teaching practices. Shulman's (1986) social cognitive theory, posits that self-efficacy beliefs influence individuals' actions, including their ability to successfully integrate new technologies in their teaching practices.

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Studies have shown that teachers with higher levels of pedagogical knowledge, including knowledge of how to integrate technology effectively, have greater levels of technology integration self-efficacy (Hernández et al., 2010). Additionally, exposure to professional development programs that emphasize the pedagogical use of technology has been found to positively impact teachers' self-efficacy beliefs regarding technology integration (Hsu, 2016).

In summary, the literature supports the hypothesis that pedagogical knowledge influences technology integration self-efficacy, with additional support for the role of teachers' perceptions of the relevance and value of technology in shaping their self-efficacy beliefs (Hernández et al., 2010).

Technological knowledge influences technology integration self-efficacy

Researchers suggest that technological knowledge positively affects technology integration self-efficacy. According to Bandura's social-cognitive theory, self-efficacy is developed through four factors: mastery experience, vicarious experience, verbal persuasion, and emotional arousal. The integration of technology into learning environments provides teachers with opportunities for mastery experiences, such as learning new technology skills or successfully integrating technology into a lesson plan. These positive experiences can increase their self-efficacy. Literature also supports the idea that technological knowledge is positively related to technology integration self-efficacy. One study found that teachers who reported higher levels of technological knowledge also reported higher levels of technology integration self-efficacy (Petko et al., 2018). Similarly, a meta-analysis by Ertmer et al. (2012) concluded that technological knowledge was a strong predictor of technology integration self-efficacy.

In addition, studies have found that professional development that focuses on improving teachers' technological knowledge has a positive impact on their technology integration self-efficacy (Seifu, 2020). Overall, the theory and literature suggest that there is a positive relationship between technological knowledge and technology integration self-efficacy. Teachers with a higher level of technological knowledge are more likely to believe in their ability to effectively integrate technology into their teaching practices.

Technology Pedagogy and Content knowledge influence technology integration self-efficacy

According to the literature, Technology Pedagogy and Content Knowledge (TPACK) have a significant influence on Technology Integration Self Efficacy (TISE). TPACK is the intersection of three domains of knowledge: technological knowledge, pedagogical knowledge, and content knowledge. TPACK is a critical foundation for technology integration in educational settings. Research supports the notion that when teachers possess good TPACK, their confidence in integrating technology increases.

Several studies have reported a positive relationship between TPACK and TISE. This relationship implies that the more competent and confident teachers are in integrating technology, the more likely they are to utilize it effectively in the classroom. Peña et al. (2021) found evidence that TPACK explains approximately 46% of the variance in TISE among teachers. The findings imply that teachers with a diverse set of TPACK skills feel more efficacious, leading to more tech-positive learning outcomes for their students.

Furthermore, several scholars have demonstrated that TPACK influences technology integration self-efficacy indirectly through other factors. For example, Petko et al. (2018) propose that TPACK can enhance teachers' perceived ease of use and usefulness of technology, which, in turn, has a positive effect on their TISE. Therefore, teachers with strong TPACK have more favorable perceptions of technology, leading to higher efficacy beliefs regarding technology integration.

In conclusion, various theoretical frameworks and empirical studies illustrate a positive relationship between TPACK and TISE. Through their ability to enhance teachers' perceptions of technology and increase their confidence, TPACK can lead to better outcomes related to technology integration in educational contexts.

Technology integration self-efficacy influences the intention to integrate technology

A review of the literature supports this theory, with numerous studies finding a positive relationship between technology integration self-efficacy and teachers' intention to use technology. For example, a study by Intayos et al. (2021) found that teachers who had higher levels of self-efficacy regarding technology integration were more likely to use it in their teaching practices. Similarly, a study found that

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teachers who had higher levels of self-efficacy regarding technology integration were more likely to have positive attitudes toward using it.

In addition, research has also found that factors such as training and support can influence teachers' self-efficacy regarding technology integration. For example, a study by Raygan and Moradkhani (2022) found that professional development programs that focused on building teachers' knowledge and skills related to technology integration led to increased levels of self-efficacy and intention to use technology.

Overall, the literature supports the hypothesis that there is a positive relationship between technology integration self-efficacy and teachers' intention to integrate technology into their teaching practices. This relationship is influenced by factors such as training and support, which can help build teachers' confidence in their ability to effectively use technology in the classroom.

Teaching Style influences the intention to integrate technology

The relationship between teaching style and intention to integrate technology has been a topic of interest in educational research. Several theories and studies have suggested that teaching style can significantly influence teachers' intention to integrate technology into their teaching practices.

One theory that supports this relationship is the Technology Acceptance Model (TAM). According to TAM, perceived usefulness and perceived ease of use are the two key factors that determine an individual's intention to use technology. Research has shown that teachers who adopt a student-centered teaching style are more likely to perceive technology as useful and easy to use, which in turn increases their intention to integrate it into their teaching practices (Mohamed et al., 2021).

Another theory that supports this relationship is the Unified Theory of Acceptance and Use of Technology (UTAUT). UTAUT suggests that performance expectancy, effort expectancy, social influence, and facilitating conditions are the four key factors that determine an individual's intention to use technology. Studies have shown that teachers who adopt a constructivist teaching style tend to have higher levels of performance expectancy and effort expectancy when using technology, which increases their intention to integrate it into their teaching practices (Kirikçilar & Yildiz, 2018).

In addition, several studies have provided empirical evidence for the relationship between teaching style and intention to integrate technology. For example, a study by Khlaif (2018) found that teachers who adopted a student-centered teaching style had higher levels of intention to use digital learning materials in their classrooms. Similarly, a study by Cabero et al. (2015) found that teachers who adopted a constructivist teaching style had higher levels of intention to use mobile learning technologies.

In conclusion, both theoretical frameworks and empirical evidence suggest that there is a significant relationship between teaching style and intention to integrate technology into teaching practices. Teachers who adopt student-centered or constructivist teaching styles tend to perceive technology as more useful and easier to use, which increases their intention to integrate it into their teaching practices.

Contextual Factors influence the intention to integrate technology

The integration of technology in various fields has become a popular trend in recent times. However, the intention to integrate technology is influenced by contextual factors. This article aims to summarize the theory and literature that support the relationship between contextual factors and the intention to integrate technology.

According to the Technology Acceptance Model (TAM), perceived usefulness and perceived ease of use are two important factors that influence an individual's intention to use technology. The TAM has been widely used in research related to technology adoption and integration. Additionally, the Unified Theory of Acceptance and Use of Technology (UTAUT) model suggests that performance expectancy, effort expectancy, social influence, and facilitating conditions are important predictors of an individual's intention to use technology.

Furthermore, the literature suggests that contextual factors such as organizational culture, leadership support, and training programs can significantly influence an individual's intention to integrate technology. For instance, a study conducted by Farjon et al. (2019) found that organizational culture significantly affects teachers' intention to use educational technology in their teaching practices.

In conclusion, theory and literature suggest that contextual factors play a crucial role in influencing an individual's intention to integrate technology. Organizational culture, leadership support, training programs, and other contextual factors should be considered when implementing new technologies in various fields.

Technology integration self-efficacy influences instructional technology outcome expectations

The theory of technology integration self-efficacy posits that a teacher's belief in their ability to incorporate technology into their instruction influences their outcome expectations for using instructional technology effectively. Several studies have provided consistent support for this hypothesis (Schmidt et

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al., 2009). Hernández et al. (2010) found that technology integration self-efficacy significantly predicted both the perceived usefulness and perceived ease of use of instructional technology among teachers. Moreover, Scherer et al. (2018) found that self-efficacy had a stronger influence on usefulness perceptions compared to ease-of-use perceptions. Similarly reported that teachers' self-efficacy in using technology predicted their technology-related outcome expectations (Tondeur et al., 2019). Specifically, teachers who felt more confident in their ability to integrate technology into their instruction were more likely to perceive that using technology would enhance student learning (Taimalu & Luik, 2019).

These findings suggest that efforts to increase teachers' technology integration self-efficacy may be an effective strategy for improving their outcome expectations for using instructional technology. Additionally, the research supports the importance of providing professional development opportunities that focus on building teachers' confidence and skills in using technology.

Conceptual Framework

This research aimed to investigate the physical teachers' attitudes toward technology integration attitude. The online questionnaires were employed as a tool for data collection. Referring to theories, literature reviews, and various related research. The conceptual framework of the study utilized previous research by Gibbons et al. (2010), Semiz and Ince (2012), and Banas & York (2014). The research conceptual framework and methodology developed as follows.

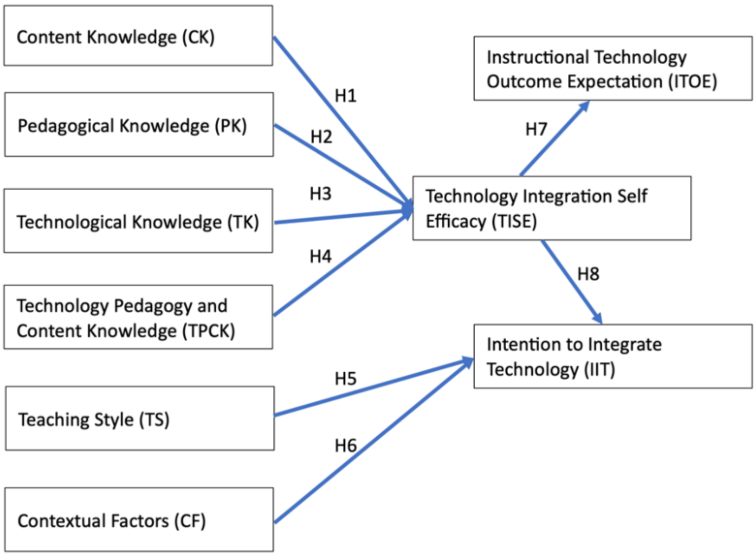

Figure 1: Conceptual Framework

H1: Content Knowledge (CK) influences Technology Integration Self-Efficacy (TISE).
H2: Pedagogical Knowledge (PK) influences Technology Integration Self-Efficacy (TISE)
H3: Technological Knowledge (TK) influences Technology Integration Self-Efficacy (TISE)
H4: Technology Pedagogy influences Technology Integration Self-efficacy (TISE)
H5: Teaching Style (TS) influences Intention to Integrate Technology (IIT)
H6: Contextual Factors (CF) influence the Intention to Integrate Technology (IIT)
H7: Technology Integration Self-efficacy (TISE) influences Instructional Technology Outcome Expectation (ITOE)
H8: Technology Integration Self-efficacy (TISE) influences Intention to Integrate Technology (IIT)

Methodology

The research aims to investigate physical education teachers on their attitudes of intention to integrate technology and other influencing factors. The research methodology for the research is quantitative survey research. This research method can help the researcher gather data from a large number of samples using questionnaires as the research instrument.

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Research Instrument

The research instrument of the study was the questionnaire, there were 9 constructs and 33 items total in the questionnaire. The questionnaire's constructs and items were based on the work by Gibbons et al. (2010), Semiz and Ince (2012), and Banas & York (2014). The questionnaire includes the following parts: technology knowledge (TK) 3 items, content knowledge (CK) 3 items, pedagogical knowledge (PK) 3, technology pedagogy and content knowledge (TPCK) 3 items, teaching style (TS) 5 items, contextual factor (CF) 5 items, technology integration self-efficacy (TISE) 4 items, intention to integrate technology (IIT) 3 items, instructional technology outcome expectation (ITOE) 4 items. The questionnaire will use a 5-point Agreement Likert-type scale.

Samples and Sample Size

To test the hypotheses using Structural Equation Model (SEM) analysis, a priori sample size calculation was calculated to estimate the number of samples. An online sample size calculation was used with the following parameters; effect size 0.3, latent variables 9, observed variables 33, p-value 0.05, and statistical power 0.95. The results showed that the minimum sample size was 264 samples (Soper, 2023) A total of 370 full-time physical education teachers from various government-led school groups in Shenzhen, each spanning over 100 square kilometers, participated in this study. The participating schools were spread across various districts of Shenzhen, including Bao'an, Longgang, Longhua, Pingshan, Guangming, Futian, Luohu, and Nanshan. After data collection, the researcher obtained 359 valid responses. Thus, the number of samples for the analysis was 359.

Pilot test

To ensure the reliability of the questionnaire, the internal consistency reliability was employed. After the modification of the questionnaire based on the five experts' judgments, it will be piloted with 40 full-time teachers working at a school with a similar background to the target schools in terms of the adopted curriculum. The reliability of the questionnaire will be done by using Cronbach's Alpha Coefficient. The results of the analysis showed the alpha level ranges from Instructional Technology Outcome Expectation (ITOE = .818) up to Content Knowledge (CK = .924). According to Hair et al. (2010), a value between .8 - and .9 is a very good level, and values greater than .9 are considered excellent. Thus, the level obtained for all constructs was considered very good and excellent. This is considered to be a high degree of reliability. Therefore, the questionnaire was determined to be dependable, as illustrated in Table 1.

Table 1 Cronbach's Alpha for All Constructs

Constructs	Cronbach's Alpha	Number of Items
Technology knowledge (TK)	.891	3
Content knowledge (CK)	.924	3
Technology pedagogy and content knowledge (TPCK)	.872	3
Teaching style (TS)	.917	4
Technology Integration Self-Efficacy (TISE)	.853	7
Intention to Integrate Technology (IIT)	.871	3
Instructional Technology Outcome Expectation (ITOE)	.818	4

Results

Demographic Information

Based on the questionnaires returned from 370 teachers in the target schools, teachers' age, gender, and educational background information were reported here as the teachers' demographic profile for the school. The survey results showed that the majority of the teachers are male, which was 79.73 percent; and only 20.27 percent were female; the majority of teachers, 40.27%, have over 15 years of experience. A smaller portion, 11.62%, have been working for 4 to 8 years. Those with 4 to 8 years of experience make up 27.57%, and a minor group of 11.62% have only 1 to 3 years of experience; the majority of teachers, specifically 77.03 percent, had Bachelor's Degrees. A smaller percentage of teachers,

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specifically 4.32 percent, had Distance University Degrees, while 18.65 percent of the teachers had Master's Degrees. Interestingly, no teachers in the survey reported having a Doctoral Degree.

Descriptive Statistics

Before Confirmatory Factor Analysis (CFA) and Structural Equation Model (SEM) to test hypotheses, the data was tested for the distribution and normality of data, the mean, standard deviation, skewness, and kurtosis values of each item were analyzed. The results showed the mean value ranges from 3.40 (TS3) up to 4.25 (PK1). The skewness ranges from -1.187 (PK1) up to -0.342 (TS3). The kurtosis values range from -0.817 up to 1.656 (TISE3). The skewness ranges between -2 and +2 and the Kurtosis range of -7 to +7 were considered acceptable. All of the items analyzed contain values within acceptable ranges.

Table 2: Descriptive Statistics and Normality Tests of questionnaire items

	N	Mean	SD	Skewness	Kurtosis
TK1	359	4.01	0.945	-0.749	0.221
TK2	359	3.96	0.927	-0.685	0.159
TK3	359	3.81	1.028	-0.564	-0.301
CK1	359	4.15	0.829	-0.939	1.014
CK2	359	4.20	0.841	-1.097	1.449
CK3	359	4.13	0.851	-0.953	1.052
PK1	359	4.25	0.851	-1.187	1.519
PK2	359	4.16	0.872	-0.950	0.686
PK3	359	4.16	0.900	-1.104	1.153
TPCK1	359	4.09	0.880	-0.942	0.957
TPCK2	359	4.10	0.879	-0.942	0.952
TPCK3	359	4.12	0.860	-0.955	1.113
TS1	359	3.84	0.985	-0.688	0.244
TS2	359	3.47	1.200	-0.345	-0.817
TS3	359	3.40	1.217	-0.342	-0.783
TS4	359	3.61	1.103	-0.469	-0.486
TS5	359	4.06	0.919	-0.902	0.688
CF1	359	4.15	0.853	-0.950	0.968
CF2	359	3.89	0.968	-0.574	-0.140
CF3	359	3.90	1.016	-0.645	-0.209
CF4	359	3.75	1.102	-0.549	-0.560
CF5	359	3.72	1.064	-0.449	-0.592
CF6	359	3.82	1.035	-0.605	-0.164
TISE1	359	4.13	0.893	-1.023	1.117
TISE2	359	4.15	0.899	-1.084	1.330
TISE3	359	4.17	0.886	-1.168	1.656
TISE4	359	4.15	0.898	-1.145	1.508
IIT1	359	4.14	0.882	-0.852	0.465

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	N	Mean	SD	Skewness	Kurtosis
IIT2	359	4.15	0.890	-0.920	0.591
IIT3	359	4.14	0.895	-0.924	0.693
ITOE1	359	4.15	0.881	-1.038	1.237
ITOE2	359	4.16	0.910	-1.130	1.341
ITOE3	359	4.22	0.865	-1.149	1.458
ITOE4	359	4.21	0.883	-1.106	1.192

Confirmatory Factor Analysis

Before applying the structural equation model (SEM) to test the hypotheses, the confirmatory factor analysis was applied to evaluate the correlation among latent variables to evaluate the model fit (Alhija, 2010). The software Jamovi version 2.3.18 on Macintosh was utilized to analyze the CFA and other subsequent analyses.

Utilizing the CFA can help the researcher analyze the fit of the data of the items that should be measured on the specific construct. As well as providing possible weaknesses of items in the construct (Mueller & Hancock, 2001).

Table 3: Confirmatory factor analysis result, Composite Reliability (CR) and Average Variance Extracted (AVE)

Factor	item	Estimate	Z	p	Stand. Estimate	(CR) (>.7)	AVE (>.5)
TK	TK1	0.848	21.5	< .001	0.899	0.915	0.784
	TK2	0.830	21.5	< .001	0.897		
	TK3	0.882	20.0	< .001	0.859		
CK	CK1	0.756	22.5	< .001	0.914	0.945	0.853
	CK2	0.787	23.5	< .001	0.937		
	CK3	0.781	22.7	< .001	0.919		
PK	PK1	0.776	22.4	< .001	0.912	0.935	0.829
	PK2	0.816	23.4	< .001	0.937		
	PK3	0.792	21.1	< .001	0.881		
TPK	TPCK1	0.826	23.7	< .001	0.941	0.956	0.879
	TPCK2	0.827	23.8	< .001	0.942		
	TPCK3	0.798	23.2	< .001	0.930		
TS	TS1	0.767	17.2	< .001	0.780	0.900	0.650
	TS2	1.066	21.2	< .001	0.890		
	TS3	1.068	20.7	< .001	0.879		
	TS4	0.945	19.9	< .001	0.858		
	TS5	0.535	11.6	< .001	0.583		
CF	CF1	0.663	17.3	< .001	0.778	0.944	0.740
	CF2	0.856	21.3	< .001	0.885		
	CF3	0.929	22.6	< .001	0.916		

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Factor	item	Estimate	Z	p	Stand. Estimate	(CR) (>.7)	AVE (>.5)
	CF4	0.950	20.4	< .001	0.864		
	CF5	0.910	20.1	< .001	0.857		
	CF6	0.882	20.0	< .001	0.854		
TISE	TISE1	0.840	23.9	< .001	0.942	0.974	0.903
	TISE2	0.855	24.3	< .001	0.952		
	TISE3	0.842	24.3	< .001	0.951		
	TISE4	0.856	24.5	< .001	0.955		
IIT	IIT1	0.827	23.7	< .001	0.940	0.962	0.894
	IIT2	0.834	23.6	< .001	0.938		
	IIT3	0.857	24.6	< .001	0.959		
ITOE	ITOE1	0.809	22.8	< .001	0.920	0.969	0.886
	ITOE2	0.861	24.0	< .001	0.947		
	ITOE3	0.824	24.4	< .001	0.953		
	ITOE4	0.834	23.9	< .001	0.944		

Remark: CR = Composite Reliability, AVE = Average Variance Extracted

Convergent Validity

Convergent validity is conducted to test the construct validity. The researcher employed Hair et al. (2010) indices which are the Factor Loading greater than 0.5 and the Average Variance Extracted (AVE) greater than .50.

Based on the data obtained from the analysis, all of the constructs had AVE values ranging from .650 (Technology Integration Self Efficacy, TS) up to .903 (Intention to Integrate Technology, TINT). All of the values were greater than the cut-off value of .5, this could indicate that all of the constructs passed the convergent validity. Furthermore, the composite reliability (CR) also showed a satisfactory level since all of them are greater than 7.

Discriminant Validity

The discriminant validity of each construct is also tested before the structural equation model analysis. According to Fornell and Larcker (1981), the discriminant validity can be based on the comparison of the correlation coefficient of each construct to the square root of the Average Variance Extracted (AVE). The results of the square root of AVE need to be larger than the correlation coefficient of the construct to ensure that the discriminant validity is obtained.

Table 4 shows the correlation coefficient and the square root of the AVE. All of the constructs showed that the square root of AVE values is higher than the correlation coefficient among constructs. Thus, the discriminant validity among constructs is achieved.

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Table 4: Discriminant Validity

	TK	CK	PK	TPCK	TS	CF	TISE	IIT
TK	0.88							
CK	0.75	0.92						
PK	0.69	0.82	0.91					
TPCK	0.73	0.79	0.84	0.94				
TS	0.45	0.48	0.53	0.57	0.80			
CF	0.65	0.67	0.70	0.75	0.65	0.86		
TISE	0.67	0.71	0.77	0.82	0.57	0.81	0.95	
IIT	0.68	0.71	0.75	0.79	0.55	0.81	0.90	0.94
ITOE	0.65	0.69	0.71	0.78	0.54	0.77	0.87	0.89

Structural Equation Model

To test the hypotheses of causal relationship among variables proposed. The Structural Equation Model (SEM) was applied to the model. To analyze SEM, the software Jamovi version 2.3.18 with the module SEMLj-SEM version 1.1.6 was utilized for the SEM calculation. In the SEMLj, utilized the R Package for the Structural Equation Model analysis (Rosseel, 2012).

Fitness of Structural Model

The structural model was tested for the model fit using the following fit indices. Standardized root mean square residual (SRMR), Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI). Table 5 shows the results of the fit indices before and after modifications of the model in the study.

Table 5: The Fit indices values after model modification

Fit Index	Acceptable Criteria	Source	Statistical Values	Statistical Values (Modified)
GFI	≥ 0.80	Cho et al. (2020)	0.932	0.953
SRMR	≤ 0.08	Cho et al. (2020)	0.120	0.062
RMSEA	≤ 0.10	Hooper et al. (2007)	0.090	0.066
CFI	≥ 0.80	Hooper et al. (2007)	0.912	0.958
TLI	≥ 0.80	Navarro & Foxcroft (2023)	0.902	0.953
Model Summary			Not in harmony with empirical data	In harmony with empirical data

Before the modification, the current model was not in harmony with the empirical data. Thus, a modification was needed to improve the fit indices (Navarro & Foxcroft, 2023). The researcher decided to remove two items from Teaching Style (TS1 & TS5), which have a low factor loading of less than .7 in the measurement model. According to the modification indices provided by Jamovi (SEMlj) (Gallucci & Jentschke, 2021), two additional influencing relationships were added to the model; the influencing of the Intention to Integrate Technology (IIT) to the Instructional Technology Outcome Expectation (ITOE) and the Technology Integration Self Efficacy (TISE) influencing on the Intention to Integrate Technology (IIT).

The results of the modification showed that the new values satisfy all of the acceptable criteria of model fit. The values were: GFI = .953, SRMR = .062, RMSEA = .066, CFI = .958, and TLI = .953. According to Cho et al. (2020), the model fit when sample N is greater than 100 can use the GFI of ≥ 0.80 and SRMR ≤ 0.08 to estimate the model fit. Since the two values passed the acceptable criteria (GFI =

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.944, SRMR = .070), the current modified model is acceptable. Figure 2 shows the modified model of the conceptual framework.

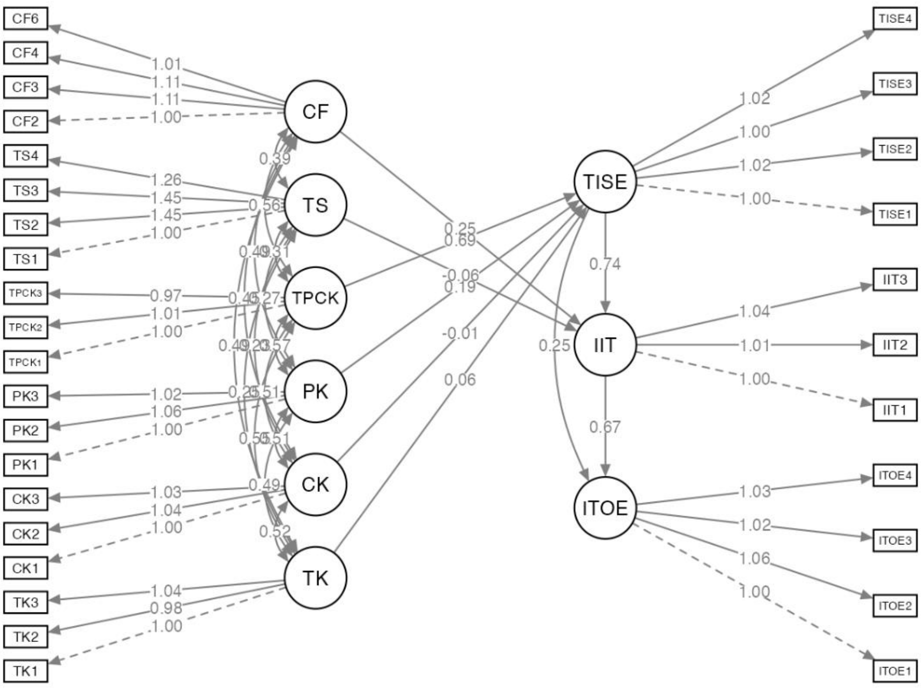

Figure 2: Structural Equation Model (After Modification)
Source: Path analysis of the SEM calculation from Jamovi

Research Hypothesis Testing

After the model modification, the hypotheses of the influencing factors were analyzed and showed the following hypotheses testing results in Table 6.

Table 6: Hypothesis Testing Results of the Structural Model

Hypothesis	Standardized Coefficients (β)	z-value	Result
H1: Content Knowledge (CK) can influence Technology Integration Self Efficacy (TISE)	-0.012	-0.156	Not Supported
H2: Pedagogical Knowledge (PK) can influence Technology Integration Self Efficacy (TISE)	0.173	1.835	Not Supported
H3: Technological Knowledge (TK) can influence Technology Integration Self Efficacy(TISE)	0.067	0.995	Not Supported
H4:Technological Pedagogical and Content Knowledge (TPCK) influence Technology Integration Self Efficacy (TISE)	0.679	8.023***	Supported
H5:Teaching Style (TS) can influence intention to integrate technology (IIT)	- 0.054	-1.81	Not Supported
H6:Contextual Factors (CF) can influence intention to integrate technology (IIT)	0.263	6.783***	Supported

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Hypothesis	Standardized Coefficients (β)	z-value	Result
H7:Technological Integration Self Efficacy (TISE) can influence instructional technology outcome expectation (ITOE)	0.267	3.687***	Supported
H8: Technological Integration Self-Efficacy (TISE) can influence the intention to integrate technology (IIT)	0.764	20.40***	Supported
H9:Intention to integrate technology (IIT) can influence instructional technology outcome expectation (ITOE)***Add after model modification	0.676	9.049***	Supported

*** = P<.001

The mediating effects of the variables in the model were analyzed. The method of secondary order analysis in SEMlj was utilized to calculate the mediating effects of constructs (Marcello, 2003) Table 7 shows the mediating effects of the model constructs.

Table 7:Indirect effects of constructs

Description	Estimate	SE	β	z	p
TISE ⇒ IIT ⇒ ITOE	0.492	0.059	0.517	8.372	< .001
TS ⇒ IIT ⇒ ITOE	-0.039	0.022	-0.036	-1.781	0.075
CF ⇒ IIT ⇒ ITOE	0.167	0.03	0.178	5.59	< .001
TK ⇒ TISE ⇒ ITOE	0.015	0.016	0.016	0.96	0.337
TK ⇒ TISE ⇒ IIT ⇒ ITOE	0.03	0.03	0.031	0.988	0.323
CK ⇒ TISE ⇒ ITOE	-0.004	0.023	-0.003	-0.156	0.876
CK ⇒ TISE ⇒ IIT ⇒ ITOE	-0.007	0.044	-0.006	-0.156	0.876
PK ⇒ TISE ⇒ ITOE	0.048	0.029	0.046	1.645	0.1
PK ⇒ TISE ⇒ IIT ⇒ ITOE	0.092	0.051	0.089	1.794	0.073
TPCK ⇒ TISE ⇒ ITOE	0.176	0.052	0.181	3.363	< .001
TPCK ⇒ TISE ⇒ IIT ⇒ ITOE	0.341	0.058	0.351	5.862	< .001

According to the results in Table 7, it showed that the following Intention to Integrate Technology (IIT) showed the mediating effect for the Technology Integration Self Efficacy (TISE) and Contextual Factors toward the Instructional Technology Outcome Expectation (ITOE). Another path that showed a statistically significant mediating effect was the mediating effect of the Technology Integration Self Efficacy (TISE) on the Technological Pedagogical and Content Knowledge (TPCK) and the Instructional Technology Outcome Expectation (ITOE). Lastly, the path of the Technological Pedagogical and Content Knowledge (TPCK) influencing the Technology Integration Self Efficacy (TISE) to the Intention to Integrate Technology (IIT) and the Instructional Technology Outcome Expectation (ITOE) also showed mediating effects. The rest of the indirect effects did not show statistically significant results, which indicated that the mediating effect of them was not found.

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Conclusion and Recommendations

In conclusion, this study aimed to explore the factors influencing physical education teachers' attitudes toward technology integration in Shenzhen schools, in China. The study unveiled important insights about the factors influencing technology integration self-efficacy and intention to integrate technology among physical education teachers in Shenzhen schools.

Notably, while individual components such as content knowledge, pedagogical knowledge, and technological knowledge did not significantly influence technology integration self-efficacy, the combined understanding of these domains, encapsulated in the TPACK framework, showed a strong positive effect. This suggests the importance of a holistic understanding of how pedagogy, content, and technology intersect for effective technology integration in teaching.

Moreover, technology integration self-efficacy was found to be a significant predictor of intention to integrate technology and the expected outcomes of instructional technology. This underscores the role of teacher confidence in their ability to use technology effectively in driving their willingness to incorporate technology into their teaching practices and their optimism about the potential benefits of doing so.

Teaching style and contextual factors were also found to significantly influence the intention to integrate technology. Teachers who are open to new approaches, perceive the importance of technology in achieving their teaching goals, and have access to necessary support and resources are more likely to integrate technology into their teaching.

The results also showed that the technology integration self-efficacy was the mediating variable for the teachers' intention to integrate technology as well as the technology integration outcome expectations. The results showed that for teachers to integrate the technology, the teacher needs to perceive that they are competent in using the technology which would lead them to further integration and expectation of the integration outcomes.

Overall, these findings highlight the importance of fostering a comprehensive understanding of technology, pedagogy, and content, enhancing self-efficacy in technology integration, and creating supportive environments for teachers to successfully integrate technology into their teaching practices.

Implications for Practice

The findings of this study have several implications for practice in Shenzhen schools, in China: Professional development: Schools and educational authorities should prioritize providing professional development opportunities for teachers to enhance their content, pedagogical, and technological knowledge to support technology integration. This could include workshops, online courses, and mentoring programs. Supportive environments: School administrators should work to create a supportive environment for technology integration by providing access to resources, technical support, and encouragement. This will help teachers feel more confident and motivated to integrate technology into their teaching practices.

Teaching styles: Teachers should be encouraged to adopt teaching styles that are more conducive to technology integration, such as student-centered and collaborative approaches. This may help facilitate the successful implementation of technology in the classroom.

Promoting a positive attitude: Schools should work to foster a positive attitude towards technology integration among teachers by emphasizing its potential benefits for student learning and engagement. This may include sharing success stories and creating opportunities for teachers to observe their peers effectively using technology in the classroom.

Future Research

Based on the findings of this study, several areas for future research can be identified: Longitudinal studies: Further research could explore the long-term effects of technology integration on teachers' self-efficacy, intention to integrate technology, and teaching outcomes. Longitudinal studies will help to better understand the lasting impact of technology integration on teaching and learning.

Effect of teacher age: Since the relationship between technology integration self-efficacy and intention to integrate technology was found to be stronger among younger teachers, future research could

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explore the reasons behind this phenomenon and identify strategies to support older teachers in integrating technology.

Comparative studies: Future research might also compare the factors influencing technology integration among physical education teachers with those of teachers in other subject areas to identify any unique challenges or opportunities specific to physical education.

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