Effects of Attitude, Self-efficacy Beliefs, and Motivation on Behavioural Intention in Teaching Science*

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A R T I C L E   I N F O

A B S T R A C T

Purpose: Teacher's behavioural intention in teaching science is one of the key determinants of students' learning outcomes. Thus, it is crucial to study which affective domains are contributed to teacher's behavioural intentions in teaching science. The present study aims to investigate the mediating effect of the dimensions of attitudes toward teaching science (i.e., cognitive beliefs, affective states, and perceived control) in the relationship between teacher self-efficacy beliefs and teaching motivation on behavioural intention in teaching science. **Method:** A quantitative research design was employed upon 127 pre-service science teachers in Malaysia and the PLS-SEM approaches were used for data analysis. The questionnaire in this research was adapted from 'Science Teaching Efficacy Belief Instrument-Form B' (STEBI-B), 'Work Tasks Motivation Scale for Teachers' (WTMST), 'Dimensions of Attitude towards Science' (DAS) and 'Behavioural Intention Scale'. **Findings:** The data analysis indicated affective states toward teaching science showed a substantial mediating effect in the relationship between teacher self-efficacy beliefs and teaching motivation on behavioural intention in teaching science. Besides, teaching motivation and affective states toward teaching science also showed a significant effect on behavioural intention in teaching science. Teacher self-efficacy beliefs and teaching motivation showed significant effect on two of the dimensions of attitudes toward teaching science (i.e., affective states and perceived control). **Implications for Research and Practice**: These empirical pieces of evidences provide insights for the education policymakers to formulate a teaching curriculum that focuses more on the development of affective domains specialised in Malaysian teacher education institutions.

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Introduction

The teaching profession is considered to be a highly stressful profession. A teacher's workload varies from teaching-related (class preparation and classroom management) to non-teaching-related (administration and meetings). Moreover, with the trends imposed by Science, technology, engineering, and mathematics (STEM) education, the national science curriculum has been revised to accommodate the philosophy of STEM with open educational resources and globally connected education. With the invention of the smartphone and its accessibility has become ubiquitous, students have more freedom to pursue their knowledge which is far beyond the level of their schooling age. Teachers should continuously explore new teaching approaches and consistently upgrade their knowledge ahead of the textbook syllabus. Consequently, there is an increase in concern and stress among science teachers in teaching students of 21st-century as they are least attracted to conventional ways of teaching. Without a positive mindset, teachers are vulnerable to job burnout, especially after a prolonged teaching service period. They may experience emotional exhaustion and feelings of ineffectiveness. After an extended time, it may lead to a detrimental effect on mental health. Although this affects teachers' psychological well-being, the teacher education curriculum only focuses on developing pre-service teachers' knowledge content and pedagogical skills. Inadequate attention was given to the development of affective domains throughout the teacher training courses.

In Malaysia specifically, teachers are experiencing physical and mentally drain after long periods of teaching service and mundane routine year in and year out (Subon & Sigie, 2016). To strengthen the quality of STEM education, many courses related to high-level thinking skills were introduced to teachers during teacher training and service. Meanwhile, in the United States, Lee (2019) highlighted negative emotion is one of the key determinants that impacted teachers' well-being and intention to leave the teaching profession. Particularly, novice teachers seem to be more vulnerable to work stress than experienced teachers (Harmsen, Helms-Lorenz, Maulana, & van Veen, 2018). This matter should not be overlooked because teachers' behaviour and their intention to teach are among the key determinants in affecting student's motivation and learning outcomes (Blazar & Kraft, 2016; Hein, 2012; Hornstra, Mansfield, van der Veen, Peetsma, & Volman,2015; Sedova & Salamounova, 2016; Ulug, Ozden, & Eryilmaz 2011). In fact, many previous studies related to teacher professional development emphasized more on the importance of studying pre-service teachers' behavioural intention in various field of research education, such as internet-based learning (Chien, Kao, Yeh, & Lin, 2012), mathematics instruction (Oh, 2003), educational technology (Lee, Cerreto, & Lee, 2010) and others. However, the study of pre-service teachers' behavioural intention in the field of science teaching is still scarce to date. By looking into these issues, there is an urgent need for researchers, educators and policymakers to pay explicit attention in identifying which affective domains will have a significant effect on teachers' behavioural intention in teaching science, and this should take place during pre-service years. Attention should be given towards pre-service teachers as once their teaching behaviour has formed; it is difficult

to change their beliefs and attitudes (Bandura, 1994; Caprara, Barbaranelli, Steca, & Malone, 2006; Hoy & Spero, 2005; Senler, 2016; Türer & Kunt, 2015).

Affective domain is the key determinant being studied in this research which estimates to influence pre-service teachers' behavioural intention in teaching science. According to Krathwohl, Bloom, & Masia (1973), the affective domain involves feelings, beliefs, values, appreciation, motivation and attitudes. The studying of the affective domain in teacher education is recommended by science education investigators as early as Woodford (1979), in which he critiqued undergraduate curricula placed great attention on cognitive and psychomotor development amongst pre-service teachers. However, little concern was given to acknowledge the interrelations between the affective domains. Amongst all the affective domains suggested by (Krathwohl et al., 1973), beliefs (Azar, 2010; Bandura, 1994; Gencer & Cakiroglu, 2007; Senler & Sungur, 2010), motivation (Oredein & Awodun, 2013; Van Droogenbroeck, Spruyt, & Vanroelen, 2014) and attitudes (Ahsan, 2015; Korur, Rocio, & Noemi, 2016); Van Aalderen-Smeets & Van Der Molen, 2015) are the most extensively studied affective domains which showed significant effects on human behaviour.

Many previous studies had confirmed the significant effect of teacher self-efficacy beliefs toward teaching behaviour in the classroom. When teachers have higher self-efficacy beliefs, they strongly believe students' achievement is influenced by skillful instruction. Also, they have the confidence in their capability to affect students' science achievement (Coladarci, 1992; Gencer & Cakiroglu, 2007). This is because teachers with higher self-efficacy beliefs tend to adopt a constructivist approach, whereas those with lower self-efficacy beliefs prefer to use a traditional teacher-centred approach (Temiz & Topcu, 2013). Apart from that, previous research on primary school teachers showed those who possessed low efficacy beliefs appeared to struggle with effective teaching as they placed heavy reliance on teaching kits rather than their intervention (Haney, Lumpe, Czerniak, & Egan, 2002). Hence, we expect that teacher self-efficacy beliefs are positively related to teaching behaviour. Although many studies had been conducted related to teacher self-efficacy beliefs, nonetheless, most of the previous studies focused on univariate or bivariate analysis. The multivariate interrelation between teacher self-efficacy beliefs and other affective domains using the Structural Equation Modelling (SEM) approach has not been researched extensively.

Apart from the concept of self-efficacy, Bandura (1977) also mentioned motivation as one of the primarily concerned affective domains, which is related to the activation and persistence of human behaviour. According to Bandura (1977, 1994), the way a person performs or behaves in a given situation is more likely depending on his or her attitudes that are attributed to cognitive and the emotional domain, such as motivation. The research on teaching motivation is crucial as it affects teachers' behaviour in the classroom and indirectly, promotes students' learning outcomes (Bernaus, Wilson, and Gardner, 2009). Furthermore, Oredein and Awodun (2013) discovered students with low academic performances are mostly affected by the teachers who have poor teaching motivation. Other than related to teachers' behaviour in the classroom, teaching motivation was correlated with their attitude as well (Chien

et al., 2012). Therefore, we expect teaching motivation is related to teachers' behaviour and their attitudes at the same time. Nonetheless, research concerning the relationship between teaching motivation and the sub-dimensions of attitude towards teaching science in higher-order model is scarce, as most studies focus on studying attitude as a unitary construct (Bjekić, Vučetić, & Zlatić, 2014; Chien et al., 2012; Perlman, 2013).

According to Fishbein and Ajzen's Theory of Reasoned Action (TRA), attitude is one of the antecedents of behavioural intention and is capable of predicting human behaviour. Previous studies have revealed that teachers who feel positive emotions during teaching share several common characteristics concerning higher self-efficacy beliefs, thus more likely will apply different teaching strategies (Santisi, Magnano, Hichy, & Ramaci, 2014) and have shown higher concern in science curriculum (Haney et al., 2002). Similarly, Korur et al. (2016) highlighted that elementary school teachers in Turkey and Spain who showed positive attitudes toward science teaching are more likely to encourage their students to develop positive attitudes toward science learning. In contrast, the elementary school teachers who showed negative attitudes toward teaching science spend less time in teaching science topics and emphasised more on expository teaching approach. Thus, they are unable to stimulate a positive learning attitude among their students (Harlen & Holroyd, 1997; Jarvis & Pell, 2004; Van Aalderen-Smeets & Van Der Molen, 2015). Based on Kidwell and Jewell (2010) on research exploring the moderating effect of one of the sub-dimensions of attitudes toward teaching (perceived control), they discovered that perceptions of control could change one's motivation to engage in deliberate or non-deliberate processing when forming a behaviour. Our research attempts to address the limitation of Kidwell and Jewell's (2010) research by studying all three sub-dimensions of attitudes toward teaching science. Consistent with previous studies, we expect that attitudes are the mediator in the relationship between teaching motivation and behavioural intention in teaching science.

Hence, the objective of this research is to explore the mediating effect of sub-dimensions of attitudes towards teaching science in the relation between teacher self-efficacy beliefs and teaching motivation on behavioural intention in teaching science using partial least square-structural equation modelling (PLS-SEM) approach.

Behavioural Intention in Teaching Science

Since the 1960s, social psychological studies went through a difficult time, research explaining human behaviour is not an easy task at the time because of the attitude-behaviour inconsistency. The prevailing assumption was that attitude and behaviour were strongly related in which behaviour is determined by attitude. Nonetheless, many previous studies consistently show a weak relationship between attitude and behaviour (Armitage & Christian, 2003; Fazio, 1986; Fazio, Powell, & Williams, 1989). In 1975, Fishbein and Ajzen discovered there was a mediator that connects both constructs. They proposed it was the behavioural intention to perform rather than the attitude towards behaviour that determined human behaviour. Hence, this concept was later explained in the TRA (Fishbein & Ajzen, 1975). Most theories shared a belief

that the best predictor of an individual's behaviour simply depended on his or her intention to engage in the behaviour. As postulated in the TRA, higher intentions are more likely to lead to an expression of behaviour (Fishbein & Ajzen, 1975). Therefore, in the context of this study, researchers focused on studying behavioural intention in teaching science (BIITS). It is referred to the pre-service teachers' willingness to plan and perform teaching tasks related to science subjects.

Ajzen (1991) postulated three independent determinants of behavioural intention in the Theory of Planned Behaviour (TPB), namely attitudes towards the behaviour, subjective norms and perceived behavioural control. The first construct, which is the attitudes toward the behaviour, refers to the expression of favour evaluation towards performing specific behaviour concerning an object or target. Similarly, Ajzen (2002) postulated attitudes are formed based on a series of beliefs and result in a value being placed on the outcome of the behaviour. Although all three constructs (attitudes towards the behaviour, social norms and perceived behavioural control) are significant predictors of behavioural intention, attitudes toward the behaviour had twice the influence of subjective norms and three times that of perceived behavioural control (Lee et al., 2010). In accordance with the conclusion made by Lee et al. (2010), researchers had decided to pay more explicit attention to studying attitudes toward behaviour as the predictor of behavioural intention in teaching science.
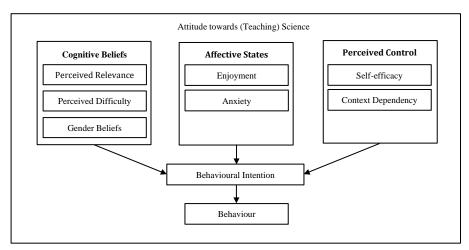
To explore the mediating effect of attitudes towards teaching science in the relationship between teacher self-efficacy beliefs and teaching motivation on behavioural intention in teaching science, current research has adopted the PLS-SEM approach. The structural model proposed in current research is an extension of Van Aalderen-Smeets, Walma Van Der Molen and Asma's (2012) Attitude towards (Teaching) Science Model (Figure 1). According to Van Aalderen-Smeets et al. (2012), attitude towards teaching science (ATTS) has three sub-dimensions, namely cognitive beliefs (CBTS), affective states (ASTS) and perceived control (PCTS) which predict behavioural intention in teaching science. The dimensions of cognitive and affective are well established within the Tripartite Model of Attitude (Eagly & Chaiken, 1993) and supported by Ajzen's (1991) TPB. In the TPB, cognitive and affective components of attitudes partly determine behavioural intention, which is the antecedent of behaviour. Thus, behavioural intention is viewed as a direct outcome of these three sub-dimensions of attitude and not as a component of the attitude itself. Perceived control is focused on people's internal beliefs and feelings of being in control to execute certain behaviour. Self-efficacy component in perceived control does not include the concept of outcome expectancy. Therefore, this sub-component measured slightly different degrees as compared to the teacher self-efficacy beliefs construct. Attitude is not a single unitary concept; conversely, it is composed of three sub-dimensions. The separate evaluations of each of these dimensions contribute in varying degrees toward the overall attitude toward the object (Ajzen, 2001). Therefore, this implies that measuring a pre-service teacher's attitude towards teaching science should involve various dimensions of attitude towards that specific subject and not a single construct.

Attitudes towards Teaching Science

Attitude is a frequently studied affective domain in the field of psychology and social science for research associated with students or teacher education. According to Van Aalderen-Smeets et al. (2012), many initiatives had focused on enhancing students' scientific literacy and learning attitudes through allocating more time in science lessons. Some of these initiatives seem to have been effective regarding students' enjoyment in science projects; however, it causes emotional exhaustion among teachers due to prolonged teaching hours and excessive workload. The causes of this problem are that teachers are inadequately trained to teach science (Van Aalderen-Smeets et al. 2012) and these teachers generally tend to have negative attitudes toward science.

From the Attitude towards (Teaching) Model (refer to Figure 1) proposed by Van Aalderen-Smeets et al. (2012), behavioural intention was predicted by three sub-dimensions of attitude (cognitive beliefs, affective states and perceived control). The sub-dimension cognitive beliefs are explained by three components (perceived relevance, perceived difficulty and gender beliefs). 'Perceived relevance' is referring to the degree to which pre-service teachers find it important to teach science subjects in the school. 'Perceived difficulty' refers to the pre-service teachers' perception of the difficulty of teaching science in general as compared to other subjects in the classroom; however, this does not reflect on their capability in teaching science. 'Gender beliefs' is referring to the pre-service teachers' beliefs whether there is any difference in the interest and enjoyment during science teaching between male and female teachers.

Another sub-dimension is affective states which are explained by two components (enjoyment and anxiety). 'Enjoyment' is related to one's positive feelings and satisfaction in teaching science, whereas 'Anxiety' is related to the negative emotional effects. The last sub-dimension is perceived control which is explained by two components (self-efficacy and context dependency). 'Self-efficacy' is related to teachers' capability to teach science and their self-confidence in dealing with science teaching obstructions. 'Context dependency' is the extent to which the teacher found it essential to depend on certain context factors (e.g., the available of teaching aids) when teaching. Current research is based on the contention that, since attitude is one of the antecedents of behavioural intention and is capable of predicting human behaviour, researchers and policymaker must understand which dimension of attitudes (cognitive beliefs towards teaching science, affective states towards teaching science or perceived control towards teaching science) is strongly associated to behavioural intention in teaching science. This allows the teacher education curriculum to focus more on developing pre-service teachers' readiness, persistence, and endurance in teaching.

Source: Van Aalderen-Smeets et al. (2012)

Figure 1. *Attitude towards (Teaching) Science Model*

Teacher Self-Efficacy Beliefs

According to Pajares (1992), many researchers focused on defining self-efficacy beliefs rather than exploring their possible interrelations with other affective domains; hence, there is insufficient empirical evidence that shows the significant interrelations among these constructs. In the proposed structural model (Figure 3), researchers intend to study the relationship between teacher self-efficacy beliefs (TSEB) and behavioural intention in teaching science. It is based on Bandura's Theory of Self-Efficacy Beliefs. As postulated by Bandura (1977, p. 191), "personal efficacy determines whether coping behaviour will be initiated, how much effort will be expended, and how long it will be sustained in the face of obstacles and aversive experiences". This implies that self-efficacy belief is associated with behaviour and there is a clear linkage between these two constructs (Andersen, Dragsted, Evans, & Sørensen, 2004; Arigbabu & Oludipe, 2010; Azar, 2010; Gencer & Cakiroglu, 2007; Senler & Sungur, 2010). However, the quantitative analysis, which focuses on studying the relationship between teacher self-efficacy beliefs and behavioural intention in teaching science, is still scarce. Furthermore, little prior knowledge was found in the relationship between teacher self-efficacy beliefs and the three dimensions of attitudes towards teaching science. Therefore, researchers intend to bridge this research gap by exploring the possible relationships between the affective domains through expanding Van Aalderen-Smeets' et al. (2012) Attitude (toward) Teaching Model and adding teacher self-efficacy beliefs into the structural model.

According to Enochs and Riggs (1990), teacher's beliefs are crucial in science teaching because it explains teachers' thought patterns, affective reactions and their behaviour in the classroom. According to Bandura (1977), self-efficacy beliefs are primarily influenced by two dimensions (personal self-efficacy and outcome

expectancy). When these dimensions are applied to the area of science teaching, it is known as 'personal science teaching efficacy' (PSTE) and 'science teaching outcome expectancy' (STOE). Teachers with a high level of PSTE will invest more effort in teaching and persist longer in overcoming obstacles. Meanwhile, the teacher with high science teaching outcome expectancy is more likely to expect their teaching strategies will positively affect students' learning outcome. According to Enochs and Riggs (1990), the construct validity was determined by factor analysis and the result had shown that the two dimensions of TSEB were modestly correlated ($r = .46$) when the oblique rotation technique was used. In collinearity assessment for first-order construct using PLS-SEM approach, the (Variance Inflation Factor) VIF value was reported being 5.12 (*VIF* > 5). Hence, this indicates multicollinearity between PSTE and STOE and therefore, the two dimensions of PSTE and STOE were merging into a single construct (i.e., TSEB) in the proposed structural model (refer to Figure 3).

Teaching Motivation

From the review of teacher motivation research, although Social Cognitive Theory (Bandura, 1977) and Self-Determination Theory (Ryan & Deci, 2000) was extensively studied in the past decades; the unilateral direct causal effect could not provide a holistic picture in viewing the relationships between related constructs associated to motivation. Besides, the argument between considering motivation as an independent variable to predict behavioural intention has never ceased (Han, Yin, & Boylan, 2016). Therefore, this has sparked the interest for researchers to study the relationship between teaching motivation (TM) with attitudes towards teaching science and behavioural intention in teaching science. According to Lai (2001), motivation involves beliefs, perceptions, values, interests, and actions that are all closely related. Motivation also shows through relative effort towards an event, their persistence towards a given task and verbalisations related to potential task accomplishment. Apart from self-efficacy, Bandura (1977) also mentioned motivation in which it is primarily concerned with the activation and persistence of behaviour. Hence, the way a person performs or behaves in a given situation is more likely depending on his or her attitudes that are attributed to cognitive and the emotional domain, such as motivation (Bandura, 1977, 1994). Based on this theoretical elaboration, researchers developed a structural model to measure the relationship between teaching motivation and the underlying dimensions of pre-service teachers' attitudes towards teaching science.

According to Ryan and Deci (2000), Self-Determination Theory posited teacher's motivation characterised by different levels of self-determination. Intrinsic motivation (IM) involves a person's need to feel in control of his or her action by having the ability to make conscious choices and decisions in a particular situation. Introjected regulation (INR) includes self-esteem, which pressurises an individual to behave in a certain manner so he or she can feel worthy of committing it. In Identified regulation (IDR), an individual feels greater freedom as he or she performs an action that is congruent with the personal goals (Gagné & Deci, 2005). Amotivation (AM) refers to

being neither intrinsically or extrinsically motivated. In a research conducted by Grolnick and Ryan (1987), they discovered that when assessing teaching motivation, the types of regulation adhere to a quasi-simplex pattern, in which each subscale correlated most positively with the subscales closest to it. The subscales can be used individually to predict outcomes. In collinearity assessment using PLS-SEM, the VIF value was reported being 5.36 (*VIF* > 5), with the condition where all data for Amotivation have been reversed coded. Hence, all dimensions for teaching motivation were merging into a single construct (i.e., TM) in the proposed structural model. Therefore, to bridge the research gap, current research has proposed a conceptual framework (refer to Figure 2) to investigate the mediating effect of underlying dimensions of attitudes towards teaching science, in the relation between teacher self-ef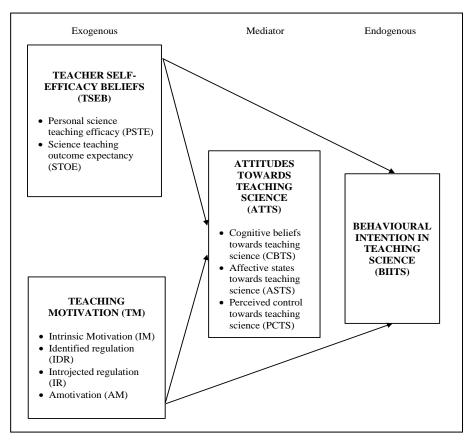ficacy beliefs and behavioural intention in teaching science, as well as between teaching motivation and behavioural intention in teaching science.

Figure 2. *Proposed Conceptual Framework*

In the proposed structural model for current research, the exogenous constructs consisted of TSEB and TM which predicted BIITS. The mediator consisted of the three sub-dimensions of ATTS, namely CBTS, ASTS and PCTS, whereas the endogenous construct is BIITS. From the literature reviewed, it can be concluded that teacher self-efficacy beliefs are positively related to attitudes towards teaching and behaviour. Teaching motivation is positively related to attitudes and behaviour (see Figure 3 for the proposed structural model). However, it remains inconclusive which specific sub-dimensions of attitudes towards teaching science (i.e., cognitive beliefs towards teaching science, affective states towards teaching science and perceived control towards teaching science) shows substantial mediating effect in the relationship between teacher self-efficacy beliefs and behavioural intention in teaching science, as well as between teaching motivation and behavioural intention in teaching science.

Figure 3. *Proposed Structural Model*

Note: TSEB=Teacher Self-Efficacy Beliefs; TM=Teaching Motivation; CBTS=Cognitive Beliefs towards Teaching Science; the ASTS=Affective States towards Teaching Science; PCTS=Perceived Control towards Teaching Science; BIITS=Behavioural Intention in Teaching Science

There are three research questions guiding this study:

1. Is there a mediating effect for the three sub-dimensions of attitudes towards teaching science in the relationship between teacher self-efficacy beliefs and teaching motivation on behavioural intention in teaching science amongst pre-service teachers?

2. Is there a positive and significant effect of teacher self-efficacy beliefs and teaching motivation on the three sub-dimensions of attitudes towards teaching science amongst pre-service teachers?

3. Is there a positive and significant effect of teacher self-efficacy beliefs, teaching motivation, and the sub-dimensions of attitudes towards teaching science on behavioural intention in teaching science amongst pre-service teachers?

Method

Research Design

Current research has aimed to propose a structural model to investigate the mediating effect of underlying dimensions of attitudes towards teaching science in the relation between teacher self-efficacy beliefs and behavioural intention in teaching science, as well as between teaching mot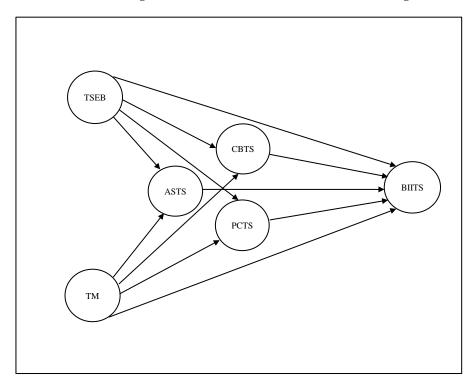ivation and behavioural intention in teaching science. Therefore, this research adopted a quantitative research method with a cross-sectional survey approach. In this study, the PLS-SEM approach was employed to assess the reliability and validity of the research instrument, as well as to assess the proposed structural model.

Research Sample

The research sample consisted of 127 pre-service teachers aged 22 to 23 years old who enrolled in the Bachelor of Education in Science program for three different government-funded universities in Malaysia (see Table 1). The Ministry of Higher Education (MOHE) classified all 20 government-funded universities into three clusters, namely research universities, focused universities and comprehensive universities. The sample respondents involved in this research were selected based on two stages: stage one, purposive sampling technique; and stage two, random cluster sampling technique. The first stage was to exclude those government-funded universities which did not offer teacher education programs. This was to ensure the research sample mainly consisted of pre-service science teachers only. In stage two, a random cluster sampling technique allowed researchers to select pre-service teachers from different clusters of universities. Thus, all universities had the same probability of being chosen during the sampling process. Although the small sample size is the most abused argument with some researchers' critique it will fail to detect a hypothesized path (Goodhue, Lewis, & Thompson, 2012; Marcoulides & Saunders, 2006; Reinartz, Haenlein, & Henseler, 2009), the overall complexity of the structural

model has little influence on the sample size requirement for PLS-SEM (Hair, Hult, Ringle, & Sarstedt, 2017). The reason is the algorithm does not compute all relationships in the structural model at the same time. Instead, it uses OLS regressions to estimate the model's partial regression relationship (Hair et al., 2017). Furthermore, the small sample size is not an issue for research adopting the PLS-SEM approach due to the bootstrapping procedure during path model estimation. Bootstrapping is a resampling approach that draws random samples 5,000 times from the data and uses these samples to estimate the path model multiple times under slightly changed data constellations (Hair et al., 2017).

Table 1

Distribution of Sample Respondent according to Cluster of University (n = 127)

Cluster of University	University	*n*
Research universities	University X	38
Focused universities	University Y	34
Comprehensive universities	University Z	55
	Total	127

The sample size was determined based on a 10 times rule recommended by Hair et al. (2017) and also estimated using the G*Power calculator. According to Hair et al. (2017), the minimum sample size should be 10 times the minimum arrowheads pointing at a latent variable in the path model. According to the measurement model shown in Figure 4, there were seven arrowheads pointing to BIITS. Therefore, the minimum number of samples required for current research was 70. The number of arrowheads was determined based on a first-ordered measurement model (Figure 4) instead of the proposed structural model (Figure 3) as it was used in validating research instrumentation. Appendix A illustrates the minimum number of samples estimated (*n* = 103) using the G*Power calculator. Thus, after the two stages of sampling, 127 sample respondents were selected to participate in the survey. The number of sample respondents exceeds the minimum sample size estimated by the G*Power calculator and the 10 times rule. As for determining the effect size, literature has suggested that exogenous latent construct with effect size 0.35, 0.15, and 0.02 indicates 'large', 'medium', and 'small' effect (Cohen, 1988; Cohen, Manion, & Morrison, 2011; Hair et al. 2017).

Research Instruments and Procedures

Research instruments consisted of Teacher Self-Efficacy Beliefs (TSEB) Instrument, Teaching Motivation (TM) Instrument, Attitudes towards Teaching Science (ATTS) Instrument, and Behavioural Intention in Teaching Science (BIITS) Instrument. Modification was made to change the scale into 11-point semantic differential scales ranging from 'Strongly Disagree' (score 0) to 'Strongly Agree' (score 10) for data analysis using the PLS-SEM approach. Besides, the questionnaire was also translated into the national language of Malaysia through back-to-back translation and pre-testing was carried out to reduce measurement error and to avoid faulty translation.

Teacher Self-Efficacy Beliefs (TSEB) Instrument

The TSEB Instrument was adapted from Enochs and Riggs' (1990) 'Science Teaching Efficacy Belief Instrument – Form B' (STEBI-B) to measure two dimensions of teacher self-efficacy beliefs (TSEB), which are 'Personal Science Teaching Efficacy' (PSTE) and 'Science Teaching Outcome Expectancy' (STOE). This instrument was initially developed based on Social Learning Theory (Bandura, 1971) to measure the teaching efficacy belief amongst pre-service teachers. It consisted of five items related to 'Personal Science Teaching Efficacy Belief' (PSTE) and six items on 'Science Teaching Outcome Expectancy' (STOE). The composite reliability and AVE value were reported being .90 and .50, respectively. For discriminant validity, the HTMT values fell under the maximum threshold value of .85 (Chan & Lay, 2018).

Teaching Motivation (TM) Instrument

The TM Instrument was adapted from Fernet, Senécal, Guay, Mars and Dowson's (2008) 'Work Tasks Motivation Scale for Teachers' (WTMST) to measure four dimensions of teaching motivation (TM), which are 'Intrinsic Motivation' (IM), 'Identified Regulation' (IDR), 'Introjected Regulation' (INR) and 'Amotivation' (AM). This instrument was developed based on Self-Determination Theory (Ryan & Deci, 2000). According to Fernet et al. (2008), WTMST was designed to be versatile in which researchers can adopt the items for particular work tasks that are relevant to the research questions. Among six work tasks suggested in WTMST, TM Instrument only adapted the items associated with teaching tasks. Thus, only 15 items measuring teaching motivation were adapted from the overall 90 items. Each dimension of teaching motivation was reflected by three items. However, only 11 items were included in the questionnaire for the actual research due to four of the items showing poor outer loading values (i.e., lower than .40). According to Hair et al. (2017), items with outer loading less than .40 in a measurement model have to be eliminated as they failed to measure the construct. Based on the reliability and validity analysis performed by Chan and Lay (2018), the AVE value for TM is .65, which is above the threshold value of .50. Another analysis that is the Fornell-Larcker Criterion for TM is reported being .81 for the square root of its AVE.

Attitudes towards Teaching Science (ATTS) Instrument

As for ATTS Instrument, it was adapted from Van Der Molen and Van Aalderen Smeets' (2013) 'Dimensions of Attitude towards Science' (DAS) instrument to measure the three sub-dimensions of attitudes towards teaching science (ATTS) which includes 'Cognitive Beliefs towards Teaching Science' (CBTS), 'Affective States towards Teaching Science' (ASTS), and 'Perceived Control towards Teaching Science' (PCTS). This instrument is a valid and reliable instrument formulated to measure teachers' attitudes toward teaching science (Van Aalderen-Smeets & Van Der Molen, 2013). All items in the ATTS Instrument were developed based on a new theoretical framework that describes different dimensions of a teacher's professional attitude in education. This new theoretical framework proposed by Van Aalderen-Smeets and Van Der Molen (2013) consists of three dimensions (Cognition, Affect, and Perceived Control)

with seven sub-components that represent cognitive beliefs and their emotions towards science teaching. The ATTS instrument consisted of 25 items, with seven subscales, namely 'Relevance of Teaching Science' (R), 'Difficulty of Teaching Science' (D), 'Gender Stereotypical Beliefs regarding Teaching Science' (G), 'Enjoyment in Teaching Science' (E), 'Anxiety in Teaching Science' (A), 'Self-Efficacy' (S) and 'Perceived Dependency on Context Factors' (C). The composite reliability is reported being .84, whereas Cronbach's alpha is .89. The AVE value for this instrument is .65, which is above the minimum requirement of .50. Fornell-Larcker Criterion showed .73, whereas the HTMT also indicated high discriminant validity (Chan & Lay, 2018).

Behavioural Intention in Teaching Science (BIITS) Instrument

The BIITS Instrument was adapted from Van Aalderen-Smeets and Van Der Molen's (2013) Behavioural Intention Scale. It consists of five items that were developed to predict pre-service teachers' behaviour in teaching science (Van Aalderen-Smeets & Van Der Molen, 2013). Chan and Lay (2018) reported the composite reliability for the BIITS instrument is .84, with an AVE value (.65) which is above the threshold value of .50. Moreover, the Fornell-Larker criterion showed .73, while the HTMT for the instrument indicated high discriminant validity.

Research Procedures

Before data collection, formal approvals were obtained from the Educational Planning and Research Division, Ministry of Education Malaysia on 6th February 2018 (refer to Appendix C). A letter of application for the survey was submitted to all selected universities. During the survey, each respondent was given a set of questionnaires written in the English language and Malaysia national's language. Respondents were reminded not to write their names on the questionnaire for confidentiality purposes. Respondents were also pre-informed about the purpose of this research and how the questionnaire should be responded to. They were asked to indicate their level of agreement and disagreement for each statement in the questionnaire by circling the number of scale ranges from zero to 10. Current research instrumentation was adapted and modified from pre-developed instruments. The adapted instrument was modified into 11-point semantic differential scales range from 'Strongly Disagree' (score 0) to 'Strongly Agree' (score 10). For items in the Behavioural Intention Scale, respondents were required to indicate their perceived intention to engage in science-related activities on a modified 11-point semantic differential scale range from 'Unlikely' (score 0) to 'Likely' (score 10).

The purpose of scale modification is due to the five-point Likert scales in the original questionnaire are ordinal scaled data. Based on Hair et al. (2017), the PLS-SEM algorithm generally requires metric data on a ratio or interval scale for the measurement model indicators. Therefore, researchers adopted the 11-point semantic differential scale. The semantic differential scale is widely used in many areas of behavioural science in measuring human attitudes due to the advantage of having a perception of equal psychometric distance between the scale points (Cummins & Gullone, 2000; Hughes, 1967; Junge & Reisenzein, 2016; Landon, 1971; Maguire, 1973;

McCallon & Brown, 1971; McCroskey & Brown, 2012; Mehling, 2017; Oulo, 2017). When it comes to popularity, Leung (2011) suggested that an 11-point semantic differential scale with a 0-to-10 range has higher preferences as it is easily comprehended by adult respondents and increases scale sensitivity.

Data Analysis

All data collected were analysed using IBM Statistical Package for Social Science (SPSS) Data Editor 22.0 software and SmartPLS 3.3.3 software. Before data analysis, the empirical data were collected and screened thoroughly for missing values, suspicious response patterns, outliers and data distribution. During data screening, eight data entries was removed from the analysis due to missing values and incomplete questionnaires. Thus, the final data entries were reduced to 127 samples. The reliability and validity of research instruments were examined using the PLS-SEM approach based on three important criteria: internal consistency reliability, convergent validity and discriminant validity. The internal consistency reliability for each subscale was determined through composite reliability (CR) and Cronbach's alpha (CA) coefficient, whereas Average Variance Extracted (AVE) is crucial to examine the convergent validity of the research instruments. According to Hair et al. (2017), the traditional criterion for internal consistency is CA. However, due to CA assuming all indicators have equal outer loadings on the construct, it is more appropriate to apply CR. The CR takes into account the different outer loadings of the indicator variables. Thus, in current research, both CR and CA were being reported. Also, the Heterotrait-Monotrait ratio (HTMT) was measured to evaluate each item's discriminant validity in the instruments. PLS-SEM is the preferred method because current research is exploratory research where theory is less developed, and the primary objective of this study is to propose a structural model for predicting a target construct. Besides, PLS-SEM mainly functions to develop a theory or new model, whereas CB-SEM (covariance-based SEM) is used in theory confirmation (Hair et al., 2017).

Once the measurement model for the research instrument was validated and all criteria were fulfilled, the assessment was continued with measuring the interrelations between the latent constructs of the proposed structural model. The assessment of the structural model included assessment for collinearity issues, assessment for the significance and relevance of the structural model relationships, assessment of the level of R^2, assessment of the f^2 effect size, assessment of the predictive relevance Q^2 and assessment of the q^2 effect size and assessment of the mediating effect.

Validity and Reliability

All research instruments were validated based on the first-ordered measurement model illustrated in Figure 4. The measurement model was used to evaluate the hypotheses in which TSEB could be explained by two sub-dimensions (i.e., PSTE and STOE); TM could be explained by four sub-dimensions (i.e., IM, IDR, INR, and AM); ATTS was explained by seven sub-dimensions (i.e., ATTS_R, ATTS_D, ATTS_G, ATTS_E, ATTS_A, ATTS_S, and ATTS_C); and BIITS was a unidimensional construct. One of the sub-dimensions of TM (i.e., ER) was removed from the measurement model

as all three items measuring the construct showed poor outer loading values, thus as a limitation, researchers excluded external regulation (e.g., tangible reward) as one of the determinants which might influence pre-service teachers' attitude in teaching science and their behavioural intention in teaching science.
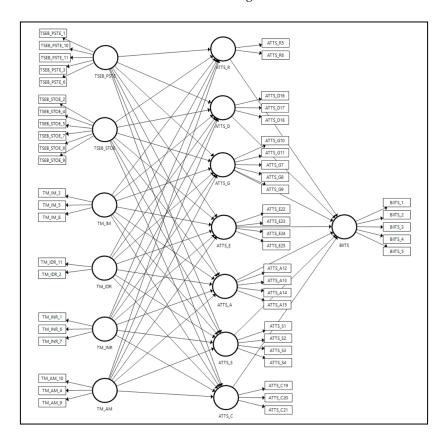

Figure 4. *First-ordered Measurement Model*

Note: ATTS_A=Attitudes towards Teaching Science_Anxiety in Teaching Science, ATTS_C=Attitudes towards Teaching Science_Perceived Dependency on Context Factors, ATTS_D=Atttudes towards Teaching Science_Difficulty of Teaching Science, ATTS_E=Attitudes towards Teaching Science_Enjoyment in Teaching Science, ATTS_G=Attitude towards Teaching Science_Gender Stereotypical Beliefs regarding Teaching Science, ATTS_R=Attitudes towards Teaching Science_Relevance of Teaching Science, ATTS_S=Attitudes towards Teaching Science_Self-efficacy, BIITS=Behavioural Intention in Teaching Science, TM_AM=Teaching Motivation_Amotivation, TM_IDR=Teaching Motivation=Identified Regulation, TM_IM=Teaching Motivation_Intrinsic Motivation, TM_INR=Teaching Motivation_Introjected Regulation, TSEB_PSTE=Teacher Self-Efficacy Beliefs_Personal Science Teaching Efficacy, TSEB_STOE=Teacher Self-Efficacy Beliefs_Science Teaching Outcome Expectancy.

Table 2 shows the reliability of research constructs (i.e., TSEB, TM, ATTS and BIITS) based on first-ordered constructs. The construct's reliability was achieved when CR and CA were more than .60, while AVE is more than .50 (Hair et al., 2014, 2017). In

Table 2, the results showed that all constructs exceeded the threshold value for CR, CA and AVE. Therefore, all instruments adapted in the current research were reliable to be used in the Malaysian context.
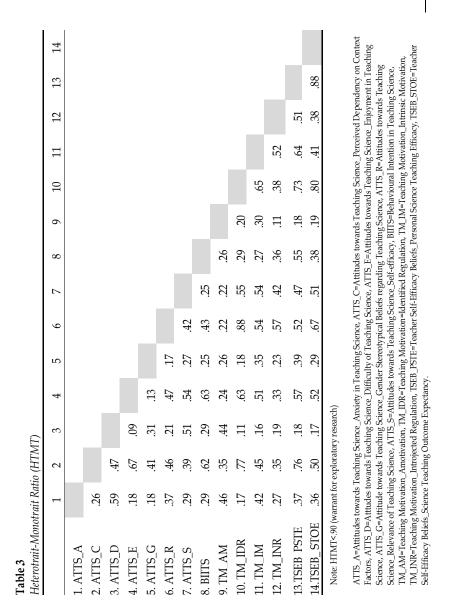
Table 2

The Internal Consistency Reliability of the Research Instrument based on First-Ordered Measurement Model

First-ordered Construct	Composite Reliability (CA)	Cronbach's Alpha (CA)	Average Variance Extracted (AVE)
TSEB_PSTE	.84	.77	.52
TSEB_STOE	.89	.84	.57
TM_IM	.91	.86	.78
TM_IDR	.88	.74	.79
TM_INR	.84	.76	.65
TM_AM	.94	.90	.83
ATTS_R	.91	.81	.84
ATTS_D	.88	.80	.72
ATTS_G	.94	.92	.76
ATTS_E	.95	.92	.82
ATTS_A	.94	.92	.80
ATTS_S	.88	.81	.65
ATTS_C	.83	.70	.63
BIITS	.84	.77	.52

Note: CR > .60; CA > .60; AVE > .50

ATTS_A=Attitudes towards Teaching Science_Anxiety in Teaching Science, ATTS_C=Attitudes towards Teaching Science_Perceived Dependency on Context Factors, ATTS_D=Atttudes towards Teaching Science_Difficulty of Teaching Science, ATTS_E=Attitudes towards Teaching Science_Enjoyment in Teaching Science, ATTS_G=Attitude towards Teaching Science_Gender Stereotypical Beliefs regarding Teaching Science, ATTS_R=Attitudes towards Teaching Science_Relevance of Teaching Science, ATTS_S=Attitudes towards Teaching Science_Self-efficacy, BIITS=Behavioural Intention in Teaching Science, TM_AM=Teaching Motivation_Amotivation, TM_IDR=Teaching Motivation=Identified Regulation, TM_IM=Teaching Motivation_Intrinsic Motivation, TM_INR=Teaching Motivation_Introjected Regulation, TSEB_PSTE=Teacher Self-Efficacy Beliefs_Personal Science Teaching Efficacy, TSEB_STOE=Teacher Self-Efficacy Beliefs_Science Teaching Outcome Expectancy.

The discriminant validity of the current measurement model was evaluated utilizing the HTMT ratio, which is shown in Table 3. Results showed that all constructs were under the maximum threshold of .90. This indicated all constructs in the structural model achieved high significant discriminant validity, by means each construct is distinct from other constructs in the structural model. Thus, this indicated the items for self-efficacy subscale found in ATTS was distinct from the items in TSEB and each construct was distinct from other constructs in the structural model.

Table 3
Heterotrait-Monotrait Ratio (HTMT)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. ATTS_A														
2. ATTS_C	.26													
3. ATTS_D	.59	.47												
4. ATTS_E	.18	.67	.09											
5. ATTS_G	.18	.41	.31	.13										
6. ATTS_R	.37	.46	.21	.47	.17									
7. ATTS_S	.29	.39	.51	.54	.27	.42								
8. BIITS	.29	.62	.29	.63	.25	.43	.25							
9. TM_AM	.46	.35	.44	.24	.26	.22	.22	.26						
10. TM_IDR	.17	.77	.11	.63	.18	.88	.55	.29	.20					
11. TM_IM	.42	.45	.16	.51	.35	.54	.54	.27	.30	.65				
12. TM_INR	.27	.35	.19	.33	.23	.57	.42	.36	.11	.38	.52			
13. TSEB_PSTE	.37	.76	.18	.57	.39	.52	.47	.55	.18	.73	.64	.51		
14. TSEB_STOE	.36	.50	.17	.52	.29	.67	.51	.38	.19	.80	.41	.38	.88	

Note: HTMT<.90 (warrant for exploratory research)

ATTS_A=Attitudes towards Teaching Science_Anxiety in Teaching Science, ATTS_C=Attitudes towards Teaching Science_Perceived Dependency on Context Factors, ATTS_D=Atttudes towards Teaching Science_Difficulty of Teaching Science, ATTS_E=Attitudes towards Teaching Science_Enjoyment in Teaching Science, ATTS_G=Attitude towards Teaching Science_Gender Stereotypical Beliefs regarding Teaching Science, ATTS_R=Attitudes towards Teaching Science_Relevance of Teaching Science, ATTS_S=Attitudes towards Teaching Science_Self-efficacy, BIITS=Behavioural Intention in Teaching Science, TM_AM=Teaching Motivation_Amotivation, TM_IDR=Teaching Motivation=Identified Regulation, TM_IM=Teaching Motivation_Intrinsic Motivation, TM_INR=Teaching Motivation_Introjected Regulation, TSEB_PSTE=Teacher Self-Efficacy Beliefs_Personal Science Teaching Efficacy, TSEB_STOE=Teacher Self-Efficacy Beliefs_Science Teaching Outcome Expectancy.

Results

The assessment of the structural model is crucial to measure and explore interrelations between the hypothesized latent constructs. For the current research, the assessment of the proposed structural model involved six procedures as recommended by Hair et al. (2017).

Step 1: Assessment for Collinearity Issues

The collinearity assessment was performed based on the following sets of exogenous constructs: (1) TSEB and TM as predictors of CBTS; (2) TSEB and TM as predictors of ASTS; (3) TSEB and TM as predictors of PCTS; (4) TSEB, TM, and CBTS as predictors of BIITS; (5) TSEB, TM, and ASTS as predictors of BIITS; and (5) TSEB, TM, and PCTS as predictors of BIITS. As shown in Table 4, all *VIF* values were clearly below the threshold of 5.00. This indicated the collinearity among the predictor constructs was not a critical issue in the proposed structural model. Thus, the structural model is fit for the following assessments.

Table 4

Collinearity Statistics (VIF)

	ASTS	BIITS	CBTS	PCTS	TM	TSEB
ASTS		2.25				
BIITS						
CBTS		1.84				
PCTS		2.49				
TM	1.96	2.52	1.96	1.96		
TSEB	1.96	2.80	1.96	1.96		

Note: *VIF* < 5.00; ASTS=Affective States towards Teaching Science; BIITS=Behavioural Intention in Teaching Science; CBTS=Cognitive Beliefs towards Teaching Science; PCTS=Perceived Control towards Teaching Science; TM=Teaching Motivation; TSEB=Teacher Self Efficacy Beliefs

Step 2: Assessment for the Significant and Relevance of the Structural Model Relationships

Table 5 shows the results of hypothesis testing for the direct effect of TSEB, TM, and sub-dimensions of ATTS (i.e., CBTS, ASTS, and PCTS) on BIITS. By assuming a 5% significance level, the relationships between TM → BIITS and ASTS → BIITS were significant. TM (β = .22, *p-value* = .02*) and ASTS (β = .20, *p-value* = .03*) had significant effect (p < .05) on BIITS. On the contrary, the relationship between TSEB → BIITS, CBTS → BIITS, and PCTS → BIITS was reported as insignificant. TSEB (β = .05, *p-value* = .34), CBTS (β = .18, *p-value* = .13), and PCTS (β = .15, *p-value* = .16) had insignificant effect (p > .05) on BIITS.

The bootstrap confidence interval also provides additional information regarding the stability of path coefficient estimates and allows testing whether a path coefficient is significantly different from zero. If a confidence interval for an estimated path coefficient does not include zero, the path coefficient is significantly different from zero (Hair et al., 2017). As can be seen in Table 5, the result indicated that the 95% confidence interval for TM → BIITS (.04 to .38) and ASTS → BIITS (.03 to .36) did not include zero. Thus, these two path coefficients were assumed to have a significant effect. However, the path coefficients for TSEB → BIITS (-.14 to .27), CBTS → BIITS (-.14 to .37), and PCTS → BIITS (-.07 to .41) included zero value. Thus, these three path coefficients assumed a non-significant effect.

Table 5

Significance Relevance for Direct Effect of TSEB, TM, CBTS, ASTS and PCTS on BIITS

Relationship	Path Coefficient (Standard β)	Std. Error	*p*-value	95% Confidence Intervals	Effect Size, f^2
TSEB→ BIITS	.05	.13	.34	[-.14, .27]	.00
TM → BIITS	.22	.10	.02*	[.04, .38]	.03
CBTS→ BIITS	.18	.15	.13	[-.14, .37]	.03
ASTS→ BIITS	.20	.10	.03*	[.03, .36]	.03
PCTS→ BIITS	.15	.15	.16	[-.07, .41]	.02

Note: *. This has met the significance level ($p < .05$); Bootstrapping ($n = 5000$); TSEB=Teacher Self-Efficacy Beliefs; TM=Teaching Motivation, CBTS=Cognitive Beliefs towards Teaching Science; the ASTS=Affective States towards Teaching Science; PCTS=Perceived Control towards Teaching Science; BIITS=Behavioural Intention in Teaching Science

Table 6 shows the results of hypotheses testing for the direct effect of TSEB, TM, on the sub-dimensions of ATTS (i.e., CBTS, ASTS, and PCTS). By assuming a 5% significance level, the relationships between TSEB → ASTS, TSEB → PCTS, TM → ASTS, and TM → PCTS were significant. TSEB had a significant effect on ASTS (β = .48, *p-value* = .00**) and PCTS (β = .49, *p-value* = .00**). On the contrary, the TSEB had insignificant effect on CBTS (β = .25, *p-value* = .12). As for TM, it had a significant effect on ASTS (β = .28, *p-value* = .00**) and PCTS (β = .32, *p-value* = .00**). In contrast, the relationship between TM and CBTS was insignificant (β = .46, *p-value* = .10).

The bootstrap confidence interval provides additional information regarding the stability of path coefficient estimates and allows testing whether a path coefficient is significantly different from zero. If a confidence interval for an estimated path coefficient does not include zero, the path coefficient is significantly different from zero. As can be seen in Table 6, result indicated that the 95% confidence interval for TSEB → ASTS (.34 to .61), TSEB → PCTS (.36 to .62), TM → ASTS (.14 to .41), and TM → PCTS (.18 to .43) did not include zero. Thus, these four path coefficients assumed as a significant effect. However, the path coefficients for TSEB → CBTS (-.23 to .45) and TM → CBTS (-.45 to .63) had included zero value. Thus, these two path coefficients assumed a non-significant effect.

Table 6

Significance Relevance for Direct Effect of TSEB and TM on CBTS, ASTS, and PCTS

Relationship	Path Coefficient (Standard β)	Std. Error	*p*-values	95% Confidence Intervals	Effect Size, f^2
TSEB → CBTS	.25	.21	.12	[-.23, .45]	.06
TSEB → ASTS	.48	.08	.00**	[.34, .61]	.24
TSEB → PCTS	.49	.08	.00**	[.36, .62]	.29
TM → CBTS	.46	.35	.10	[-.45, 0.63]	.19
TM → ASTS	.28	.08	.00**	[.14, .41]	.08
TM → PCTS	.32	.08	.00**	[.18, .43]	.12

Note: *. This has met the significance level ($p < .05$); **. This has met the significance level ($p < .01$); Bootstrapping ($n = 5000$)

Step 3: Assessment for the Coefficient of Determination (R² value)

The coefficient of determination (R^2 value) is another measure used to calculate the model's predictive power. It is calculated as the squared correlation between a specific endogenous construct's actual and predicted values. The R^2 value ranges from 0 to 1, with higher values indicating greater predictive accuracy. R^2 values of .26, .13, or .02 represent substantial, moderate, or weak (Cohen, Manion, & Morrison, 2011).

Based on Figure 5, the R^2 value of .45 for construct BIITS indicated 45% of the construct's variance was explained by teacher self-efficacy beliefs (TSEB), teaching motivation (TM), cognitive beliefs towards teaching science (CBTS), affective states towards teaching science (ASTS) and perceived control towards teaching science (PCTS). According to Cohen et al. (2011), the R^2 value of .45 is considered large, which means TSEB, TM, CBTS, ASTS, and PCTS in the structural model substantially predicted the BIITS.
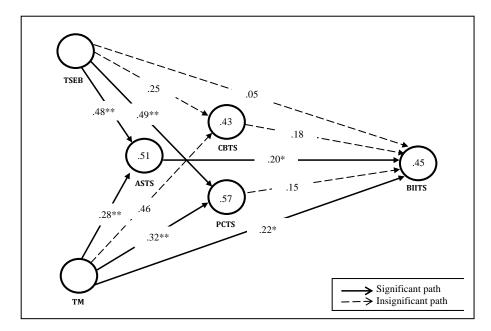

Figure 5. *Path Model Estimation and R² Values*

Note: TSEB=Teacher Self-Efficacy Beliefs; TM=Teaching Motivation; CBTS=Cognitive Beliefs towards Teaching Science; the ASTS=Affective States towards Teaching Science; PCTS=Perceived Control towards Teaching Science; BIITS=Behavioural Intention in Teaching Science

Step 4: Assessment of the f ² Effect Size

Further assessment to strengthen the R^2 values is by evaluating the f^2 effect size. The f^2 effect size measures the exogenous constructs' (i.e., TSEB, TM and three sub-dimensions of ATTS; CBTS, ASTS, and PCTS) contribution to endogenous construct's (i.e., BIITS) R^2 value. Based on the literature, f^2 values of .02, .15, and .35 indicate an exogenous construct contributes small, medium, or large effect towards an endogenous construct (Cohen, 1988; Cohen, Manion, & Morrison, 2011; Hair et al. 2017). By referring to Table 5, the effect size, f^2 shows TM (.03), CBTS (.03), and ASTS (.03) have medium effect size on BIITS, while TSEB (.00) and PCTS (.02) had small effect size.

Step 5: Assessment of the Predictive Relevance Q²

After the evaluation of f^2 effect size is to assess the model's out-of-sample predictive power by examining its Stone-Geisser's Q^2 value. The Q^2 value is obtained by carrying out the blindfolding procedure. The Q^2 value that is larger than zero for a specific reflective endogenous latent variable indicates the path model's predictive relevance for the dependent construct, which is the behavioural intention in teaching science is high. In contrast, values of zero and below indicate a lack of predictive relevance (Hair et al., 2014; Hair et al., 2017). Thus, the Q^2 value for current research was calculated using the cross-validated redundancy approach, which fits the PLS-SEM approach and the result is shown in Table 7.

Table 7
Construct Cross-Validated Redundancy

Exogenous	Endogenous	Std. β	R^2	Q^2	q^2	Predictive Relevance
TSEB	CBTS	.25	.43	.07	.00	Yes
TM		.46			.02	
TSEB	ASTS	.48**	.51	.26	.08	Yes
TM		.28**			.03	
TSEB	PCTS	.49**	.57	.24	.07	Yes
TM		.32**			.03	
TSEB	BIITS	.05	.45	.25	.00	Yes
TM		.22			.01	
CBTS		.18			.01	
ASTS		.20			.01	
PCTS		.15			.00	

Note: TSEB=Teacher Self-Efficacy Beliefs, TM=Teaching Motivation, CBTS=Cognitive Beliefs towards Teaching Science, ASTS=Affective States towards Teaching Science, PCTS=Perceived Control towards Teaching Science, BIITS=Behavioural Intention in Teaching Science

Step 6: Assessment of the q^2 Effect Size

The final step in estimating the structural model is by evaluating the effect size q^2. The effect size q^2 assesses the exogenous construct's contribution to the Q^2 value for the behavioural intention in teaching science constructs. As mentioned by Hair et al. (2017), the q^2 values of .02, .15 and .35 indicate the exogenous construct has a small, medium, or large predictive relevance for the endogenous construct. Based on Appendix B, the results of constructing cross-validated redundancy in which the Q^2 values of all four endogenous constructs were above zero. More precisely, ASTS has the highest Q^2 value (.26), followed by BIITS (.25), PCTS (.24), and finally CBTS (.07). These results provided clear support for the model's predictive relevance regarding the endogenous latent variable. As for the q^2 effect size, results showed that all exogenous constructs TSEB (.00), TM (.01), CBTS (.01), ASTS (.01), and PCTS (.00) had a small predictive relevance for the endogenous construct (BIITS).

By referring to the summary of results for mediating effect as shown in Table 8, it shows the *p-value* for the relationship between TSEB and BIITS, which involved mediator ASTS is .03 ($p < .05$). A similar result was obtained for the relationship between TM and BIITS, which involved mediator ASTS in which the *p-value* is .04 ($p < .05$). Therefore, research findings proved that only one sub-dimension of attitudes towards teaching science (i.e., affective states towards teaching science) mediated the relationship between teacher self-efficacy beliefs and teaching motivation on behavioural intention in teaching science. This also further proved the mediating role of attitudes towards teaching science in the relationship between teacher self-efficacy beliefs and teaching motivation on behavioural intention in teaching science.

Table 8

Summary of Results for Mediating Effect

Indirect Effect				Mediating Effect		
Path	Std. β	Path	Std. β	Std. β	SE	*p*-Value
TSEB→CBTS	.25	CBTS→BIITS	.18	.04	.03	.10
TSEB→ASTS	.48**	ASTS→BIITS	.20*	.10*	.05	.03*
TSEB→PCTS	.49**	PCTS→BIITS	.15	.07	.07	.16
TM→CBTS	.46	CBTS→BIITS	.18	.08	.04	.06
TM→ASTS	.28**	ASTS→BIITS	.20*	.06*	.05	.04*
TM→PCTS	.32**	PCTS→BIITS	.15	.05	.05	.18

Note: *. This has met the significance level ($p < .05$); **. This has met the significance level ($p < .01$); Bootstrapping ($n = 5000$); TSEB=Teacher Self-Efficacy Beliefs; TM=Teaching Motivation; CBTS=Cognitive Beliefs towards Teaching Science; the ASTS=Affective States towards Teaching Science; PCTS=Perceived Control towards Teaching Science; BIITS=Behavioural Intention in Teaching Science

Discussion, Conclusion and Recommendations

The primary goal for current research is to explore the mediating effect of the sub-dimensions of attitudes towards teaching science (ATTS) in the relation between teacher self-efficacy beliefs (TSEB) and behavioural intention in teaching science

(BIITS), as well as between teaching motivation (TM) and BIITS in a new proposed structural model. The proposed structural model is an extended model based on the Attitude towards (Teaching) Model proposed by Van Aalderen-Smeets et al. (2012). Apart from that, the ATTS construct in this research was measured based on the three sub-dimensions, namely cognitive beliefs towards teaching science (CBTS), affective states towards teaching science (ASTS) and perceived control towards teaching science (PCTS). Through the proposed structural model, researchers managed to explore which sub-dimensions of ATTS showed a significant mediating effect on BIITS. Also, researchers discovered TM as a new construct that showed a significant path in predicting pre-service teachers' behavioural intention in teaching science. The mediating effect for current research was categorised based on the guidelines recommended by Zhao, Lynch, & Chen (2010), which includes direct-only non-mediation, no-effect non-mediation, complementary mediation, competitive mediation and indirect-only mediation. According to Zhao et al. (2010), direct-only non-mediation indicates the direct effect is significant but not the indirect effect, whereas no-effect non-mediation indicates neither the direct or indirect effect is significant. Furthermore, complementary mediation is shown when the indirect effect and the direct effect both are significant and point in the same direction, whereas competitive mediation is shown when the indirect effect and the direct effect both are significant and point in the opposite direction. As for the indirect-only mediation, it is shown when the in-direct effect is significant but not the direct effect.

The Mediating Effect of the Sub-dimensions of ATTS in the Relation between TSEB and TM on BIITS

Research findings showed only one of the sub-dimensions of ATTS (i.e., ASTS) has a full mediating effect (indirect-only mediation) in the relationship between TSEB and BIITS amongst pre-service teachers from the three selected government-funded universities. On the contrary, the CBTS and PCTS have no-effect non-mediation between TSEB and BIITS. This indicates when pre-service teachers possess high self-efficacy beliefs, they are more confident about their capability to bring positive learning outcomes. Furthermore, they also believed students' achievement are highly influenced by their commitment and passion towards science knowledge. With greater self-efficacy beliefs, it affects pre-service teachers' affective states towards teaching science. They showed more enjoyment and less anxiety while teaching. This influences their teaching strategies as well as the instructional approaches which they intend to adopt during the science lesson. Moreover, positive emotion towards teaching science will bring about great behavioural intention in teaching science. This finding is supported by Van Der Molen and Van Aalderen-Smeets (2013), who claimed teachers who enjoyed teaching science are more often show high self-efficacy and feel less dependent on external factors. The findings of this research further confirmed Fishbein and Ajzen's Theory of Reasoned Action (1975), in which he posited salient beliefs are the antecedents of attitudes, and this attitude will influence a person's behaviour. It is proven that to account for the formation of an intention; a person has to change his or her attitude, which is influenced by the self-efficacy beliefs and motivation towards performing the behaviour.

Furthermore, amongst all three sub-dimensions of ATTS, only ASTS has a partial mediating effect (complementary mediation) in the relationship between TM and BIITS amongst pre-service teachers in the three selected government-funded universities. On the other hand, the CBTS and PCTS have direct-only non-mediation effect in the relationship between TM and BIITS. These results revealed that when pre-service teachers possess high TM, they are more internally driven to teach science. When they are intrinsically motivated, they feel less anxiety in teaching and hence, they are more likely to increase their effort, engage in school activities and learning. Furthermore, pre-service teachers with greater motivation are more likely to provide an instructional setting that positively influenced their students' learning motivation. This enables students to feel more enjoyable during science lessons. On the other end of the spectrum of Self-Determination Theory, people with lower motivation (i.e., amotivation) tend to be less engaged, feeling anxiety and avoid participating in the teaching and learning tasks. As such, pre-service teachers with higher TM are aligned with more positive attitudes towards teaching in the education setting (Perlman, 2013).

The Effect of TSEB on BIITS amongst Pre-service Teachers

Based on the empirical evidence, the direct effect for the path relationship between TSEB and BIITS is positive but insignificant. This positive relationship indicates that when the pre-service teachers' self-efficacy beliefs are high, their BIITS is also high. However, the relationship between TSEB and BIITS is insignificant. The research findings are inconsistent with the previous study conducted in Pakistan among 198 teachers where teachers with higher self-efficacy beliefs were more likely to engage students in their teaching and they manage their classroom better as compared to permanent teachers who had low self-efficacy beliefs (Sadia Shaukat & Hafiz Muhammad Iqbal, 2012). Besides, current research findings also contradicted Gencer and Cakiroglu (2007), in which they concluded that those pre-service teachers who possessed higher TSEB scored more interventionist orientations on the instructional management subscale. This is because pre-service teachers believe that by maintaining order and strictly controlling students' instructional activities, they will have greater confidence in their abilities to generate a positive student learning environment and this belief can play an important role in determining teacher's behaviour. The rationale behind this contradicted result is due to the presence of the three mediators (CBTS, ASTS and PCTS) in the proposed structural model. When a mediator is introduced into a structural model, it provides an indirect path that acts as a link that explains the causal-effect relationship between TSEB and BIITS. This has, therefore, weakened the direct effect of TSEB on BIITS. It also shows that the mediator has greater explanation power to link the relationship between TM and BIIT. This is crucial empirical evidence contributed to the literature of teacher education so that future research can study the possible expansion of the Attitudes toward (Teaching) Model proposed by Van Aalderen-Smeets et al. (2012).

The Effect of TM on BIITS amongst Pre-service Teachers

Another contribution of this research is the discovery of positive and significant effects for the relationship between TM and BIITS amongst pre-service teachers in three government-funded universities. Based on the results, when pre-service teachers possess high TM, they showed greater BIITS. These results were similar to the findings reported in Gorozidis and Papaioannou (2014), where they employ the research upon 218 teachers in Greek high schools. Their research was also grounded on Self-Determination Theory and the result had revealed that autonomous motivation positively predicted teacher intentions to implement innovation in their teaching. Furthermore, the current research findings are supported by Perlman (2013), who concluded that highly self-determined pre-service teachers scored significantly higher in terms of professional knowledge and commitment. Since TM affects pre-service teachers' BIITS, teacher education institutions should focus more on how to instil their interest, enjoyment, and satisfaction towards the teaching profession. Pre-service teachers should be trained during pre-service years and so they will be fully committed throughout their teaching profession. Moreover, teacher education institutions should focus more on developing pre-service teachers' affective domain, such as teaching motivation and not just concentrate on teachers' capabilities to deliver instructional designs using different pedagogical approaches.

The Effect of the Sub-dimensions of ATTS on BIITS amongst Pre-service Teachers

According to the empirical evidence, amongst all three sub-dimensions, only affective states towards teaching science show positive and significant effect on BIITS. As for the other two sub-dimensions of ATTS (i.e., CBTS and PCTS), both showed a positive but insignificant effect on the BIITS. This indicates that pre-service teachers' affective state, which includes their emotional aspects, is the most salient mechanism through which it is reflecting upon one's teaching behaviour. When pre-service teachers have great enjoyment in students' interaction and science teaching, their BIITS will also become greater. The pre-service teachers are prone to adopt collaborative and constructivist approaches to enhance students' engagement in the classroom. Conversely, when pre-service teachers feel anxious while teaching, they are more likely to avoid answering students' enquiries and refuse to conduct open-ended discussions during the science lesson. Thus, in general, they prefer to carry out science lessons passively and dominate the class through a teacher-centred approach. This will directly reduce their intention to teach science. When a teacher has less anxiety in teaching, they are more likely to perform inquiry-based practices and students become very enthusiastic about the new way of learning. This can reduce their stress level in working, especially for novice teachers who intend to quit at the beginning of their teaching profession. Furthermore, teachers with less risk for stress were three times more likely to attend seminars, received supportive communication from school administrators and improve teacher-student relationships (Harsem et al., 2018). Apart from that, researchers discovered a teacher with high teaching motivation would have greater behavioural intention in teaching science. This provides insights for the Ministry of Education to ensure that accreditation of teachers is rigorously gained and

they should design a customized core curriculum to build the proficiency of pre-service teachers aligned with the requirement of the Ministry. When teachers' performance is being recognized through grading and portfolio assessment, they feel more worthy in committing and this can encourage teachers to sustain their passion for teaching. As mentioned by Ryan and Deci (2000) in Self-Determination Theory, when a person feels in control over his or her action, this self-esteem will pressurise an individual to behave in a certain manner so he or she can feel worthy of committing it.

The Effect of TSEB on the Sub-dimensions of ATTS amongst Pre-service Teachers

Based on the empirical evidence obtained from current research, TSEB showed a positive and significant effect on two of the sub-dimensions of ATTS, which are ASTS and PCTS. These results indicate the higher the teacher self-efficacy beliefs, the greater is the pre-service teachers' affective states towards teaching science and their perceived control towards teaching science. However, an insignificant effect was discovered in the relationship between TSEB and CBTS. These findings further support Ajzen's (1991, 2002) Theory of Planned Behaviour in which he posited salient beliefs are the antecedents of attitudes that influence attitudes toward a certain behaviour. When the pre-service science teachers strongly believed that they are capable of achieving desired learning outcomes, it will affect their level of effort they are willing to invest in the classroom. Furthermore, it also affects their perception of the difficulty of teaching science as compared with other subjects. Similarly, when pre-service teachers have high self-efficacy beliefs, they showed greater appreciation towards the importance of teaching science subjects in the school, rather than just completing the teaching task for the sake of gaining tangible reward (such as salary or teaching allowance). Teachers who possessed strong self-efficacy beliefs are often well-organized and always prepare for their lessons before entering the classroom. This mental state of readiness exerted a directive sense of intention towards the individual's behaviour.

From the results, a positive and significant effect was shown in the relationship between TSEB and ASTS. When examining the predictive power of ASTS, the R square value (R^2 = .51) proved that 51% of the variance in the ASTS was explained by TSEB. This indicates TSEB substantially predicts and determines pre-service teachers' affective states towards teaching. When pre-service teachers have high self-efficacy beliefs, they usually showed greater desire and excitement in teaching science. Apart from that, they are more likely to use open-ended inquiry and student-centred teaching approach to cultivate 21st-century learning skills amongst their students. Thus, with greater confidence, the majority of the pre-service teachers in three of the government-funded universities in Malaysia are more persistent and resilient when facing obstacles in teaching science. This has led to the development of positive tolerance and less critical when dealing with students who are poor in their academic performances. Besides, it has also affected their sense of anxiety in teaching science, in which pre-service teachers who possessed high self-efficacy beliefs will have less anxiety in teaching science and showed greater behavioural intention in teaching science.

Current research findings are following Bandura's (1977) Social Cognitive Theory which he posited self-efficacy as people's beliefs and thoughts about their capabilities to produce designated behaviour that can affect their life. Furthermore, Bandura also stipulated self-efficacy beliefs to have two sub-dimensions, namely personal self-efficacy and outcome expectancy. Personal self-efficacy is the "belief in one's capabilities to organize and execute the courses of action required to produce given attainments, whereas outcome expectancy is a judgement of the likely consequence such performance will produce" (Bandura, 1997 in Cantrel et al., 2003). For the context of this research, when pre-service teachers have positive outcome expectancy towards their science teaching, it will lead to more enjoyment experienced by the teachers as well as the students themselves. Furthermore, based on Berman et al. (1977), teacher efficacy has been defined as "the extent to which the teacher believes he or she can affect student performance". When applied in science teaching, this self-efficacy dimension is generally known as Personal Science Teaching Efficacy (PSTE). Science teachers with a high assurance of PSTE tend to approach difficult teaching tasks as challenges to be mastered rather than as threats to be avoided. They are more confident to develop teaching instructions that can solve the obstacles in students' learning. Besides, they are highly consistent in maintaining their teaching commitment and quickly rebound their sense of efficacy after each setback. They often attribute their failure to insufficient effort or deficient knowledge and pedagogical skills, which are acquirable through consistent trials (Bandura, 1994). Bandura's second dimension, outcome expectancy, advocates that an intention to undertake some action is based on the expected success of that action. When applied in science teaching, this dimension is generally known as Science Teaching Outcome Expectancy (STOE). Teachers with low STOE were less effective in science teaching as they have low aspirations and often expecting failure. When faced with difficult tasks, they will dwell on their weaknesses and the adverse outcomes rather than concentrate on how to perform successfully (Riggs & Enochs, 1989; Tschannen-Moran et al., 1998).

Besides, the results from this research have supported the statement of Türer and Kunt (2015), which suggested that science prospective teachers who possessed positive self-efficacy often showed positive attitudes towards teaching to be effective and qualified science teachers. They believed this could allow teachers to transfer their knowledge and skills to their students in a more effective way. They also recommended that the most effective way of positively developing their self-efficacy and attitudes towards teaching science is via the education process throughout the pre-service years. In Celal Bayar University, a positively significant but low linear correlation between prospective teachers' attitudes towards science education and their self-efficacy scores was identified among 497 prospective teachers using Enochs and Riggs' (1990) "Science Teaching Self-Efficacy Beliefs Scale". Besides, other similar results were shown in previous research done by Joseph (2010) when he claimed that a person with high science teaching efficacy is more likely to approach science teaching with confidence, rather than viewing it as a threat or giving up quickly when faced with a difficult situation. Conversely, the sense of low efficacy has often been linked with teachers' avoidance of teaching science. Thus, the teachers' attitudes and beliefs influence the total of their actions in the classroom.

As for another research conducted by Senler (2016) on 356 pre-service science teachers from five universities in Turkey, he claimed that attitudes towards science teaching were positively associated with science teaching self-efficacy. Pre-service science teachers who believed they are responsible for student performance and student-level outcomes are related to their effort and ability. Thus, they are more likely to have a positive attitude towards science teaching. This is also justified by previous research by Ugras et al. (2012), in which their findings suggested that self-efficacy and attitude are two preliminary factors for the pre-service teachers in Firat University and Erzincan University in Turkey to succeed in their teaching professions. Besides, the researcher emphasised that although a teacher has strong knowledge content, he or she is not expected to be productive without the right attitude to teach.

In Turkey, 101 pre-service teachers were discovered to show a positive correlation between their high teacher efficacy and constructivist-based teaching practice (Temiz & Topcu, 2013). They also concluded that pre-service teachers with high teacher efficacy tend to employ a constructivist approach in their teaching, while pre-service teachers with low teacher efficacy tend to use the traditional approach. It is the attitudes and behavioural intention which lead to the action they take in the classroom. Thus, with greater self-efficacy beliefs, pre-service teachers are more likely with possessed positive attitudes towards teaching science and they are willing to put extra effort to improve their students' learning outcomes. In another research, similar findings were reported by Rimm-Kaufman et al. (2004) in which they claimed that teachers who reported using more responsive classroom approaches were those who possessed greater self-efficacy belief. They were also more likely to report positive attitudes toward teaching as a profession.

The Effect of TM on the Sub-dimensions of ATTS amongst Pre-service Teachers

According to the empirical evidence discovered from current research, TM showed a positive and significant effect on two of the sub-dimensions of ATTS, which are ASTS and PCTS. These results indicate that the higher the teaching motivation, the greater is the pre-service teachers' affective states and perceived control towards teaching science. Besides, this research also discovered the TM amongst pre-service teachers in the three selected government-funded universities has a positive but insignificant effect on cognitive beliefs towards teaching science. The estimated significant effect for the interrelation between TM and sub-dimensions of ATTS is the same as the results shown in the interrelation between TSEB and sub-dimensions of ATTS. Amongst all three sub-dimensions of ATTS, the ASTS and PCTS showed a positive and significant effect. Conversely, the exogenous latent variables hypothesised in current research (i.e., TSEB and TM) both showed an insignificant effect on CBTS.

Concerning theoretical and model development, current research managed to explore the interrelation between TM and the sub-dimensions of ATTS and analyze the predictive power of both latent variables. When examining the predictive power of ASTS, the *R* square value (R^2 = .51) proved that 51% of the variance in the ASTS was explained by TSEB and TM. As for the PCTS, it had an R square value of .57 which meant 57% of the variance in the PCTS was explained by TSEB and TM. Moreover, the

R square value (R^2 = .43) for CBTS indicated a slightly lower value, 43% of the variance in the CBTS was explained by TSEB and TM. Thus, these result findings indicate TM substantially predict and determine pre-service teachers' ATTS. These results provide substantial empirical evidence to support the notion that pre-service teachers' TM affects their ATTS. The ATTS includes pre-service teachers' CBTS, ASTS and their PCTS. When examining the Q^2 value, the predictive relevance obtained was shown to be medium for sub-dimensions ASTS (.26) and PCTS (.24) but was considered small for cognitive beliefs towards teaching science (.07).

Current research has discovered that the pre-service teachers in three government-funded universities possessed high teaching motivation. Pre-service teachers with great teaching motivation are those who can make conscious choices and decisions during the teaching task. When the pre-service teachers found it interesting to explain the scientific facts based on their passion for science, they will feel more enjoyable when interacting with the students. Thus, high motivated pre-service teachers showed a positive and significant effect on the affective states towards teaching science. When pre-service teachers are lacked teaching motivation, they face difficulty in teaching, which will eventually increase their anxiety in teaching science. Moreover, low-motivated pre-service teachers are unwilling to commit extra effort and allocate additional hours to assist students with low academic achievement. Pre-service teachers who are lack teaching motivation often times facing self-denial issues in which they claimed the school did not provide proper teaching aids or lab facilities and caused their failure in carrying out effective teaching approaches. Thus, low-motivated pre-service teachers are often correlated to context dependency in which their motivation to teach is depending on the context of the classroom. This attitude has therefore affected their sense of perceived control towards teaching science.

Apart from that, the present research has also confirmed the hypothesised relationship in which teaching motivation has a positive and significant effect on attitudes towards teaching science amongst the pre-service science teachers in the three government-funded universities. When comparing the strength of causal effect towards behavioural intention in teaching science, teaching motivation has a stronger effect on the attitudes towards teaching science. These findings are similar to the previous research conducted by Hein et al. (2012) in a cross-cultural comparison study with physical education teachers from five countries. Their research findings indicated that Spanish teachers were more intrinsically motivated whilst Lithuanian teachers were more externally motivated than those teachers from Estonian, Hungarian, and Latvian. Research findings also showed that intrinsically motivated teachers using more productive (student-centred) teaching styles.

A similar result was reported by Santisi et al. (2014), in which they claimed teaching motivation is strongly related to teachers' metacognitive attitude . When the teachers feel positive emotions during teaching, they tend to use different teaching strategies depending on students' level of achievement. In another research performed among 68 pre-service teachers from Physical and Health Education, the findings indicated that pre-service teachers' motivation toward teaching is an important disposition or item of effective teaching practices (Perlman, 2013). The author believed that to

produce effective teaching, teachers should have great motivation to teach. This result has also supported by Cavallo et al. (2002) where they claimed that motivation in teaching seems to promote elementary pre-service teachers' positive attitude and interest in science teaching. This can be observed when highly motivated pre-service teachers chose to adopt inquiry-based science instruction compared with low-motivated teachers who teach their students using the traditional chalk-and-talk teaching approach. As for Cullen and Greene (2011), they claimed that intrinsic and extrinsic motivation were among the two dominant predictors that affected pre-service teachers' attitudes towards adopting technology into their daily teaching routine in the classroom. Thus, from the review of previous literature, it can be concluded that pre-service teachers who possessed high teaching motivation will often show greater attitudes towards teaching science as what hypothesised in current research.

Furthermore, the literature involved in motivational psychology had suggested that salient motivations determined one's attraction, retention, and concentration towards a certain action. Therefore, in terms of teaching and teacher education, motivations determined what attracts the pre-service teacher to teach, how long he or she can sustain in teacher education, and subsequently the extent to which they will continue to grow in the teaching profession. Understanding how teaching motivation affects pre-service teachers' attitudes towards teaching science enables teacher education institutions to gain insight into how important it is to develop a teaching curriculum that focuses not only on the instructional content but also on how to improve pre-service teachers' teaching motivation. The attractiveness of teacher education programs enables more undergraduate students to enrol in this course. Thus, this can attract more pre-service teachers with a genuine desire to work with children or adolescents to enrol in the teacher education program (Sinclair, Dowson, & McInerney, 2006).

Conclusion

The structural model proposed in this research is a crucial step towards a convergence of the research in teacher education. Theoretically, this research facilitates the reconceptualization of teacher self-efficacy beliefs, teaching motivation, attitudes towards teaching science and behavioural intention in teaching science in theoretical perspectives. It contributes to the literature by providing empirical data to examine the research instrumentations using the secondary data analysis method, which is the PLS-SEM approach. Other than that, more prominent empirical pieces of evidence were showed in the mediating effect of attitudes towards teaching science in which the researcher had discovered among all three sub-dimensions, only the affective states towards teaching science showed a significant mediating effect in the relationship between teacher self-efficacy beliefs and teaching motivation on behavioural intention in teaching science.

The professionalization of teachers in teaching cannot be accomplished without improving their science knowledge and their pedagogical skills in delivering the instructional strategies. However, in the context of teacher education, it should be noted that increases in knowledge do not always lead to improvements in the quality

of science teaching. Only when teachers have strongly believed that they perceived themselves to be capable of teaching, possessed great teaching motivation, and feeling enjoyed while teaching, then will the teachers show great behavioural intention in teaching science.

Recommendations

Future research may be needed to address the aforementioned limitations to provide a better understanding of how the constructs in the structural model influences different subject areas. Moreover, future research is recommended to involve educational research that crosses national boundaries as it generates more promising and new insights from different perspectives. This is because similar educational practices, beliefs and attitudes in one country can be questioned and doubted. Parallel longitudinal studies can also provide in-depth information related to the influence of pre-service teacher education programs on prospective teachers across cultures. Likewise, different correlation studies should be addressed in the future to investigate teacher self-efficacy beliefs, teaching motivation, attitudes towards teaching science and behavioural intention in teaching science on students' learning outcome. To gain a better understanding of the respondents' thoughts and behaviour, this can be achieved through qualitative research by employing interview sessions with the pre-service science teachers and carry out observation in the actual classroom. This allows the discovery of other potential determinant variables that predict and affect pre-service science teachers' behavioural intention in teaching science.

Limitations

Based on Self-Determination Theory, there are six types of motivation regulation in predicting a human's behaviour towards action, which are intrinsic regulation, integrated regulation, identified regulation, introjected regulation, external regulation, and amotivation. However, the instrumentation adapted in the context of current research did not include integrated regulation and external regulation. The rationale behind this exclusion is due to integrated regulation is a form of extrinsic motivation which is more fully internalized than identified regulation (Fernet et al., 2008). Thus, it is more difficult to measure this motivation regulation. This exclusion is also justified by another widely used instrument called the Multidimensional Work Motivation Scale (MWMS). According to Gagné et al. (2015), the integration regulation subscale does not include in the instrument due to the factorial problem and face value in data analysis (Gagné et al., 2015). Furthermore, authors of MWMS also claimed that, to date, no research has demonstrated that integration regulation accounts for additional variance in outcomes after including identified or intrinsic motivation. They also questioned the value of adding an integrated regulation subscale to the instrument since it would lengthen the measure with no apparent benefits (Gagné et al., 2015). Therefore, the research instrument adapted in current research may lose some important information as it cannot fully measure all dimensions of the motivation constructs amongst pre-service teachers.

Beyond that, another limitation is associated with the variation of sample respondents. The number of sample respondents in this research is limited to pre-service science teachers from three selected government-funded universities. A small sample size has caused the impossibility of generalizing the findings into the whole target population. Thus, future research may involve respondents in the different backgrounds of social context to understand how the behavioural intention changes across different geographical settings. Besides, the present research only focuses on a cross-sectional study by collecting one-time data on the pre-service science teachers. As a result, researchers were not able to study the pattern through which the teacher self-efficacy, teaching motivation, attitudes towards teaching science, and behavioural intention in teaching science transform along four years of the teacher education program.

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Appendix A

Appendix B

Exogenous	Endogenous	Q^2 included	Q^2 excluded	Calculation for q^2 Effect Size	q^2 Effect Size
TSEB	CBTS	0.067	0.065	$q^2 = (0.067-0.065) /$ $(1-0.067)$ $q^2 = 0.002$	Small
TM		0.067	0.051	$q^2 = (0.067-0.051) /$ $(1-0.051)$ $q^2 = 0.017$	Small
TSEB	ASTS	0.260	0.200	$q^2 = (0.260-0.200) /$ $(1-0.260)$ $q^2 = 0.081$	Medium
TM		0.260	0.238	$q^2 = (0.260-0.238) /$ $(1-0.260)$ $q^2 = 0.030$	Medium
TSEB	PCTS	0.242	0.188	$q^2 = (0.242-0.188) /$ $(1-0.242)$ $q^2 = 0.071$	Medium
TM		0.242	0.222	$q^2 = (0.260-0.222) /$ $(1-0.242)$ $q^2 = 0.026$	Medium
TSEB	BIITS	0.251	0.251	$q^2 = (0.251-0.251) /$ $(1-0.251)$ $q^2 = 0.000$	Small
TM		0.251	0.242	$q^2 = (0.251-0.242) /$ $(1-0.251)$ $q^2 = 0.012$	Small
CBTS		0.251	0.246	$q^2 = (0.251-0.246) /$ $(1-0.251)$ $q^2 = 0.007$	Small
ASTS		0.251	0.244	$q^2 = (0.251-0.244) /$ $(1-0.251)$ $q^2 = 0.009$	Small
PCTS		0.251	0.248	$q^2 = (0.251-0.248) /$ $(1-0.251)$ $q^2 = 0.004$	Small

Appendix C

Ethics Committee Aproval Letter

KEMENTERIAN PENDIDIKAN TINGGI
MINISTRY OF HIGHER EDUCATION
Bahagian Perancangan, Penyelidikan Dan Penyelarasan Dasar
Aras 13, No. 2, Menara 2, Jalan P5/6
Presint 5, 62200 PUTRAJAYA
MALAYSIA

Tel : 03-8870 6000
Faks : 03-8870 6809
Web : http://www.mohe.gov.my

Rujukan Kami : KPT.600-8/2/5 JLD.3 (62)
Tarikh : 6 Februari 2018

Puan Chan Sane Hwui
Hse. No. 218, Phase 2
Lorong Palas 2
Taman Jindo Luyang
88300 Kota Kinabalu
SABAH
E-mel : shanee_0212@hotmail.com

Puan,

Permohonan Untuk Menjalankan Kajian Di IPTA / IPTS Di Bawah Kementerian Pendidikan Tinggi

Dengan segala hormatnya saya diarah merujuk perkara di atas.

2.   Dimaklumkan bahawa Kementerian ini tiada halangan mengenai permohonan puan untuk menjalankan kajian bertajuk :

"The Mediating Effect of Attitudes towards Teaching Science in the Relationship between Self-Efficacy Beliefs and Teaching Motivation on Behavioral Intention in Teaching Science Amongst Pre-Services Science Teachers in Sabah"

3.   Kebenaran ini adalah berdasarkan kepada cadangan penyelidikan yang dikemukakan puan ke Kementerian ini. <u>Walau bagaimanapun, kebenaran secara bertulis untuk mendapat dan menggunakan sampel kajian perlu diperoleh daripada Naib Canselor / Rektor / Presiden / Ketua Eksekutif / Pengarah / Dekan Fakulti/ di IPTA / IPTS yang berkenaan.</u>

4.   Puan adalah diminta untuk mengemukakan senaskah laporan akhir kajian ke Kementerian ini setelah kajian tersebut selesai dilaksanakan untuk tujuan rekod. Selain itu, sekiranya sebahagian atau keseluruhan hasil dapatan kajian tersebut hendak dibentangkan di mana-mana forum atau seminar atau hendak diumumkan melalui mana-mana media massa, kebenaran bertulis hendaklah dipohon terlebih dahulu daripada Kementerian ini.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menurut perintah,

(ANG LI LING)
Bahagian Perancangan, Penyelidikan dan Penyelarasan Dasar
b.p. Ketua Setiausaha
Kementerian Pendidikan Tinggi