

Direct and Indirect Effect of Teachers' Knowledge, Skills and Attitude on Teachers Behaviour: The Role of Teachers' Self Efficacy and Teachers' Belief as a Mediator

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Abstract

This study aims to identify the sub components of learning acquired from PD, namely teachers' knowledge, skill and attitude and their direct relationship with teachers' implementation of PBL STEM. This study also aims to identify the indirect relationship between knowledge, skill and attitude and implementation of PBL STEM, mediated by each of the two mediating variables examined in the study, namely teachers' efficacy and teachers' belief. The study is undertaken in schools selected by MoE to implement STEM PD and from then, use the PBL teaching method in the classroom. A total of 221 teachers participated in the study and data is analysed using Smart PLS 3.0. It was found in this study that two of teachers' learning components; knowledge and attitude has a direct relationship with teachers' behaviour in implementing STEM. Another component which is teachers' skill is not related to their behaviour in a direct relationship. In the indirect relationship, the first mediator, self efficacy mediates the relationship between teachers' skill and their behaviour as well as teachers' attitude and their behaviour but does not mediate the relationship between teachers' knowledge and behaviour. The second mediator which is teachers' belief mediates the relationship between teachers' knowledge and their behaviour as well as teachers' attitude and their behaviour but does not mediate the relationship between teachers' skill and behaviour in the indirect relationship. The type of mediator was determined for both self efficacy and belief and recommendations were made on the significance of the mediators in influencing transfer of teachers' knowledge, skill and attitude into their behaviour

Keywords. Professional development; knowledge, skill, attitude, behaviour, self efficacy; belief

1. Introduction

If PD is viewed as the solution to issues and challenges in the implementation of integrated STEM in the classroom, there exists a need therefore to systematically evaluate the programme. An evaluation of PD is desirable in order to investigate the training and its after-effect, specifically looking at the domains of teachers' learning comprising their knowledge, skill and attitude which will influence teachers' behaviour in the implementation of STEM PBL in their lesson (Kirkpatrick). Fore et al. (2015) highlights that evaluation on intervention through PD pays little attention to the process of teachers' learning, which refers to what takes place during PD. As in the context of this study, what is material is that whether there is knowledge, skill and positive attitude among teachers taking place as a result of attending the PD and whether these elements are translated into desired behaviour in the form of PBL implementation in their STEM lessons.

PD implemented by any organisation is deemed meaningful if the programme yields some form of return of investment. Therefore, programme such as STEM PD calls for properly planned evaluation to determine the extent it impacts the organisation. If

no evaluation is undertaken, information on whether knowledge, skills and positive attitude among teachers during PD will not be made available for decision maker and in the context of this study refers to MoE. Aside from that, there is a need to also determine whether the elements (knowledge, skills, positive attitude) are transferred into a change in classroom practice. If things do not turn out as planned, there is a need to also identify the issues and challenges faced and ways to resolve them. Besides, MoE as PD provider needs to identify the strengths and weaknesses of the programme so that teachers attending the PD will be equipped with knowledge and skills relevant to the teaching of STEM in an integrated manner. Moreover, information on whether the PD has enhanced teaching and learning process also needs to be made available in order to better the implementation of the programme if there is a need to retain the programme or expand it in the future.

Apart from that, if any outcome from PD needs to be further understood, an evaluation of the subjectivity components (perception, self efficacy and belief) need to be undertaken (Clarke 2009; Ghaani et al, 2021). In the context of the current study, questions that need further addressing are whether these subjectivity elements, namely self efficacy and belief

influence the implementation of STEM PBL as a new desired behaviour in classroom among teachers based on the acquisition of knowledge, skill and attitude from PD. In the case that these elements are not investigated, PD implementors will be armed with lack of information on whether learning has taken place among teachers after attending PD. Without this information, outcome from any PD will not be identified and recommendations for improvement of future PD cannot be made.

Learning as the second tier in this Kirkpatrick programme evaluation is seen as an important level of evaluation given that without learning (acquisition of knowledge, skill and positive attitude), change in behaviour will not occur (Kirkpatrick 1996). Alongside this, an evaluation of behaviour is deemed valuable since a change in behaviour indicates that learning, which comprises knowledge, skill and attitude exposed to teachers during PD is translated into implementation, which refers to new behaviour in the context of work or task (Kirkpatrick 1994).

In the field of education, teaching conducted by teachers has a close relationship with their knowledge. Wilkins (2008) emphasizes the significant relationship between teachers' knowledge about the subject they teach and their implementation of teaching. Knowledge at a low level about lesson to be carried out results in low confidence in enacting classroom activities. Consequently, knowledge among teachers on PBL approach in the teaching of STEM in an integrated manner ideally should be given focus given that such knowledge can influence the implementation of teaching. In other words, low level of knowledge on PBL approach may impede teachers in implementing lessons using PBL.

Further, Ngaisah et al. (2018) stated that apart from knowledge, high level of skill about a certain teaching approach (in the context of the current study, it is the PBL approach) also can drive teachers in implementing PBL steps, especially in guiding students to carry out investigation activity. Such activity is to provide students with the capability to construct knowledge on STEM concepts learned based on their participation in PBL. This approach which is a branch of constructivist approach provides teachers with the avenue to guide students to build their own knowledge which is not acquired from teacher-centred approach.

Abdullah et al. (2017) implemented a study among teachers and investigated their level of knowledge and skill in implementing thinking skills in Mathematics (one of STEM subjects). It was discovered in the study that the level of knowledge among teachers was high. The study also discovered a moderately positive correlation between knowledge about thinking skills and implementation of those skills among teachers. On teachers' skill in implementing thinking skills in Mathematics, the study discovered that the skill was at a high level and its correlation with implementation of thinking skills was also found to be moderately positive. These findings substantiated that the significance of

knowledge and skill among teachers in the implementation of thinking skills in their lesson.

Jones and Carter (2007) argued about the passion among researchers on the attitude element based on the fact that the basic model on attitude points to that element as the driving factor for a change in behavior and in the context of teachers, refers to the implementation of their teaching practice. In fact, according to Theory of Reasoned Action (TRA), a strong predictor for a change in behaviour is attitude (Ajzen 2001). This is testament to the fact that for teachers to implement change in their existing behaviour in classroom, a positive attitude toward the change is already sufficient.

In the context of STEM teaching, Osborne et al. (2003), Osborne and Dillon (2008) stressed on the positive attitude among teachers that will result in a better teaching which in turn will increase positive attitude among students towards STEM. Equally emphasized for a comparison between attitude and implementation among teachers, Jarret (1999), Mulholland and Wallace (1996), Palmer (2002) Tosun (2000) Yiung and Kellogg (1993) argued that teachers' negative attitude mainly stemmed from their own past experience which was equally negative while learning which has been brought along when they were undergoing teacher training.

Further, attitude as an element in the affective domain may be used to evaluate training programme (Kirkpatrick 1996). Participants undergoing training programme with a positive attitude will have the determination to implement the new behaviour acquired during training to their workplace despite facing hindrances. However, participants will give excuses to justify their reasons for not implementing the desired behaviour if the attitude among them is not positive towards change despite attending the programme.

With respect to motivation, it is seen as an important element in bolstering learning and application of knowledge and skills to workplace. As emphasized by Noe (1986), motivation influences change in behaviour when individuals attend PD. When the individuals are highly motivated, they are interested to learn and successfully follow the training until the end (Hicks 1984 in Noe; Schmitt 1986). Knowledge and skill gained from PD subsequently are fully benefitted at workplace. Thus, motivation, which in the context of this study is one component of attitude is crucial since it is seen as contributory towards outcomes of PD.

Motivation is also closely related to participants attending PD with regards to their expectation as well as attitude towards their work apart from attitude towards their career. Noe (1986) stated that participants' expectation about PD that they attend towards their career advancement is closely related to performance and a change in behaviour. In addition, teachers' commitment and teaching goal in their lesson bolster their motivation in learning new skill during PD and subsequently improve their performance in teaching.

This study aims to identify the sub components of learning acquired from PD, namely teachers' knowledge, skill and attitude and their direct relationship with teachers' implementation of PBL STEM. This study also aims to identify the indirect relationship between knowledge, skill and attitude and implementation of PBL STEM, mediated by each of the two mediating variables examined in the study, namely teachers' efficacy and teachers' belief. Specifically, the objectives of the study are as follow:

1. Identifying the direct relationship between knowledge, skill, attitude and implementation of PBL STEM among teachers who attended STEM PD
2. Identifying the indirect relationship between teachers' knowledge, skill, attitude and their implementation of PBL STEM through teachers' self efficacy as a mediator
3. Identifying the indirect relationship between knowledge, skill, attitude and implementation of PBL STEM through teachers' belief as a mediator
4. Identifying the type of mediator for teachers' self efficacy and teachers' belief

2. Methodology

The design of this study uses the survey method recommended by Babbie (2015) as the best method to gather data from a population. Cross-sectional survey is used in the approach of the current study whereby according to Creswell (2008), data collection is administered once and is easy to be administered when limited time is the issue. The survey method is seen as fitting to gather information on the variables in the current study and analyse the relationship between the predictive and the observed variables. Creswell (2008) and Mohd. Majid Konting (2000) emphasized that the survey method adopted in the current study is seen as befitting the objectives of the study to measure relationship between variables without questioning why and how the variables exist.

The quantitative data collected cross-sectionally correspond to the objectives of the study are to evaluate direct relationship between knowledge, skill, attitude and behaviour of teachers and indirect relationship between knowledge, skill, attitude and behaviour of teachers when mediated by teachers' self efficacy as well as mediated by their belief. For this purpose, a total of 221 questionnaires have been sent to STEM teachers at schools that are involved in the use of PBL approach in their lessons. Inferential analysis is utilised to answer research objectives. For this purpose, Smart-PLS Ver. 3.0 software is used to evaluate the structural model in testing the direct relationship between the variables and the indirect relationship between those variables with the mediators' presence proven and their type ascertained.

3. Results and Discussion

Based on Research Objective 1, the study aims to identify components of teachers' learning gained

from STEM PD, namely knowledge, skills and attitude and their relationship with teachers' behaviour in the classroom. Using the bootstrapping procedure in Smart-PLS which is then summarised in Table 1, teachers' knowledge acquired from STEM PD is found to correlate with teachers' behaviour ($\beta=0.207$, $t=2.637$, $p=0.008$). Similarly, teachers' attitude gained from PD is also found to correlate with teachers' behaviour ($\beta=0.219$, $t=2.052$, $p=0.040$). However, one component of teacher's learning namely teachers' skill exposed to them during STEM PD is found to not correlate to teachers' behaviour at a significant level ($\beta=0.204$, $t=1.752$, $p=0.080$). It can therefore be concluded that, from the STEM PD attended by the teachers in this study, their behaviour in the classroom referring to the implementation of the PBL teaching approach can be associated with the knowledge and attitude acquired from STEM PD.

Relationship	Path Coefficient, β	t value	p value
Knowledge-Behaviour	0.207	2.637	0.008
Skill- Behaviour	0.204	1.752	0.080
Attitude-Behaviour	0.219	2.052	0.040

Further, there is a need to identify the strength of the manipulated variables, (in this study, they refer to teachers' knowledge, skills and attitude gained from STEM PD) on the observed variable which is teachers' behaviour. The bootstrapping procedure in Smart-PLS, summarised in Table 2 yields the value of R^2 at 0.673 indicating that the total change of the manipulated variables is 67% has caused change in teachers' behaviour in the classroom. From this, it can be concluded that the remaining 33% change in teachers' behaviour is explained by other factors not investigated in the current study.

	R^2	t value	p value
Teachers' behaviour	0.673	17.619	0.000

A bigger R^2 indicates a more accurate prediction towards teachers' behaviour. However, there is not a fixed standard valued for R^2 considering the fact that it depends on the discipline of the study undertaken (F. Hair Jr et al. 2014). For instance, in the field of marketing, a value of R^2 of 0.75 and above is considered as having prediction and accuracy of supposition at a high level. In the field of human behaviour on the other hand, R^2 value generally reported is below 0.50 (Frost 2013). In the context of this study, prediction of teachers' behaviour investigated is on those who attended STEM PD as a training programme. Therefore, $R^2=0.67$ is seen as sufficient in explaining the changes in teachers' knowledge, skill and attitude that have caused a change in their behaviour.

Next, there is also a need to determine the effect size of teachers' knowledge, skills and attitude gained from STEM PD on teachers' behaviour. Apart from determining R^2 value for all the independent variables in the current study, a change in R^2 value when a certain independent variable is excluded from the analysis can also be utilized to evaluate whether that particular independent variable has a substantive effect on the observed variable. This is achieved through the approach of getting the effect size (f^2). To derive the value of f^2 , the following calculation is used:

$$f^2 = R^2_{included} - R^2_{excluded} / 1 - R^2_{excluded} \quad (1)$$

The value of $R^2_{included}$ and $R^2_{excluded}$ are values of R^2 for dependent variable when a certain independent variable is excluded (taken out) or included (put in) in the analysis. In order to derive the f^2 value, PLS calculation is performed everytime a certain independent variable is put in or taken out from the analysis. The value of f^2 for each of the independent variable is in Table 3.

	Behaviour
Knowledge	0.038
Skill	0.021
Attitude	0.047

Smart-PLS via bootstrapping procedure gives value of f^2 for knowledge, skills and attitude each at 0.038, 0.021 and 0.047 respectively. It can be concluded that, compared to knowledge and skills, it is attitude that has the largest effect size in predicting the changes in teachers' behaviour.

Next, after direct relationship between teachers' knowledge, skill, attitude and behaviour is tested and proven, the next analysis is aimed at testing teachers' self efficacy and teachers' belief as mediators. The analysis is on the indirect relationship between teachers' knowledge, skill and attitude on teachers' behaviour mediated by teachers' self efficacy and teachers' beliefs. Generally, study on the relationship between constructs are not just limited to only direct relationship but also indirect relationship involving mediating variable. Analysis as such is seen as providing information about the indirect effect of the predictive variables on the observed variable in the presence of a mediating variable.

For this purpose, steps taken are to analysis the indirect relationship between teachers' knowledge, skill, attitude and their behaviour via the inclusion of teachers' belief and teachers' self efficacy. Bootstrapping procedure in PLS with the use of 5000 sub-sample is used to explain the indirect relationship via each the mediating variables. This indirect relationship will explain the role and type of teachers' self efficacy and teachers' belief as a mediating variable. The Barron and Kenny's (1986) analysis for mediating variable is not used to test the role of mediating variable after the direct relationship between independent and dependent

variables are established to be significant. Instead, the Bootstrapping Bias Corrected and Accelerated approach is employed to test the presence of the mediating variable and its type at one go.

In order to determine the presence of self efficacy as a mediator, based on the Bootstrapping Bias-Corrected and Accelerated approach, analysis in Table 4 provided β value (0.281) for skill and β value (0.216) for attitude are both significant, each with t value (6.235) and t (4.273) respectively. The indirect effect 95% Boot CI Bias Corrected: (Lower Level (LL)= 0.065, Upper Level (LL)=0.251) and (LL= 0.076, UL=0.241) for skill and attitude respectively do not have the value of 0 straddling between LL and UL. This signifies that the mediating effect is statistically significant and the presence of self efficacy as the mediator in the indirect relationship of teachers' skill and their behaviour as well as in the indirect relationship of teachers' attitude and their behaviour. Nevertheless, based on the analysis, the β value (-0.0054) for knowledge is not significant with t value (1.724). In fact, the indirect effect 95% Boot CI Bias Corrected: (LL= -0.122, UL=0.000) for knowledge has the value of 0 straddling between LL and UL indicating no presence of self efficacy as the mediator in the indirect relationship between teachers' knowledge and teachers behaviour.

In order to determine the presence of belief as a mediator, based on the Bootstrapping Bias-Corrected and Accelerated approach, analysis in Table 4 provided β value (0.154) for knowledge and β skill (0.156) for attitude are both significant, each with t value (3.326) and t (3.440) respectively. The indirect effect 95% Boot CI Bias Corrected: (Lower Level (LL)= 0.065, Upper Level (LL)=0.251) and (LL= 0.129, UL=0.311) for knowledge and attitude respectively do not have the value of 0 straddling between LL and UL. This signifies the mediating effect is statistically significant and the presence of belief as the mediator in the indirect relationship of teachers' knowledge and their behaviour as well as in the indirect relationship of teachers' attitude and their behaviour.

Nevertheless, based on the analysis, the β value (0.029) for skill is not significant with t value (0.872). In fact, the indirect effect 95% Boot CI Bias Corrected: (LL= -0.028, UL=0.099) for knowledge has the value of 0 straddling between LL and UL indicating no presence of belief as the mediator in the indirect relationship between teachers' skill and teachers behaviour.

The role of teachers' self efficacy and teachers' belief as mediator towards their behaviour has been proven in the indirect relationship between the constructs in the current study. As a recapitulation, in the direct relationship, knowledge is related to behaviour. The indirect relationship between knowledge and behaviour is mediated by teachers' belief. Although, as discovered in this study, teachers' skill is not directly related to their behaviour, they are related in an indirect relationship when mediated by self efficacy. Next, in the direct

relationship, teachers' attitude is related to their behaviour. In the indirect relationship with behaviour, teachers' attitude is mediated by self

efficacy and the indirect relationship between attitude and behaviour is also mediated by teachers' belief.

Table 4. Indirect relationship between teachers' knowledge, skill, attitude and their behaviour through teachers' self efficacy and belief, each as a mediator

Indirect Relationship with Mediators	β	t value	p value	Upper Level (UL) (97.5%)	Lower Level (LL) (2.5%)	Mediator
Knowledge – Self efficacy- Behaviour	0.029	0.872	0.384	-0.028	0.099	No
Skill – Self efficacy- Behaviour	0.281	6.235	0.000	0.203	0.378	Yes
Attitude – Self efficacy- Behaviour	0.216	4.273	0.000	0.129	0.311	Yes
Knowledge – Belief- Behaviour	0.154	3.326	0.001	0.065	0.251	Yes
Skill – Belief- Behaviour	-0.054	1.724	0.085	-0.122	0.000	No
Attitude – Belief- Behaviour	0.156	3.440	0.001	0.076	0.241	Yes

p<0.05

A further question arises on the type of mediator for self efficacy and the type of mediator for belief. For this purpose, Hair et al. (2017), Nitz, Roldan and Cepeda (2016) recommend that more information can be interpreted from the effect of a mediating variable. McKinnon (2007) also emphasizes the types of mediator namely full and partial mediator. Partial mediator is further divided into complementary partial of competitive partial. In analysing the type of these mediators, their presence has to be proven first in the indirect relationship between teachers' knowledge, skill, attitude and their behaviour.

significant (p=7.574). Therefore, the first step to prove the significance of the relationship is complete.

Table 5. Indirect relationship when mediator is included in the analysis

	Original Sample (O)	Sample Mean (M)	Bias	t statistics	p value	2.5 %	97.5 %
skill -> behaviour	0.228	0.225	0.003	3.675	0.000	0.112	0.342
knowledge -> behaviour	0.184	0.186	0.002	3.534	0.000	0.083	0.286
attitude -> behaviour	0.372	0.379	0.007	7.574	0.000	0.264	0.457

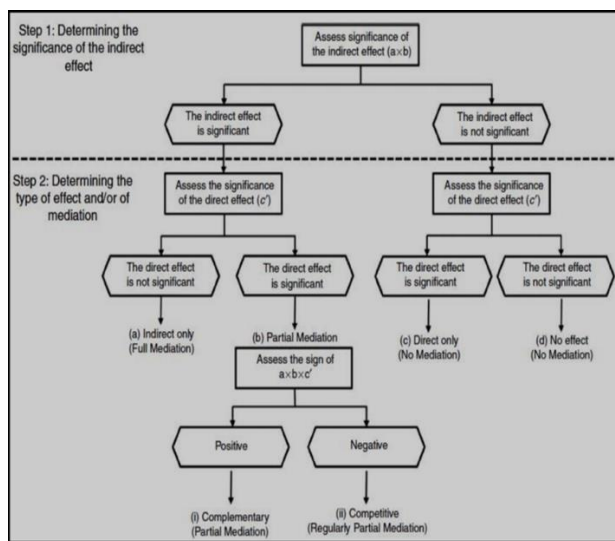


Figure 1. Mediator evaluation model (Zhao et al., 2010)

Based on the above analysis, the type of mediator is determined. The role of teachers' self efficacy and teachers' belief as a mediator has been proven in the indirect relationship involving the variables. Further, for the purpose of determining the type of mediator for teachers' belief which is found to mediate the relationship between knowledge and behaviour, the first step is to ascertain whether the indirect relationship between teachers' knowledge, skill, attitude and their behaviour is significant. From Table 5 it was discovered that in the indirect relationship, teachers' skill and their behaviour, β (0.228) is significant (p=3.675), teachers' knowledge and their behaviour, β (0.184) is significant (p=3.534) as well as teachers' attitude and their behaviour, β (0.372) is

The second step is to investigate the direct relationship among all the variables involved, one by one whether they are significant in order to determine on the type of mediator. Based on Table 4 self efficacy is proven as a mediator in the indirect relationship between teachers' skills and behaviour. Next, based on Table 5, the direct relationship between teachers' skills and behaviour β (0.204) is not significant (t=1.752). Therefore, based on Mediator Evaluation Model (Zhao et al., 2010), teachers' self efficacy in the relationship between their skills and behaviour is a full mediator.

Next, based on Table 4, teachers' belief is proven as a mediator in the indirect relationship between knowledge and behaviour. Based on Table 3 the direct relationship between knowledge and behaviour β (0.207) is significant (t=2.637). When the direct relationship is significant, the next step is to look at both Table 4 and Table 5 to ascertain whether there is negative or positive value at any of the figure for the direct and indirect relationship. If, there is only positive value in all relationships, the mediator is considered as complementary partial mediator. On the other hand, if there is a negative value in any of the relationship, the mediator is considered as competitive partial mediator. In Table 4 and Table 5 for direct relationship and indirect relationship between knowledge and behaviour, there is no negative value at any figure. Therefore, it can be concluded that in the indirect

relationship between teachers' knowledge and behaviour mediated by teachers' belief which is complementary partial mediator.

Next, based on Table 4, teachers' self efficacy is proven as a mediator in the relationship between attitude and behaviour. Teachers' self efficacy is also proven as a mediator in the relationship between attitude and behaviour. Further, the direct relationship between teachers' attitude and behaviour β (0.219) is significant ($t=2.052$) based on Table 5. First, to determine the type of mediator for self efficacy that mediates the relationship between attitude and behaviour, Table 4 and Table 5 are referred for indirect and direct relationship which did

not show negative value for any of the figure in both relationships. Therefore, it can be concluded that relationship between attitude and behaviour mediated by self efficacy is determined from the analysis as partial complementary mediator. Next, to determine the type of mediator for belief which mediated the relationship between attitude and behaviour, Table 4 and Table 5 are also referred for direct and indirect relationship between attitude and behaviour which did not show negative value for any of its figure in both relationships. Therefore, it can be concluded that relationship between attitude and relationship mediated by belief which is determined from analysis as partial complementary mediator.

Table 5. Direct relationship between knowledge, skill, attitude self-efficacy, belief and behaviour

	Original sample (O)	Sample Mean (M)	Std. Deviation (STDEV)	T Statistics (O/STDEV)	p value
Self efficacy -> behaviour	0.113	0.121	0.139	0.816	0.415
Belief -> behaviour	0.198	0.198	0.073	2.698	0.007
Skill -> self efficacy	0.525	0.522	0.077	6.846	0.000
Skill -> belief	-0.184	-0.188	0.107	1.728	0.084
Skill -> behaviour	0.204	0.199	0.116	1.752	0.080
Knowledge -> self efficacy	0.055	0.059	0.057	0.968	0.333
Knowledge -> belief	0.523	0.529	0.082	6.340	0.000
Knowledge -> behaviour	0.207	0.206	0.079	2.637	0.008
Attitude -> self efficacy	0.404	0.403	0.061	6.668	0.000
Attitude -> belief	0.529	0.527	0.066	8.034	0.000
Attitude -> behaviour	0.219	0.216	0.107	2.052	0.040

4. Conclusion

From the three sub elements of learning, two of them; namely teachers' knowledge and teachers' attitude are directly positively and significantly related to their behaviour. One remaining sub element of learning which is teachers' skill does not have a statistically significant relationship with their behavior.

One implication from this study is the reinforcement to the Kirkpatrick Evaluation Model which states that each level in the model as having relationship to the next level in the model. However, when one level in the model (learning) is investigated in this study, there is an implication that there is one dimension (teachers' skill) that is not directly related to the level below (teachers' behaviour) in the model.

The significantly positive relationship discovered in this study provide insights on the relationship of each element in teachers' learning and their behavior. The first sub element of learning; knowledge is found to have a significantly positive relationship and contribute to the change in teachers' behaviour. Therefore, knowledge with the three aspects investigated in the study; knowledge about STEM Initiative, knowledge about STEM PBL needs and knowledge about steps in implementing PBL need to be continuously emphasized in next PD.

One sub element of learning which is teachers' skill which was found in the study as not having a direct relationship with their behaviour provides another

new insight on the relationship between levels in Kirkpatrick Evaluation Model, especially when it involves more than one element or dimension in one level. On the other hand, aspects of teachers' skill investigated in this study namely skill about STEM PBL needs and skill which are discovered as not contributing to their behaviour calls for further research in order to understand the rationale of these aspects. In addition to that, given that teachers' skill which is found to not have a direct relationship with and contribute to their behaviour, it provides opportunity to improve and reinforce that element in STEM PD, especially when teachers' skill is also discovered in this study to only be at a moderate level.

For the third sub element of learning which is teachers' attitude, it was discovered in the study that such element has a positively significant relationship with their behaviour. Therefore, the relationship and the significant contribution of attitude toward their behaviour as discovered in the study reinforce the Kirkpatrick Evaluation Model and are also capable of providing insight on the importance of evaluating attitude in teachers' learning during PD. Besides, aspects of teachers' attitude in this study being motivation, self concept and attitude towards job satisfaction should be further emphasized in next PD. Further, what can be gathered next from this study is the implication to the theory on the role of self efficacy as a full mediator between teachers' skill and their behaviour indicating an understanding from the discovery in this study that both variable do not have

a direct relationship. When self efficacy is tested in the indirect relationship between the two variables, there is an established relationship with self efficacy functioning as a full mediator. Therefore, the implication from the study is the comprehensible explanation that the skill on PBL exposed to teachers during PD influences their self efficacy which in turn influences their behaviour. Such a discovery adds to the existing body of knowledge and provides avenue in the body to expand concept, theory and existing learning model adopted by PD's especially the ones that integrate self efficacy as a mediator.

Next, another implication to the theory from this study is the role of belief as a mediator in the relationship between teachers' knowledge and their behaviour indicating another understanding about knowledge that is already directly related to behaviour. When belief is tested as a mediator in the indirect relationship between teachers' knowledge and their behaviour, there exists a relationship between these two variables and belief functions as complementary partial mediator. Therefore, an implication from such a finding is that knowledge on PBL exposed to teachers influence their belief along with their behaviour and that their belief also influences their behaviour. Discovery as this also adds new information to the body of knowledge in expanding concept, theory and existing learning model adopted by PD's especially the ones that integrate belief as a mediator in the relationship between teachers' knowledge and their behaviour.

The final implication to the theory is on the role of self efficacy as a mediator between teachers' attitude and their behaviour and the role of belief as a mediator, also between teachers' attitude and their behaviour, both indicating a new insight that can be gathered from this study. Attitude towards PBL exposed to teachers in PD is already directly related to their behaviour. When self efficacy is tested as a mediator in the relationship between teachers' attitude and their behaviour and behaviour is also tested as a mediator in the relationship between teachers' attitude and their behaviour, there exist a relationship between attitude and behaviour resulting in self efficacy and belief taking up the role as complementary partial mediator. An implication from this discovery is that attitude exposed to teachers during PD influences self-efficacy as it does behaviour and belief. Self efficacy and belief also influences behaviour. Discovery like this also adds new knowledge to the existing body and expands concept, theory and existing learning model adopted by PD's especially the ones that integrate self efficacy and belief as a mediator in the relationship between teachers' attitude and their behaviour

As a takeaway from this understanding, PD implementor should ensure that in their effort to expose teachers with the skill on PBL, teachers' self efficacy needs to also be nurtured in order that the skill acquired by teachers in PD is translated into practice. Self efficacy can be nurtured among others,

through the exposure on PBL to teachers, coupled with micro teaching activities, not just limited to hands-on activities only. These micro teaching activities will complement the skill and hands-on components exposed to teachers. Apart from that, the micro teaching activities are capable of gathering feedback from colleagues who attend PD as well as from the trainer in order for him to effectively implement the approach in the classroom.

In an effort to expose teachers to knowledge about STEM and PBL, teachers' belief should not be ignored given that both knowledge and belief are complementary in ensuring that the desired behaviour is translated into classroom practice. Similarly, in providing exposures to teachers on attitude towards change and in the current study, that attitude refers to PBL which is the selected teaching approach in implementing change in the classroom, so self efficacy and belief should also be nurtured alongside attitude given that self efficacy and attitude as well as belief and attitude complement each other in ensuring that teachers translate the attitude exposed to them during PD to a change in their behaviour in the classroom regarding their teaching approach.

One of the contributions in this study with regard to findings from the evaluation of STEM PD is the expansion to the Kirkpatrick Training Model. Apart from evaluating training programme using the existing factors in the model: reaction; learning (knowledge, skill and attitude); behaviour, other factors contributing to the change of behaviour such as self efficacy and belief are also investigated regarding behaviour and transfer of training content to work place. Therefore, these two new elements should be focused by MoE in ensuring that teachers' behaviour is transformed to what has been desired from attending STEM PD. This focus ideally should be explicit and intentional in order for the elements nurtured remain positive to maximize change.

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