

Leading Teaching and Learning in the Era of Education 4.0: The Relationship between Perceived Teacher Competencies and Teacher Attitudes toward Change

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<https://doi.org/10.24191/ajue.v18i1.17171>

Received: 12 May 2021

Accepted: 7 January 2022

Date Published Online: 31 January 2022

Published: 31 January 2022

Abstract: The objective of the survey was to examine the relationship between perceived teacher competencies in the era of Education 4.0 (TCEdu4.0) and teacher attitudes toward change (TATC) in Malaysian secondary schools. A total of 1,293 teachers from 80 secondary schools that were chosen using disproportionate stratified sampling method completed the questionnaires with valid data. The results demonstrated that, i) there was a significant, positive and strong correlation between TCEdu4.0 and TATC; and ii) except *Functional and Research Competency, Self-Management and Interactive Competency, Leading Learning and Mentoring, Problem Solving, Technological and Digital Competency, and Pedagogical Psychology and Assessment* were the five predictors of TATC that contributed 49.20% to the total variation. The study re-affirms the practicality of the competency and planned behavioural theories, provides evidence that teacher's individual factor is a major determinant of attitudes toward change. Moreover, it expands the understanding among educational practitioners regarding the interplay between these two variables and is a significant resource for Institut Aminuddin Baki in developing future training programmes for school leaders in enhancing TCEdu4.0 and TATC. In summary, the study offers valuable insights for driving school change effectively that sustainable school change is correlated to individual factors.

Keywords: Teacher Competencies, Teacher Attitudes Toward Change, Education 4.0, Fourth Industry Revolution, School change

1. Introduction

Education is an important driver for the development of human capital and economic growth. To ensure the education ecosystem constantly stays dynamic and relevant, Education 4.0 has been developed in response to the Fourth Industry Revolution (FIR) (Tai & Omar, 2019). Schools, being at the heart of education, perform many important functions especially in preparing the young generation for the future workplace and to meet the demands of an ever-changing world (Ministry of Education [MOE], 2016). Therefore, there has been a growing need for teacher quality as teacher is one critical determinant on student achievement (Harris, Jones & Huffman, 2018). Of primary concern is whether teachers are competent enough to conduct effective teaching and learning that can positively

impact student learning, faced with the challenges of Education 4.0 worldwide (Zhang, Shi & Lin, 2020).

Presently many schools are actively planning or engaging school reforms in response to the growing demands for quality education and accountability. However, most of these school reforms might not take off if there is no buy-in or acceptance from the teachers (Tai & Omar, 2018). Fullan (2001) and Oreg (2003) point out that teachers are the actual players and a crucial factor for any school change. Teacher attitudes toward change (TATC) in particular, will determine their behavioural intention on whether to embrace or to resist school change, which would subsequently have impact on the outcomes of school change (Tai & Omar, 2018). Hence, TATC is viewed as a crucial determinant of effective school reform (Bouckenooghe, 2009).

The Malaysia Education Blueprint 2013-2025 was crafted to transform the education system effectively and sustainably, and to prepare young Malaysians to thrive and compete globally (Nusrah & Chan, 2020; Wilson & Narasuman, 2020). Among the 11 operational shifts, “Transform teaching into the profession of choice” is one initiative meant to realize the educational goals of the Blueprint (MOE, 2013). Subsequently, vast resources were allocated by the government to this initiative to specifically enhance teacher competence through different policies and diverse teacher professional development programmes that have the potential to reframe teaching practices that meet the needs of the students (Tai & Omar, 2018). However, research into teacher competence and classroom practice did not show encouraging results.

For instance, Education 4.0 requires radical, technology-based teaching and learning methods. But research into the digital literacy of 2,661 teachers in Malaysia by Umar and Abu Hassan (2015) revealed a relatively low incidence of teachers integrating information and communication technology (ICT) into their teaching. Also, the results of the international assessments TIMSS and PISA over the last ten years showed that Malaysian students had poorer performance than their international counterparts (Joseph 2017, Samuel, Tee & Pe Symaco, 2017). In terms of TATC that was found significant in influencing teacher change readiness, instead of at the level of *Good*, most of the studies demonstrated that schoolteachers only achieved the level of *Quite Good* (Omar & Tai, 2018; Tai & Omar, 2014; Tai & Omar, 2016). Towards this end, the question posed was whether teacher competencies would be one of the crucial determinants of TATC.

Considering that on the one hand, teacher competence holds great promise for quality teaching (Harris, Jones & Huffman, 2018); but on the other, the relationship between teacher competencies and TATC has not been well-researched in the local education arena, the purpose of the study was to examine the relationship between perceived teacher competencies in the era of Education 4.0 (TCEdu4.0) and TATC in Malaysian secondary schools. This study would not only broaden our understanding about the interplay between these two variables, it will also guide practices especially in crafting strategies for enhancing TCEdu4.0 and developing positive TATC in schools. The insights from this study are meaningful at this juncture because we are moving into the last quarter of the implementation of the Blueprint in Malaysia.

2. Teacher Competencies in the Era of Education 4.0 (TCEdu4.0)

The emergence of successive industrial revolutions that started more than 200 years ago has altered the global socio-economic fabric tremendously. The Fourth Industrial Revolution that is already in motion is set to make an even greater impact. According to Herold (2016), the four major components of the FIR are i) the internet of things; ii) the internet of data; iii) the internet of services; and iv) the internet of people. Importantly, technology and autonomous systems developed by intelligent networks of data and machines have diffused into every facet of our lives, influencing our values and lifestyles. Education 4.0 has been developed to respond to the demands of FIR and as a result, created a strong impetus to transform pedagogical practices, re-craft subject content, curriculum and assessment, and infuse educational management skills into schools continuously (Brown-Martin, 2018).

For example, instead of focusing on cognitive development, schools are important platforms for constructing knowledge and values (O’Flaherty & Beal, 2018); rather than traditional teaching tools and facilities, technology-based resources and aids are employed to drive education in unconventional ways (Tang, Wong & Cheng, 2015); instead of repositories of knowledge to be conveyed to the students,

teachers are facilitators of learning (Dubovicki & Jukic, 2017). In essence, learning is not so much a social activity but a unique personal practice that feeds the learners' talents, interests, passion and needs (Brown-Martin, 2018). Broadly, the major feature of Education 4.0 is that it actively constructs and applies knowledge to solve problems collaboratively in real life, at the same time meeting the demands of FIR (Tai, Omar & Khalip, 2021).

In the light of the above, TC Edu4.0 makes reference to a number of competencies that enable teachers to perform teaching and learning practices effectively to meet the demands and challenges of FIR (European Commission, 2013; Gokee, 2015). Teachers equipped with these competencies can enhance student learning outcomes and inspires them towards creativity and innovations. In a sense, teachers have the privilege, rather than just a task of producing trained and qualified professionals who are highly competent in technical skills, social skills, interdisciplinary thinking as well as problem solving techniques for a technological-driven, virtualised and highly globalised world of work (Brown-Martin, 2018).

In Malaysia, Tai, Omar and Khalip (2021) developed the Teacher Competency Model for Education 4.0 (TC Edu4.0) to examine concerned or relevant competencies in Malaysian secondary schools. It would be impractical to produce lists of every competency that teachers may need for Education 4.0 (Tai, Omar & Khalip, 2021). Thus, only those competencies that account for effective teaching and learning measured by the demands of Education 4.0 were identified through literature review and by balancing the trade-offs between generic versus specific scope, organizational versus individual need, and acknowledging the challenges of Education 4.0 in Malaysia. As displayed in Figure 1, the TC Edu4.0 consists of six components: one human competency i.e., the *Self-Management and Interactive Competency*, and five technical competencies; the *Functional and Research Competency*, *Pedagogical Psychology and Assessment*, *Leading Learning and Mentoring*, *Technological and Digital Competency* and *Problem Solving* (Tai, Omar & Khalip, 2021). Each competency's details are discussed in the theoretical and conceptual sections of this article under point 4.

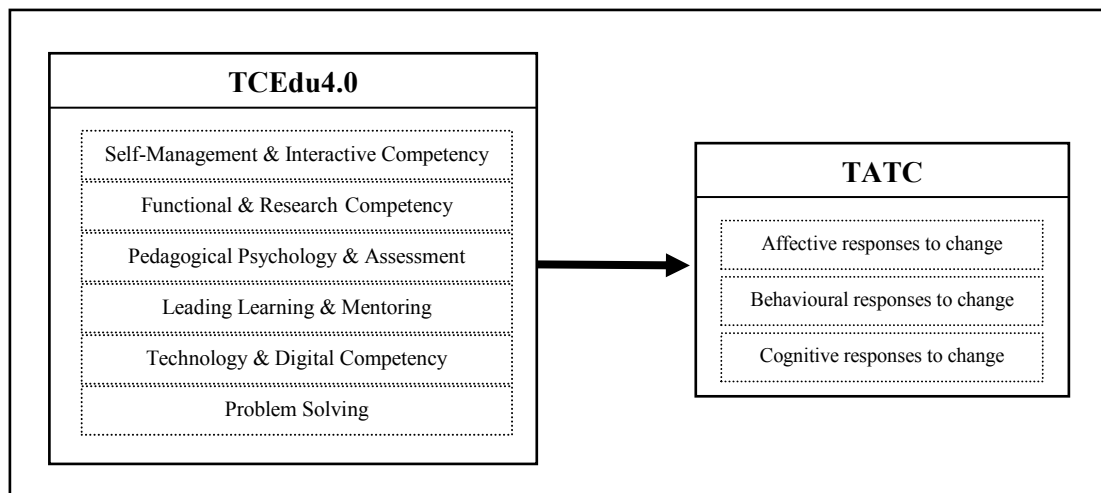


Fig. 1 The conceptual framework of the study

3. Attitudes toward Change

An attitude is a learned inclination to react to objects or events in a consistently favourable or unfavourable manner (Fishbein & Ajzen, 2010). Attitudes toward change are defined as the internal state including individual or personal thoughts, feelings and predispositions that affects personal choices, or the response proneness toward a change conducted by any organisation (Elias, 2009; Vakola & Nikolaou, 2006). Attitudes toward change have been an important focus in the literature of

organizational change management because it affects the individual's behavioural intention that will determine one's behaviour (Tai & Omar, 2017).

Fishbein and Ajzen (2010) highlight that individual attitude is affected by the intervention of cognitive, affective and behavioural components. Simply put, one's thinking, emotions and behaviours exert significant impact upon his response. Despite of differing effects upon each of these elements on attitude response, these three dimensions of attitude are closely interlinked (Ajzen & Fishbein, 2010). Similarly, Sabates and Capdevila (2010) point out that the cognitive element influences in turns and is dependent upon the affective elements and the behavioural components, being expressed as behavioural and skill habits.

On a practical note, a positive attitude toward change may lead to positive behavioural intention and concerned behaviours, such as being actively committed to change or engaging greatly in change (Oreg, 2003). Conversely, a negative attitude toward change will hinder change as it results in negative behavioural intention and subsequent behaviours such as intentions to withdraw, quit, sabotage the intended initiatives or even go against the change (Armenakis & Bedian, 1999). Whether attitudes are positive or negative, the organizational outcomes will be affected substantially (Tai & Omar, 2017).

There is a large body of evidence suggesting that contextual variables and individual factors are two major determinants of attitudes toward change (Tai & Omar, 2017). Organizational trust (Gomez & Rosen, 2001), organizational uncertainty (Hallgrimsson, 2008), organizational culture (Avidov-Ungar & Eshet-Alkay, 2011), information about change (Subramanian, 2017; Wanberg and Banas, 2000), conflicting stakes (Deline, 2018) and organizational leadership (Kursunoglu & Tanriogen, 2009; Tai & Omar, 2018) are contextual variables found in resource literature regarding attitudes toward change.

Individual or personal factors that affect evaluative judgement toward any change efforts in organizations includes self-esteem (Stone & Cooper, 2003; Wanberg & Banas, 2000), tolerance of ambiguity (Dunican & Keaster, 2015), locus of control (Chen & Wang, 2007; Verschure, 2017), disinclination to give up old habits (Hayes, 2010; Oreg, 2003), cognitive dissonance (Burnes, 2014), emotional intelligence (Osman Uslu, 2019; Vakola, Tsaousis & Nikolaou, 2004) and defence mechanisms (Bovey & Hede, 2001; Forsell & Astrom, 2012). These individual factors form a major cluster that determines attitudes toward change. However, not much is known about the relationship between TCEdu4.0 and TATC. Given this backdrop, it seems timely and meaningful to examine the above relationship in Malaysian secondary schools.

4. The Theoretical and Conceptual Framework of the Study

Welch and Hodge (2018) conceptualized competency as clusters of knowledge, skills, behaviours, capabilities or attitudes that drive outstanding performance. Gokee (2015) defined teacher competencies as teachers' abilities to execute teaching and learning practices or instruction effectively and excellently. The study will be based on the competency theory upheld by Markus, Cooper-Thomas and Allpress (2005), that by acquiring new and better knowledge, skills and attitudes, individuals are able to perform their tasks and roles competently.

Fishbein and Ajzen (2010) viewed attitude as a major factor in an individual's intention to carry out a specified action. They emphasize that an individual's behaviour is predicted by his belief that informs and ultimately determines his consequent action. Simply put, a person's belief determines one's behavioural intention, attitude and behaviour (Ajzen & Fishbein, 2010). Given that beliefs drive one's attitudes and behaviours, the focus of the study was to examine whether teachers believe that they were competent in conducting teaching and learning in the era of Education 4.0, and whether these beliefs would influence their attitudes toward change.

To measure the independent variable TCEdu4.0, the TCMEdu4.0 designed by Tai, Omar and Khalip (2021) was employed to guide the study. This is an empirical model derived within the Malaysian cultural and educational setting as, to a large extent, education including teaching is embedded within a culture (Krull, 2001). As stated earlier, the TCMEdu4.0 consists of six components (Tai, Omar & Khalip, 2021) (Figure 1). The first component --- *Self-management and Interactive Competency* is the awareness of teachers regarding approaches guiding their actions towards positive outcomes in teaching and learning. These include effective communication, collaboration, utilization

of emotion and stress management (Tai, Omar & Khalip, 2021). *Pedagogical Psychology and Assessment* is the second component which refers to those knowledge and skills in applying psychological knowledge in education, understanding the psychology and the psychological phenomena of learners as well as assessment skills, both formative and summative, that help teachers gather information about effective student learning (Tai, Omar & Khalip, 2021).

Functional and Research Competency is the third component of TCMEdu4.0 made up of analytical skill, critical thinking, research skill and technique. This encompasses knowledge and skills needed in gathering, analysing, synthesizing and interpreting the collected data that may bring solutions to problems in teaching and learning (Tai, Omar & Khalip, 2021). *Leading Learning and Mentoring* is the fourth component and is viewed as the ability of teachers to serve as leaders or mentors among their peers to influence instructional practices, improve student learning and shape the learning culture in schools. Teachers with this skill can provide guidance in subject curriculum, classroom instruction, procedures and best practices to help other teachers develop and reach their personal best (Tai, Omar & Khalip, 2021).

Technological and Digital Competency is the fifth component and is defined as the capability of teachers to handle data, organize and maintain data processes that meet on-going information lifecycle needs; integrate ICT into their teaching and learning efficiently; and to conduct blended learning that includes virtual or on-line classes effectively (Tai, Omar & Khalip, 2021). *Problem Solving* is the sixth component and is seen as the ability to make choices among alternatives, develop new ideas and solutions, as well as turning problems into opportunities; it enables teachers to make sense of a situation, think and plan strategically, and come up with a solution in the process of handling difficulties (Tai, Omar & Khalip, 2021).

TATC is the dependent variable of the study and is defined as the internal state that impacts teachers' positive or negative evaluative judgements toward a change carried out by a school (Tai & Omar, 2017). It encompasses three important components namely, the cognitive responses to change, the affective responses to change and the behavioural reaction to change (Figure 1). The cognitive component refers to the belief of the teacher regarding the need and the importance of change, the personal and organizational benefits that the change might bring as well as the essential knowledge for conducting effective change. The affective responses are the feelings of the teachers about the change --- they may feel comfortable, satisfactory or at ease; or unhappy, anxious and angry upon a change. The behavioural reaction to change is the subsequent action taken by teachers to support the concerned school change, for example, actively engaged in the change or go against the change by distancing themselves from the change carried out in schools (Tai & Omar, 2017).

Since the implementation of the Malaysia Education Blueprint in 2013, different school reforms or changes have been conducted by the MOE through different stages (MOE, 2016). Notwithstanding the various changes and reforms that have taken place, and to measure TATC accurately, 'change' in this study was defined as those important policies or programmes such as, i) the Secondary School Standards-based Curriculum, ii) Integrated STEM Education, iii) School-based Assessment, iv) Higher Order Thinking Skills (HOTS) and v) 21st-century Learning Skills, all of which are meant to improve student and school performance nationwide. Given that changes implemented in the classroom necessitate teachers to be at the centre of the change process, the overall TATC toward the above five policies or programmes were measured in the study.

5. Methods

5.1 Sample

The Malaysian secondary schools were the targeted locality of the present study. There are 16 states/federal territories in Malaysia with different sizes and different number of secondary schools. In order that the secondary schools in every state/federal territory have equal chance to be engaged in the study, disproportionate stratified method was applied in the sampling. The school lists were provided by the education department of each state/federal territory and five secondary schools were selected respectively and randomly from the list, giving a total of 80 schools (16 x 5) engaged in the survey. Following this, 20 teachers were identified randomly from each school and a total of 1,600 (80 x 20) teachers were chosen as respondents in the study.

5.2 Survey Instrument

To examine TCEdu4.0, the TCEdu4.0 Scale designed by Tai, Omar and Khalip (2021) was applied in the study. As noted earlier, it encompasses six components, and each component consists of five items. To measure TATC, the Teacher Attitudes toward Change Scale adapted by Tai and Omar (2017) from the Attitudes toward Change Scale developed by Dunham, Grube, Gardner, Cummings & Pierce (1989) was applied in the current study. It is made up of three components i.e., *Cognitive*, *Affective* and *Behavioural* responses to change, with each component consisting of three items.

With normed $\chi^2=4.125$, TLI=.948, CFI=.953 and RMSEA=.056, the TCEdu4.0 Scale possesses excellent goodness of fit (GOT). Similarly, the TATC Scale also demonstrates good GOT; normed $\chi^2=4.412$, TLI=.966, CFI=.977 and RMSEA=.060. The psychometric analyses of both scales provided evidence for convergent validity because the squared multiple correlations met the 0.5 threshold (Hair et al. 2010); the average extracted value are well above the cut off value of 50% (Hair, Black, Babin & Anderson, 2010); and the composite reliability indices are higher than the requirement level of 0.60 (Awang, 2012). Besides, the discriminant validity of TCEdu4.0 and TATC Scale are equally encouraging as all the average extracted values are more than 0.50 (Hair, et al., 2010). Both the scales also applied a Likert scale of six with responses ranging from “strongly disagree” to “strongly agree”.

5.3 Data Analysis

There were 1,600 sets of questionnaires posted to all the selected respondents in 80 secondary schools in Malaysia. After two months, there were 1,346 sets of questionnaires returned to the researchers. However, only 1,293 sets of questionnaires were kept for further analysis as 53 sets were with invalid responses or technical errors, giving a response rate of 80.81%. For data analysis, descriptive statistical analysis was used to acquire means and percentages. The Pearson product-moment correlation coefficients were run to examine the correlation between TCEdu4.0 and TATC and the strength of the correlation coefficient is delineated in Table 1. To measure how the components of TCEdu4.0 predict TATC, multiple regression was employed to analyse the data.

Table 1. The strength of the correlation coefficient

Coefficient (<i>r</i>) Value		The strength of Association
Positive	Negative	
00	00	No correlation
.1 to .3	-0.1 to -0.3	Weak
.3 to .5	-0.3 to -0.5	Moderate
.5 to 1.0	-0.5 to -1.0	Strong

6. Demographic Information

Among all the respondents, 71.08% (N=919) are females and 28.92% (N=374) males. Most of the respondents i.e., 38.19% (N=493) are from the 41 to 50 years age group, followed by 29.08% (N=376) from the 31 to 40 years age group, 24.67% (N=319) from the 31 to 40 years group and 8.12% (N=105) from the 21 to 30 years age group. In terms of academic qualifications, 77.18% (N=998) of the respondents hold a bachelor's degree; 18.02% (N=233) has a master's degree; 4.41% (N=57) with a diploma or certificate; and only 0.39% (N=5) has a Ph.D. degree. In terms of school location, 60.63% (N=784) of the respondents are from the rural areas, whereas 39.37% (N=509) are from the urban areas.

7. Results

The relationship between TCedu4.0 and TATC was examined by employing Pearson product-moment correlation coefficients. As demonstrated in Table 2, there was a significant and positive relationship between these two variables ($r=.689$, $N=1,293$, $p<0.01$); with high levels of perceived TCedu4.0 associated with higher levels of perceived TATC. Additionally, based on the strength of the correlation coefficient displayed in Table 1, the above relationship was found relatively strong ($r=.689$).

Table 2. Correlations

		TCedu4.0	TATC
TCedu4.0	Pearson	1	.689**
	Correlation		
	Sig. (2-tailed)		.000
	N	1293	1293
TATC	Pearson	.689**	1
	Correlation		
	Sig. (2-tailed)	.000	
	N	1293	1293

To investigate how the six components of TCedu4.0 predict TATC, multiple regression was used for the analysis of the data. Preliminary tests such as normality, linearity and homoscedasticity analyses were employed to ensure that there was no assumption violation. As shown in Table 3, five predictive variables i.e., *Self-Management and Interactive Competency* (SMI) ($\beta=.29$, $p<.05$), *Leading Learning and Mentoring* (LLM) ($\beta=.20$, $p<.05$), *Problem Solving* (PSO) ($\beta=.12$, $p<.05$), *Technological and Digital Competency* (TED) ($\beta=.10$, $p<.05$), and *Pedagogical Psychology and Assessment* (PPA) ($\beta=.09$, $p<.05$) were found significant at .05 level and were included in the model whereas *Functional and Research Competency* were shown to be insignificant and were excluded from the regression model. The combination of the above five components contributed 49.20 per cent ($r=.70$) (Table 4) of the total variation of TATC [$(5, 1,287) = 249.29$, $p<.05$] (Table 5).

Table 3. Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.654	.128		5.090	.000
	SMI	.801	.027	.639	29.828	.000
2	(Constant)	.527	.122		4.319	.000
	SMI	.486	.036	.388	13.525	.000
	LLM	.372	.030	.355	12.395	.000
3	(Constant)	.349	.124		2.806	.005
	SMI	.413	.038	.329	10.945	.000
	LLM	.252	.036	.241	6.977	.000
	PSO	.231	.040	.199	5.799	.000
4	(Constant)	.305	.124		2.451	.014
	SMI	.397	.038	.317	10.493	.000
	LLM	.205	.039	.196	5.307	.000
	PSO	.186	.042	.160	4.431	.000
	TED	.120	.036	.111	3.316	.001
5	(Constant)	.169	.133		1.270	.204
	SMI	.364	.039	.290	9.229	.000
	LLM	.206	.039	.197	5.337	.000
	PSO	.134	.046	.115	2.940	.003
	TED	.111	.036	.103	3.078	.002
	PPA	.117	.041	.091	2.845	.005

a. Dependent Variable: TATC

Table 4. Model Summary^f

R	R Square	Adjusted R Square	Std. Error of the Estimate
.639 ^a	.408	.408	.59568
.686 ^b	.471	.470	.56331
.696 ^c	.484	.483	.55632
.699 ^d	.489	.487	.55418
.701 ^e	.492	.490	.55266

a. Predictors: (Constant), SMI

b. Predictors: (Constant), SMI, LLM

c. Predictors: (Constant), SMI, LLM, PSO

d. Predictors: (Constant), SMI, LLM, PSO, TED

e. Predictors: (Constant), SMI, LLM, PSO, TED, PPA

f. Dependent Variable: TATC

Table 5. ANOVA^f

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	315.698	1	315.698	889.694	.000 ^a
	Residual	458.098	1291	.355		
	Total	773.796	1292			
2	Regression	364.450	2	182.225	574.259	.000 ^b
	Residual	409.346	1290	.317		
	Total	773.796	1292			
3	Regression	374.857	3	124.952	403.730	.000 ^c
	Residual	398.939	1289	.309		
	Total	773.796	1292			
4	Regression	378.234	4	94.559	307.895	.000 ^d
	Residual	395.562	1288	.307		
	Total	773.796	1292			
5	Regression	380.707	5	76.141	249.292	.000 ^e
	Residual	393.089	1287	.305		
	Total	773.796	1292			

- a. Predictors: (Constant), SMI
b. Predictors: (Constant), SMI, LLM
c. Predictors: (Constant), SMI, LLM, PSO
d. Predictors: (Constant), SMI, LLM, PSO, TED
e. Predictors: (Constant), SMI, LLM, PSO, TED, PPA
f. Dependent Variable: TATC

The findings of the analysis showed that *Self-Management and Interactive Competency* ($\beta=.64$, $p<.05$) (Table 3) contributed significantly at 40.80 per cent of the variance ($R^2=.408$) (Table 4) in TATC [$F(1, 1,291)=889.69$, $p<.05$] (Table 5). This implied that *Self-Management and Interactive Competency* ($\beta=.64$, $p<.05$) was the main predictor of TATC. The combination of *Self-Management and Interactive Competency* ($\beta=.39$, $p<.05$) and *Leading Learning and Mentoring* ($\beta=.36$, $p<.05$) (Table 3) contributed significantly at 47.10 per cent of the variance ($r=.69$) (Table 4) in TATC [$F(2, 1,290)=574.26$, $p<.05$] (Table 5). The combination of *Self-Management and Interactive Competency* ($\beta=.33$, $p<.05$), *Leading Learning and Mentoring* ($\beta=.24$, $p<.05$) and *Problem Solving* ($\beta=.20$, $p<.05$) (Table 3) contributed significantly at 48.40 per cent of the variance ($r=.69$) (Table 4) in TATC [$F(3, 1,289)=403.73$, $p<.05$] (Table 5). Besides, the combination of *Self-Management and Interactive Competency* ($\beta=.32$, $p<.05$), *Leading Learning and Mentoring* ($\beta=.20$, $p<.05$), *Problem Solving* ($\beta=.16$, $p<.05$) and *Technological and Digital Competency* ($\beta=.11$, $p<.05$) (Table 3) contributed significantly at 48.90 per cent of the variance ($r=.70$) (Table 4) in TATC [$F(4, 1,288)=307.90$, $p<.05$] (Table 5).

Based on the above findings, it can be summarized that except *Functional and Research Competency*, *Self-Management and Interactive Competency*, *Leading Learning and Mentoring*, *Problem Solving*, *Technological and Digital Competency*, and *Pedagogical Psychology and Assessment* of TC Edu4.0 were the five predictors of TATC in Malaysian secondary schools that contributed 49.20 per cent of the total variation of TATC (Table 4).

8. Discussion

Several important findings of the study have emerged. Firstly, the study demonstrated that there was a significant, positive and strong relationship between perceived TC Edu4.0 and TATC. This implied that teachers who believed that they were competent in TC Edu4.0 tend to yield less variability in their cognition, emotion and their action to support school change; ultimately there was a buy-in or acceptance toward school change. In other words, the higher the perceived TC Edu4.0 possessed by teachers, the greater the enhancement of TATC in the process of school change that may lead to positive

behaviours such as active commitment and engagement towards the change. This finding not only reaffirmed the competency theory of Markus, Cooper-Thomas and Allpress (2005) about the importance of acquiring new and better knowledge, skills and attitudes, it is also consistent with the planned behaviour theory of Fishbein and Ajzen (2010) that an individual's belief determines one's attitudes.

Secondly, the study also found that except *Functional and Research Competency*, *Self-Management and Interactive Competency*, *Leading Learning and Mentoring*, *Problem Solving*, *Technological and Digital Competency*, and *Pedagogical Psychology and Assessment* were the five predictors of TATC that contributed 49.20 per cent of the total variation of TATC. This implies that although many factors may impact TATC, if teachers are equipped with the above five components of TCEdu4.0, it can develop and shape TATC significantly up to 49.20 percent of the total variation. Simply put, a higher level of TCEdu4.0 enables the laying of a solid foundation for adoptive behaviours among teachers and thus greatly affects TATC --- the internal state of the teachers that impacts their positive evaluative judgements toward a change implemented by the school. Therefore, it would be logical to make the assumption that in order to raise the level of buy-in from the teachers in any school change in the era of Education 4.0, enhancing the above five components of TCEdu4.0 is an effective pathway to foster positive TATC and bring better outcomes to school change.

Among the above five components, *Self-Management and Interactive Competency* is the only human competency of TCEdu4.0; it was found as the main predictor of TATC. This implies that teachers' competence in knowing effective approaches that guide their actions towards positive outcomes in teaching and learning was critical in fostering positive TATC in the era of Education 4.0. On a positive note, this probably may affect teachers' tendency toward change and may even appreciate the change greatly at the level of *Cognitive*, *Affective* and *Behavioural*, resulting in teachers' acceptance of the change (Tai, Omar & Khalip, 2021).

This human competency of *Self-Management and Interactive Competency* may be demonstrated as: teachers being able to have effective two-way communication among colleagues in daily interaction; collaborating on solutions to classroom difficulties even across departments; and expressing their emotions wisely in facilitating thought and guiding their actions, particularly helping themselves through their emotional reaction to change. Besides, teachers equipped with such abilities are able to handle stress and hold up under pressure in realizing change goals (Tai, Omar & Khalip, 2021). Consequently, all these competencies can reduce uncertainties related to classroom or school change among teachers and even leave room for them to make positive justifications about the change. In short, effective *Self-Management and Interactive Competency* helps teachers to act intentionally rather than reactively, which contributes significantly to the development of positive TATC. As this human skill can promote positive relationships and reduce conflicts, it was found to be the main predictor of TATC.

Leading Learning and Mentoring of TCEdu4.0 was another important predictor of positive TATC in schools. Learning to be a leader or mentor requires the ability of teachers to serve among their peers effectively to improve classroom practices, enhance student learning, foster healthy learning culture in schools, promote group solidarity and morale, and ethical judgements (Tai & Omar, 2021). Specifically, teacher leaders can lead and provide guidance in instructional practices, subject curriculum, collective inquiry, daily management and help others to develop and unlock their potential. By creating such a conducive environment and the primacy of secure relationships in school community, there is a high likelihood that teachers would be discharged safely with no fear of abandonment, escalation, and humiliation (Harris, 2007). Teachers will likely engage in professional learning, interact and learn collaboratively with others, leading to positive enhancement of their TATC, expressed as the recognition of the need for change, positive feelings toward change and active actions to support change.

Problem Solving was also found to be one of the important predictors of positive TATC among teachers. TATC was enhanced when teachers believe that they were able to perform cognitive activities such as logical thinking and judgement, making sense of a situation, making choices among alternatives and identifying an effective solution in the process of change (Tai, Omar & Khalip, 2021). As teachers were competent in accurate reasoning and informed judgements, they were able to turn problems into opportunities. The ability of the teachers to facilitate positive cognitive activities by integrating their experiences and emotions is crucial in handling complex problems in schools (Tai, Omar & Khalip,

2021). Importantly, this ability is central to the settlement of disagreements and mitigation of change conflicts during the process of making decisions in problem solving among teachers; it is crucial in influencing teachers' internal state that impacts teachers' positive evaluative judgements toward a change, contributing towards positive TATC among teachers in the face of school change.

As Education 4.0 basically embraces technology, *Technological and Digital Competency* was found as another important predictor of positive TATC in schools. It has never been more important than it is in this era of Education 4.0 to re-shape teaching and learning in the classroom that parallels the accelerating global revolution in technology. With such competencies, teachers can integrate ICT into their classroom instruction effectively and to conduct blended learning that includes virtual or on-line classes efficiently especially in conveying many spatial concepts to their students (Tai, Omar & Khalip, 2021). Indeed, it is quite natural that teachers may feel vulnerable during school change if they are unable to carry out their daily instruction effectively as this *Technological and Digital* is a *sine quo non* in the era of Education 4.0. Substantial research has shown that teachers with low efficacy normally possess low motivation for teaching and learning (Thoonen, Slegers, Oort, Peetsma & Geijsel, 2011; Khorshid, 2015; Win & Min, 2020). This kind of performance deficit may distance a teacher from others, even finding difficulty in forming any positive change in his cognitive, affective responses and behavioural intention toward change. As a result, it will be difficult to get buy-in from the teacher, thus jeopardizing change outcomes.

The study also found that *Pedagogical Psychology and Assessment* as one of the five predictors of TATC in Malaysian secondary schools, is the most fundamental aspect of competence that teachers should possess in their daily teaching duties in school. Teachers who possess this competence employ different teaching pedagogy, understand educational psychology, and skilfully apply psychological knowledge in daily practices in the classrooms, as well as in both summative and formative assessment. As a result, there is effective teaching and learning that meet the students' diverse needs (Tai, Omar & Khalip, 2021). The command of such competencies would enhance their efficacy and contribute to teachers' positive cognitions, emotions and positive behavioural intention toward classroom reforms and change. Eventually, there would be less space for teachers to make negative judgements and even help facilitate the process of change willingly and foster positive TATC.

However, among the six components of TCEdu4.0, the study found that *Functional and Research Competency* was not an important predictor of TATC among teachers. One possible explanation for this finding could be that teachers at secondary schools were not competent enough in their analytical and research skills and techniques, and critical thinking; therefore, to a certain extent it did not impact TATC effectively. Ironically, this competence has direct reference to the teachers' capability of gaining insights that inspires them to acquire thinking and problem-solving skills to improve student learning effectiveness (Tai, Omar & Khalip, 2021). To meet the challenges of Education 4.0, analytical and critical thinking skills were emphasized in Malaysian secondary school-based assessments, for example, Higher Order Thinking Skills (HOTS) and school-based project work are important integral components of the present Secondary School Standards-based Curriculum (Ilhavenil, Pillay, Kim & Sudiman, 2020). As teachers are unable to help students learn the above competencies at higher levels until the teachers themselves begin performing at higher levels in this area, there is a pressing need for teachers to further enhance the *Functional and Research Competency* so that our students are trained to be critical thinkers and problem solvers and not be left behind in the FIR.

9. Implications

Theoretically, this study not only re-affirms the practicality of the competency theory (Markus, Cooper-Thomas & Allpress 2005) and the planned behavioural theory (Fishbein & Ajzen, 2010), it also provides evidence that individual factor is one of the major determinants of attitudes toward change. Teacher competency is yet another individual factor that can impact school members' attitudes towards change, among those mentioned earlier such as self-esteem, tolerance of ambiguity, locus of control, disinclination to give up old habits, cognitive dissonance, emotional intelligence and defence mechanisms. With this emphasis on examining the relationship between TCEdu4.0 and TATC, the researchers have

bridged some theoretical gaps in the literature especially in the context of Education 4.0. This evidence-based study also contributes to the field of competency management and organizational behaviours.

In terms of practice, TCEdu4.0 was found to be a significant predictor of TATC that links significantly to teachers' adoption of school change; hence it bears significant implication for the MOE, especially Institut Aminuddin Baki (IAB), the solely training centre for school leaders in Malaysia; that it is essential to rethink, revise or even re-craft some current practices in the professional development programmes for school leaders. More initiatives and effective strategies need to be adopted by IAB in this era of Education 4.0 so that they can meet the desired educational goals in enhancing TCEdu4.0 and improving TATC, and to achieve the objectives of the Blueprint. This study would benefit IAB in developing future training programmes for school leaders' in enhancing TCEdu4.0 and TATC that are so central to continuous and sustained school improvement.

Additionally, this study also provides insights into the correlation between TCEdu4.0 and TATC. These valuable insights would help school principals understand the need to equip teachers with adequate TCEdu4.0 in enhancing TATC through effective school-based training programmes or professional learning communities in schools. Specifically, it is necessary for teachers to be equipped with *Management and Interactive Competency* as it was the main predictor of TATC; comparatively this human competency brings more impact than the other four technical competencies of TCEdu4.0 in enhancing TATC. Apart from this, it is essential to pay specific attention to the *Functional and Research Competency* that was found insignificant in affecting TATC in the study as this capability correlates significantly with teachers' overall ability of thinking and problem-solving skills that would improve student learning effectiveness school wide.

10. Limitations and Future Directions for future research

Some limitations of the study deserve to be highlighted to guide future research. Firstly, to avoid egocentric biases of self-reported efficacy beliefs and to gain a multidimensional perspective, data can be collected from other change agents in schools such as school principals and senior assistants. This would help to cross-validate the findings and interpret the findings more accurately. Secondly, to capture and understand the interplay between TCEdu4.0 and TATC, a longitudinal research study that employs interviews, observations, focus group discussions and survey is essential to analyse and gain a wider perspective of the above relationship. Thirdly, it is essential to examine the assumption made in the present study pertaining to the potential reason why *Functional and Research Competency* was not an important predictor of TATC by using subsequent instruments. This initiative would ensure the concerned reasons are accurately predicted and would advance our understanding of the predicament. Fourthly, although the study demonstrated that there was a significant, positive and strong correlation between TCEdu4.0 and TATC, there is a need to identify any mediators, if any, between these two variables. Hence, the relationship needs to be examined further by investigating the mediating mechanism between TCEdu4.0 and TATC.

11. Conclusion

It is indeed a challenging task to actualize a positive change in schools in the era of Education 4.0. Teachers are the front-line change implementers; not only do they need to equip themselves with TCEdu4.0, their TATC is an indispensable prerequisite of any effective school change. The current study revealed that there was a significant, positive and strong relationship between TCEdu4.0 and TATC. This implies that teachers with adequate TCEdu4.0 can enhance their TATC greatly which would increase the possibility of the teachers' buy-in to the change. TCEdu4.0 is one crucial determinant that advances teachers to realize the change goals whereby TATC is enhanced through teacher competencies that serve different functions in effectuating the envisaged school change. In fact, instead of emphasising material development, focusing on people is a more effective pathway to lead change successfully (Tai & Omar, 2018). Therefore, purposeful initiatives that focus on enhancing TCEdu4.0 among teachers can help the MOE and school principals in creating ways to influence and harness positive TATC in the era of Education 4.0. In summary, the study offers one small step in

school improvement that successful and sustainable school change is correlated closely to the individual factors that drive school change effectively and continuously.

12. Co-authors' contributions

The first co-author provided substantial contribution to the design and conceptual framework of the study as well as revising it critically for the intellectual content; the second and the third co-authors were responsible for the data collection and analysis.

13. Acknowledgement

This work was supported by the Fundamental Research Grant Scheme (Code: 1/2019/SSI09/UPSI/02/4), Ministry of Higher Education Malaysia.

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