Epistemological Beliefs of Secondary School Students: Relation Goal Orientations, Learning Approaches, and Science Achievement

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ABSTRACT: The present study was conducted to examine the mediational role of achievement goal orientations and learning approach on the relation between epistemological beliefs about science and students' science achievement. This study was carried in the form of a survey, using questionnaires as a method of data collection. A total of 302 students (168 males, 134 females) between the age of 15-16 years old in Pahang, Malaysia participated in the study. Structure Equation Mode (SEM) was used to validate the proposed model. The result showed that epistemology beliefs exert a significant direct effect on science achievement. Mastery goals mediated the relationship between source and science achievement. Mastery, performance, and avoidance goals also mediated the relationship between certain and science achievement significantly. Mastery and avoidance goals mediated the relationship between development and science achievement. For the mediation role of learning approach, deep approach mediated the relationship between source and science achievement and also mediated the relationship between justification and science achievement. The result also showed that there are no significant differences between boys and girls. The results might be
INTRODUCTIONS

In tertiary Malaysian education systems, awareness of the indispensability of education is increasing, a transformation has been made. In Malaysia, Primary School Standard curriculum has been implemented in stages since 2011 and will be fully implemented in 2016. Students in the level of secondary school in Malaysia have often been reported to lack motivation and learning approaches (Habshah et al., 2013). Educators have been concerned for years about the decline in achievement and motivational beliefs of students. Although learning has become the most important issue in psychology today, it is one of the most difficult concepts to define because the importance and complexity of the paradigm shift in education are in progress concerning the way educators view students.

Educators have concluded that learner’s views about the nature of learning and knowledge may affect their reasoning modes, learning approaches and decisions when acquiring and processing information (Hofer, 2001). Thus, in general, students who are highlighting the process of knowledge construction and interpretation tend to utilize better cognitive strategies and attain higher learning outcomes than those holding more shallow views or beliefs about the nature of knowledge and learning process. In this context, the basic pillars of any educational society are to learn to act, learn to know and also learn to live together. From this perspective, learning is understood in a broad sense, as learning about oneself, an inner journey and at the same time as the process of forming relationships with others (Barvarz, Nami & Ahmadi, 2014).

In Malaysia context, competition is fairly widespread when students enter into school, and grows stronger as they progress through the grades. In a competitive learning environment, students attempt to outperform each other, or attempt to avoid being less competent than others (Ong, 2014). In the Malaysian context, a sense of competition for good results and grades is felt at all levels of education to various degrees. A reason for that is that grades usually are part of what determines entrance into the next level of education or into attractive programs with limited access, or into a good university. A general claim is that students aiming for good grades design their study activities to fit the exam requirements, giving less attention to the course
objectives and scheduled learning activities, if these are not well aligned with what is important in order to get good exam grades. Kvale (1980) found that "grade behavior" made students in high schools moving their self-image towards grade identification, shifting motivation towards a focus on rewards (extrinsic motivation), and adopting a surface approach to learning. This is behavior that is contrary to the educational goals expressed in policy documents, namely student independence, peer cooperation, self-development, intrinsic motivation and a deep approach to learning (Ghorban, 2007).

Specifically, competitive learning environments are performance-focused, where the emphasis is on grades, public displays of ability, and performances that are compared to those of others (Elliot, McGregor & Gable, 1999). One factor that promotes a performance-focused learning environment is an emphasis on Malaysia school examinations, which is a dominant form of assessment in secondary schools. In such an environment, students' academic success is based largely on the marks they achieve in the examinations held at school and national levels. Consequently, lower and higher secondary students spend a large percentage of their time preparing for the examinations. However, educators are trying to find ways to motivate students by creating mastery-focused learning environments where the emphasis is on students' effort, continuous understanding, and improvement in the subject. Such environments focus on students' interest and knowledge acquired in the subject area, rather than the performance outcome of the subject (Leonadri & Gialamas, 2002).

Education in Malaysia is considered foundational to the nation's development. Over the years, there has been a tendency for Malaysian to judge students' capabilities based on their grades. It is common for parents to judge their children, depending on the marks the child receives at school (Abdulla, 2008). Parents also compare their children's scores and judge their children's intelligence based on these scores, with the result that parents view their children as less competent when they score worse than other children. Hence, a highly competitive learning environment exists in the country's education sector (Barkur, 2013).

Literature reviews show that the significant relation between students' epistemology beliefs, their goal orientations, and also their learning approach is supported (Duperyat, 2005, Diseth, 2011). For this reason, students' epistemology beliefs ought to be taken into account when their beliefs about goal orientations and learning approach are examined. The current empirical study examined the above variables in different theoretical frameworks and their influences on students' academic performance (Bandalos, Finney, &
Although there has been a substantial body of findings supporting the separate strands of research inquiry, very few researchers if any have explored these inquiries in totality. From this focus, the premise of this study is also based on the theoretical and empirical contention that students' sociocultural settings may play a pivotal role in influencing the factors that are under investigation.

In the Malaysian context, some research in Malaysian studies about epistemological beliefs on science by Nabeel Abedalaziz et al. (2013) and Habshah et al. (2013). Research by Barvarz, Navi and Ahmadi (2014) in the study of the relationship between epistemological beliefs and academic performance of students showed that it has no relationship between rate learning and academic performance. Based on the local study, the present study has to refine and extend the model of motivational variables as explanatory factors of Science achievement in the Malaysian context. There is the gap in the literature that identifies and links the predictors to students' academic success. Therefore, this study will attempt to identify and link the salient predictors to students' academic success in the Malaysian context.

Generally, the objective of this study is to examine a meditational model to see if epistemology beliefs are related to students' science achievement, mediated by achievement goals and learning approach. Different specific pathways will be used to test the model to examine the indirect relation on science achievement. Based on the theory of epistemology beliefs, achievement goal theory and theory of learning approach, the achievement model will be tested on the students. The questions and hypothesis assess whether there are any relationships between the predictor variables to the achievement in Science. 1. Do goal orientations mediate the relationship between epistemology beliefs to science achievement? The goal orientation construct includes (mastery, performance approach, and performance-avoidance). We hypothesized that goal orientation mediate the relationship between epistemology beliefs to science achievement 2. Do learning approaches mediate the relationship between goal orientation to science achievement? The learning construct includes (deep and surface learning). We hypothesized that learning approaches mediate the relationship between goal orientation to science achievement.

Table 1.: Conceptual Framework of the effect of epistemology beliefs, achievement goals and learning approaches in Science achievement. Source : Schommer,M.,Christy & Gianna,G. (1997)
PREVIOUS ACADEMIC EXPOSURE IN VARIABLES

Zaeema Riaz Ahmad, Saba Yasir, & Riaz Ahmad (2014) had used the Structural equation modelling techniques to test a three-path mediational model of mathematics achievement on the relationships among higher secondary students' beliefs about mathematical ability, achievement goals, learning strategies, and mathematics achievement. Participants were higher secondary students who were studying advanced level mathematics at the Centre for Higher Secondary Education, one of the largest schools that provides higher secondary education in the Maldives. The result of the study showed that Incremental beliefs had a positive relation with mathematics achievement, mediated by mastery goals and deep learning strategies. Incremental beliefs had a negative relation with mathematics achievement, mediated by performance-approach goals and surface learning strategies. Entity beliefs had a negative relation with mathematics achievement, mediated through performance-avoidance goals and surface learning strategies. Incremental beliefs also had an overall indirect positive relation, and entity beliefs had an overall indirect negative relation with achievement. The results of the mediational model showed the best possible pathways that students could follow in the academic setting as far as performance and building capacity in mathematics were concerned.

Achievement goal theory explains and predicts the relations among goals, achievement-related behaviours, such as learning strategies, and achievement in academic settings (Ames, 1992; Dweck & Leggett, 1988; Pintrich, 2000). For instance, Bandalos et al. (2003) investigated the relations among goals, processing strategies, and achievement for undergraduates who were taking a course in statistics. They found that mastery goals were related to deep processing, performance goals were related to disorganisation, and
deep processing was related to achievement. However, though they measured learning and performance goals, they did not make a distinction between performance-approach and performance-avoidance goals. Thus, results from Bandalos et al. (2003) and similar studies provided a basis for investigating the relations among goals, processing, and achievement. However, it is important to measure these relations for performance-approach and performance-avoidance goals because previous research has shown that these goals have different relations with learning strategies and achievement (e.g., Cutinho & Savia, 2008; Kaplan & litchiniger, 2009).

Seo and Taherbhai (2009) found performance-approach goals were more strongly related to cognitive/metacognitive strategies and achievement than performance-avoidance goals, and Kaplan and litchiniger (2009) found performance-approach goals were more strongly related to study organisation than performance-avoidance goals. Further, Cutinho and Savia (2008) found students who adopt performance-avoidance goals were more disorganized in their studies than students with performance-approach goals and found students’ performance-approach goals were positively and performance-avoidance goals were negatively related to their achievement. Thus, a trichologist goal framework was used in the present study to provide a more detailed investigation of the role played by different types of goals in mathematics achievement.

Bernardo (2003) found deep learning strategies were positively related to academic achievement, whereas surface learning strategies were negatively related to academic achievement. Similarly, Crawford et al. (1998) found that deep learning strategies were positively related to mathematics achievement, whereas surface strategies were negatively related to mathematics achievement for university students. Thus, both deep and surface learning strategies were used in the present study to explore the role played by the depth of learning in mathematics achievement.

Chan and Lai (2006) used path analysis to investigate the relations among goals (i.e., mastery, performance approach, performance-avoidance), strategies (i.e., deep-processing and surface-processing), and academic achievement for secondary students in Hong Kong. They found that mastery goals were positively related to both deep-processing and surface-processing. Conversely, performance-approach and performance-avoidance goals were positively related to surface-processing. Neither deep nor surface processing strategies were significantly related to achievement. While the relation between goals and strategies was expected, the lack of relations between strategies and achievement was surprising given that deep processing
strategies are often positively related to performance, whereas surface processing strategies are often negatively related to achievement.

In the another study, similar to that of Cha and Lai (2006), Liem et al. (2008) studied the impact of trichotomies goals and learning strategies on English achievement for Year 9 students in Singapore. They found that mastery goals were positively related to both deep and surface learning strategies. Performance-approach goals were positively related to deep learning strategies, whereas performance-avoidance goals were positively related to surface learning strategies. The results also indicated that deep learning had a direct positive relation, and surface learning had a direct negative relation with English achievement. Similar to Chan and Lai (2006), this study, in general, showed the relation among goals, strategies, and achievement but some differences appeared as far as the relations demonstrated in the model.

Liem et al. (2008) found that performance-approach goals were positively related to deep learning strategies, but this relation was non-significant in Chan and Lai's (2006) study. This difference could be because these two studies tested the variables in different academic contexts. For example, the academic context in Liem et al. (2006) was English language learning in Hong Kong while Chan and Lai (2006) focused on academics in general. From the methodological point of view, this study also had a large sample size for conducting a SEM study. The model explained 44% of the variance (i.e., equivalent of .78 of Cohen's f2) in English language achievement by goal orientations and learning strategies variables. According to Cohen (1992), a value of f2 greater than .35 produces large effect size. The study also tested alternative models to identify the limitations of the original model and to increase the fit of the model used. However, the authors did not conduct a principal component analysis (PCA) or an exploratory factor analysis (EFA) procedure, which would have been important to test the dimensionality of the variables and extract the exact number of factors that accounted for the maximum number of the variance from the variables of the study.

Simons et al. (2004) also used path analysis to investigate the role of goals, study strategies, and achievement for Belgium students in a nursing program. For these students, mastery goals (referred to as task goals in the article) were positively related to deep processing, excitement, persistence and regular studying, and negatively related to surface level processing. Approach ego (performance-approach) and avoidance ego (performance-avoidance)
goals were positively related to surface-level processing. However, both performance-approach and performance-avoidance goals were negatively related to deep learning strategies. The results also indicated that deep-level processing, persistence, and regular studying were positively related to students' performance, whereas surface-level processing was negatively related to performance.

Similar to Chan and Lai (2006) and Liem et al. (2008), this study also used achievement goal theory to investigate the relations among goals, strategies, and achievement. However, results from Simon et al. differed from Liem et al. (2008). For example, in Liem et al. (2006) mastery goals were not related to surface learning strategies, but Simons et al. found a negative relation between mastery goals and surface learning strategies. Similarly, Simon et al. did not find a relation between performance-approach goals and deep learning strategies, but Liem et al. (2008) found a positive relation between the two. These differences could be due to the fact that Liem et al.’s (2008) study used secondary students while Simon et al. (2004) used college students of 18-45 years or Liem et al.’s (2008) study was on English language while Simon et al.’s (2004) study was on nursing program.

Furthermore, in contrast with Chan and Lai (2006), and Liem et al.’s (2008), Simon et al. (2004) used principal component analysis (PCA) with varimax rotation to reduce the dimensionality of the factors used in the study. It is a strength of this study compared to Chan and Lai (2006) and Liem et al. (2008) which did not use any procedure to identify the dimensionality of the factors used. However, the method and the type of rotation used in the study can be questioned. PCA does not account for errors in doing the procedure and varimax rotation is one of the orthogonal rotations where the factors are assumed to be uncorrelated. That study, however, used many variables and tested the relation among them and assumed correlations among them. Exploratory factor analysis (EFA) which accounts for the measurement error while measuring the factors, a rotation (e.g., an oblique rotation) that assumes the correlation among the factors, could have been a better choice for Simons et al. Further, the effects size values were not provided to explain the percentage of variance in the achievement predicted from other independent variables. This was a limitation of the study.
Vrugt and Oort (2008) also used path analysis to investigate the relationships among achievement goals, learning strategies and achievement for Dutch students enrolled in a psychology course. The relationships were tested between group of students who were more effective and less effective at self-regulation. In both of the groups, it was found that mastery and performance-approach goals were positively related to deep-processing strategies. In both the groups, performance-approach goals were also positively related to surface-processing strategies. However, in the more effective group, performance-avoidance goals were not related to either deep or surface cognitive strategies whereas in the less effective group, performance-avoidance goals were negatively related to deep strategies, and were not related to surface strategies. Although surface-processing strategies in the both the groups showed a negative effect on examination scores, surprisingly deep processing strategies did not show any effect on examination scores. Some of the Vrugt and Oort's results, in general, differed from Simons et al. (2004) study. For instance, Simons et al. (2004) showed that only mastery goals were related to deep-processing strategies, which in turn were related to achievement.

Finally, in this category, Al-Emadi (2001) tested the relationships among goal orientation, study strategies, and achievement for 424 United Arab Emirates high school students who were enrolled in various introductory courses in different faculties, including humanities, social sciences, science, engineering, law, and economics. The students completed questionnaires designed to measure trichotomies goal orientations (mastery, performance approach and performance avoidance) and specific learning strategies (deep processing, surface processing). Mastery goals were positively related to deep processing, and surface processing; performance-approach goals were positively related to surface processing but were not related to deep processing; performance-avoidance goals were positively related to surface processing, but were not related to deep processing. When surface processing strategies were positively related to achievement, deep processing strategies were not significantly related to the achievement. The study, in general, highlighted the importance of achievement goal theory and how goals are related to study strategies and subsequent achievement.
Take together, all the studies showed that mastery goals were positively related to deep learning strategies, while three studies (Al-Emadi, 2001; Chan & Lai, 2006; Simons et al., 2004) showed that mastery goals were negatively related to surface learning strategies. Only Liem et al. (2008) showed that performance-approach goals were positively related to deep learning strategies, while all the studies except Liem et al. (2008) and Al-Emadi (2001) showed that performance-approach goals were positively related to surface learning strategies.

Study of variables that are associated with academic achievement, is one of the main topics of research in educational systems. Over the past two decades, educational experts have brought attention to study the factors affecting academic achievement, especially the "cognition" more than before. One of the most important theories in this area is self-regulated learning theory. The main framework of this theory is based on how the students organize their learning. Pintrich (2000b) defines the self-regulated learning as an active process that the learner set and control his learning activities, cognition, motivation, and behaviour.

Some researchers have studied the relation between epistemological beliefs and using behavioural and motivational strategies and indicates that there is a relation between these components and the academic achievement (Paulsen and Feldman 2005, 2007). Despite the importance of epistemological beliefs and using self-regulatory learning strategies in academic achievement, no research has been studied the relationship between cognitive and metacognitive components of self-regulated learning strategies and epistemological beliefs with academic achievement simultaneously. The present study intends to determine the predicting role of each aspect of epistemological beliefs and self-regulated learning strategies (cognitive-metacognitive) on academic achievement.

Other groups of researchers like Kizilguunes et al, (2009) have found that higher level of beliefs in source and development of knowledge were related to higher levels of the performance goal, learning goal, and self-efficacy. Although the relation between beliefs about the source of knowledge and learning approach was found to be negative, the relation between beliefs about developmental nature of knowledge and learning approach was positive.
Results also indicated that certainty beliefs were negatively associated with performance goal and learning goal. Similarly, beliefs about the justification of knowledge were found to be negatively related with all achievement motivation variables except learning goal. Certainty beliefs and justification beliefs were positively associated with learning approach. In addition, although learning goal was positively related to meaningful learning, performance goal and self-efficacy were negatively related to the learning approaches. The direction of the relation between learning approaches and achievement was positive.

Some previous investigations like Cano (2005) found that epistemological beliefs exert a significant direct effect on academic achievement. Cano explored the effects of secondary school students' epistemological beliefs on their learning approaches. Cano's study also showed that epistemological beliefs affected academic achievement directly and indirectly through students' learning approaches. Cano concluded that the relation between epistemological beliefs and academic achievement is mediated by approaches to learning. His study also indicated that throughout the secondary education years, epistemological beliefs and learning approaches to change. Although students' epistemological beliefs become more realistic and complex, their learning approaches become less meaningful. Collectively, the aforementioned studies show that students with sophisticated epistemological beliefs and those who adopted meaningful-learning orientation for learning were likely to perform better than were those holding naive beliefs or using rote-learning orientation. Indeed, studies focusing on learning approaches have suggested that there is a statistically significant association between students’ learning approaches and their science achievement.

This lends support to some results reported by Ravindran et al (2005), found that combinations of goal and belief variables were involved in the explanation of variance. Those findings contribute uniquely to the literature on goals and epistemological beliefs. Learning and performance goals demonstrated the expected positive relationships with cognitive engagement; learning goal explained substantial variance in meaningful engagement scores, whereas performance goal explained substantial variance in shallow engagement scores. Also consistent with theory, it found that having a naïve belief about authority meant that one was less likely to report engaging
meaningfully with course materials, and having a naïve belief that knowledge is simply meant that one was more likely to report engaging in shallow strategies.

Supporting this proposition, Tsai (1998) claimed that learners' scientific epistemological beliefs may shape their meta-learning and hence affect their learning approaches. Past research has identified two approaches to learning: meaningful approaches (deep approaches to learning) and rote approaches (surface approaches to learning). Learners' choice of using rote memorization as a mode of learning is called surface- or rote-learning orientation. However, when students choose to deal with a learning task and attempt to relate newly learned and previously learned concepts, students' learning orientation is known as deep or meaningful.

Rasoul Barvarz, Yaghoob Nami, Somayeh Ahmadi (2013) had determined the relationship between the epistemological beliefs and academic performance of students. With 385 students of two universities were chosen in random sampling. In order to analyse the parameters of the research researcher used epistemological beliefs questionnaire (2007). The questionnaire used in this research is standard, fur there more its validity and reliability are confirmed by .74 coefficients. Regression in step by step form and for special question Pearson correlation test is used. There is a meaning linear relation between Academic performance and knowledge speed aspect about the main question and there is only a meaning negative relation between knowledge speed aspect and academic performance about a special question and there is not any relation to any other aspects.

Study the relationship between epistemological beliefs and academic performance of students has not a relationship between rate learning and academic performance the rest of relations has resulted in significant. The results of such research findings & Conley, A. ,Pintrich , Vekiri I. & Harrison (2004) and similar studies are inconsistent. The dimensions of epistemological beliefs and knowledge organization with the highest average speed are the average of the lowest. But the meaning of that beliefs are derived from knowledge of the rate that can be paid to the evaluation they have taken reasonable speed, which is a deep understanding and grasp material Action to improve academic performance. And adopt the beliefs of naive and superficial
Leads to a superficial understanding of the learning rate, which is the low performance is avoided.

Miller (2010) investigated the relationship between students' beliefs about intelligence (entity and incremental beliefs), academic goals (mastery, performance approach, and performance-avoidance), study behaviour (self-handicapping strategies and effort), perceived ability, and achievement. Participants were 152 undergraduate students in an introductory psychology course in the US. Using the correlation analysis it was found that incremental, and entity beliefs were positively related to mastery goals, while no other relations between theories of intelligence and goal orientations were demonstrated. Mastery goals were positively related to effort, while none of the goal orientations showed the relation with self-handicapping. However, self-handicapping were positively related to the achievement. Several hypotheses were also developed, and the hypotheses were tested using single chi-square and analysis of variance. However, none of the hypotheses was confirmed.

Educational psychologists are interested in understanding the mediational processes that occur via relationships among variables. In a study in which a causal relationship exists, "a mediational analysis provides the researcher with a story about the sequence of effects that lead to something" (Kenny, 2008, p.354). A mediator or an intervening variable indicates the measure of the process through which independent variable impacts the dependent variable (Iacobucci, Saldanha, & Deng, 2007). Mediation is essential to research because it allows the researcher to conduct scientific investigations, where the intriguing part is to explain how something comes about from something else (Kenny, 2008). Mediational effects are common in social sciences.

**METHODOLOGY**

**Participants and procedure**

This study will carry in the form of the survey, using questionnaires as a method of data collection. Total of 302 students (168 males, 134 females) form 3 and 4 students in Pahang, Malaysia participated in the study. Approval
by the Educational Planning and Research Division (EPRD), the Malaysian Ministry of Education.

The samples were selected from a district out of 14 districts randomly chosen from National Secondary Schools located in states of Pahang. As such, Kuala Lipis, Raub, and Bentong had been selected. 7 schools will be selected. 3 classes from each school by using the table of random numbers.

This study is a quantitative study that relied on self-report data using a survey method and science achievement data collected from students. To analyze the data for the meditational model for the present study, SEM techniques, and confirmatory factor analysis will be used. The steps in this conventional approach of structural equation model are to determine suitable theory as the basis or foundation for the research, develop the model and specify the model. Then, a process of determining the sample from a population and continued with data collection process. The assumption process will be utilizing on the model and at this point, it should fit the model. If it cannot fit the model, then the model will run the modification and assumption again and if the model achieves the standard fit, the process of analyzing the data and discussion over the result can be implemented (Kaplan et al., 2002). This technique can be used as a viable tool to assess measurement errors and provide explicit estimates of the relationship between variables.

**Measures**

**Epistemological Beliefs Questionnaire (EBQ)**

Epistemological beliefs were measured along with a 26 item instrument adapted from the previous work with elementary science students (Elder, 2002) Item were rated on a 5 point Likert scale (1=strongly disagree, 5= strongly agree), and all questions were worded to have students focus on the domain of science. Previous studies have reported reliabilities for scales in the Epistemological Beliefs Inventory as ranging from .62 to .81. Source (5 item, .72), Certain (6 item, .61), Development (6 item, .65), Justification (9 item, .81). For the present study, the Cronbach's alpha valued is 0.90, an acceptable level of reliability.
Achievement Goal Orientation

Achievement goals were measured by using the Achievement Goal Scale developed by Middleton and Midgley (1997). The scale measures three kinds of goals: mastery, performance approach and performance-avoidance goals. The achievement goals scale was adapted from Middleton and Midgley (1997) and include three subscales, with six items assessing mastery goals (e.g., "In a course like this, I prefer class materials that really challenge me so I can learn new things."). Six items measuring performance-approach goal (e.g. I want to do well in this science course to show my ability to my family, friends, advisors, or others.) and six items measuring performance-avoidance goal (e.g. I wish this science course was not graded.) These Cronbach alphas were .75, .70 and .72. This instrument was used to assess achievement goal orientation as a predictor of students' academic success.

Learning approaches

Students approach their learning in different ways, operating in response to a series of motivations, internal and external to themselves. The terms describe the way students tackle their learning. Learners may use deep or surface strategies, or a combination of both throughout their studies. The current study used Duff’s 2004 Revised Approaches to Studying Inventory (RASI), a 5-point Likert scale. This instrument used to assess approaches to studying as a predictor of academic success relative to the deep and surface approaches. In the present study, it had an acceptable reliability of Cronbach's alpha .78 (Hair et al., 2006).

Science achievement

Performance in Science measured by collecting students' year-end result. Test Academic achievement is measured by grade point averages in Science.

Data analyses

Data analysis was conducted using a model-fitting program named (AMOS) (Version 22) and IBM SPSS Statistics (Version 22). One of the advantages of using model-fitting programs over multiple regression procedures is that it explicitly notes the error variance associated with the variables in the model, and simultaneously assesses all the path coefficients of the entire model (Meryer et al., 2006). In this study, we tested a structural model examining the relationships between epistemology
beliefs through the mediating role of the achievement goals and learning approaches, using path analysis. The goodness of fit was assessed by examining several indices. We selected these various fit indices to include measures of both absolute degrees of freedom and comparative fit index. In addition, the root means square error of approximation (RMSEA) was chosen to indicate the error in the approximation of the hypothesized model to the population and the RMSEA 90% confidence interval (RMSEA 90% CI). The adequate fit is normally assumed when comparative fit indices are equal to or greater than 0.90. Root mean square errors of approximation smaller than 0.08 indicate fair fit (Hu & Bentler, 1999). The meaning of model rejection is the opposite for the test of close fit and not the close fit, with the former suggesting a good fit of the model and the latter indicating a poor fit of the model. In addition, the test of close fit is the one that is readily available through various SEM packages, thus making the investigation most relevant to practical researchers. So, in this article, we propose two tests that make use of the CI in a consistent way, using the criteria of a lower bound of CI ≤ 0.05 and upper bound of CI ≤ 0.1 as two candidates cut off values. Rejection of the model thus suggests a poor fit in both tests.

RESULTS

Descriptive statistics

Descriptive statistics, alpha coefficients, and correlations among the variables are presented in Table I. A preliminary confirmatory factor analysis (CFA) carried out at the individual item level across all of the items and constructs to be included in the empirical model. Each of the constructs in this overall model was treated as a latent variable and its respective items were used as observed variables. The science achievement outcome was also treated as a latent variable. This overall CFA model provides (a) a correlation matrix among measured variables by taking into account their unreliability measurement, and (b) a baseline of comparison for all subsequent SEM models that are nested under this model.

The CFA model, and all other SEM models tested in this study, was run using AMOS and the model fit was evaluated by the following indices: the ratio between chi-square and degree of freedom (χ2 / df), the comparative fit index (CFI), the root mean square error of approximation (RMSEA), the standardized root-mean-square (SRMR), and the Tucker-Levis index (TLI), Value of χ2 / df that fall below 5.00, CFI above .90 , RMSEA below .08 ,
SRR at .05 or below, and TLI values close to .95, especially for large samples, are indicative of good fit. The fit indices indicate that in this data fit the overall CFA model very well: $\chi^2/df=2$, CFI = 1.00, RMSEA = .013, and TLI = .997. Factor loadings for the epistemology belief range from 0.840 to 0.606 and goal orientations items ranged from 0.746 to 0.656, for the learning approaches items ranged from 0.646 to 0.604. All loadings were significant at $p<.001$.

**Discriminant Validity**

Discriminant validity is the extent to which a construct does not correlate with measures of another construct (Hair et al., 2006). Discriminant validity is said to be present when the amount of variance shared between a construct and its indicators is more than the amount variance shared among other constructs of the study (Fornell, Tellis, & Zinkhan, 1982). In general, discriminant validity checks whether the constructs are different from one another. To assess the discriminant validity of a particular construct, the correlations between the constructs are compared with the square root of the value of the AVE for that particular construct (Teo & Koh, 2010). In Table 1, the figures across the diagonal in bold represent the square root of the AVE values for the individual constructs. Other values represent the correlations among the constructs.

Discriminant validity of a particular construct is present if the diagonal value for that construct is greater than the strength of correlations the construct has with other constructs. The data in Table 2 indicate that all the constructs satisfied this criterion, indicating that discriminant validity was satisfactory for all constructs.

<p>| Table 1 Mean, standard deviation and Correlations among the variables in the study |
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<tr>
<td>DEV</td>
<td>3.306</td>
<td>5.517</td>
<td>0.252</td>
<td>-0.095</td>
<td>-0.042</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>IMP</td>
<td>3.58</td>
<td>3.858</td>
<td>0.221</td>
<td>0.157</td>
<td>-0.165</td>
<td>0.145</td>
<td>1</td>
<td>1</td>
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<tr>
<td>JUST</td>
<td>3.919</td>
<td>5.373</td>
<td>0.323</td>
<td>0.046</td>
<td>-0.005</td>
<td>0.668</td>
<td>0.266</td>
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<tr>
<td>MAS</td>
<td>4.616</td>
<td>3.614</td>
<td>0.56</td>
<td>0.205</td>
<td>-0.174</td>
<td>0.273</td>
<td>0.356</td>
<td>0.444</td>
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<tr>
<td>PER</td>
<td>3.872</td>
<td>4.148</td>
<td>0.581</td>
<td>0.276</td>
<td>0.018</td>
<td>0.146</td>
<td>0.218</td>
<td>0.259</td>
<td>0.608</td>
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<tr>
<td>SOU</td>
<td>3.331</td>
<td>3.002</td>
<td>0.184</td>
<td>0.339</td>
<td>0.077</td>
<td>0.123</td>
<td>0.077</td>
<td>0.205</td>
<td>0.395</td>
<td>0.265</td>
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<tr>
<td>SFC</td>
<td>3.045</td>
<td>4.138</td>
<td>0.394</td>
<td>0.193</td>
<td>-0.129</td>
<td>0.327</td>
<td>0.397</td>
<td>0.489</td>
<td>0.601</td>
<td>0.456</td>
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Pertaining to this model, correlations provided initial support for hypotheses of how epistemology beliefs and learning approach would be related to mediator and outcome variables. All construct of goal orientations were correlated positively with epistemology beliefs construct. It could be classified as a good factor for high Science achievement for students. Consistent with hypotheses, epistemology beliefs also were correlated positively with science achievement. Significant correlations between Epistemology beliefs and goal orientations and between learning approaches and epistemology beliefs suggested that goal orientation and learning approaches were appropriate for inclusion as a potential mediator in this study. Overall, correlations among study variables were small to moderate, and ranged from -.09 to .668.

**The mediation role of Goal orientations**

Mastery goals mediated the relationship between source and science achievement ($z = 2.45$, p<.05), but performance-approach goals ($z = -0.63$, p<.05) and avoidance-approach ($z=1.68$, p>.05) did not mediate this relationship. Mastery, performance and avoidance goals mediated the relationship between certain and science achievement ($z = -5.85$, p < .05, $z=3.90$, p<0.05 and $z= -2.52$, p<.05) significantly. Mastery, performance and avoidance goals also mediated the relationship between justification and science achievement ($z =6.80$, $z=-3.55$, $z=2.43$, p < .05) significantly. Mastery and avoidance goals mediated the relationship between development and science achievement ($z = -3.05$, $z=2.43$, p < .05) but performance goals not ($z=1.36$, p>.05) mediate this relationship.

**The mediation role of Learning Approach**

Deep approach mediated the relationship between source and science achievement ($z =-2.71$, p <.05) and also mediated the relationship between justification and science achievement ($z = -1.98$, p < .05). Surface-mediated the relationship between development and science achievement ($z = -5.86$, p < .01), and also mediated the relationship between source and science achievement
CONCLUSION

The confirmatory factor analysis suggested that each item retained in the subscales that measured students' beliefs about science achievement. The achievement goals and learning strategies had good factor loadings ranging from .62 to .82. The associated composite reliability estimates for the latent variables were high which indicated that they adequately represented their respective underlying latent variables in the structural model. Furthermore, the results of the preliminary analysis demonstrated that for all the constructs, the convergent and discriminant validity was adequate.

When examining the mediational relationships among the variables in the model (i.e., epistemology beliefs -> goals -> achievement). Mastery goals mediated the relationship between source and science achievement (z=2.45, p <.05), but performance-approach goals (z= -0.63, p<.05) and avoidance-approach (z=1.68, p>.05) did not mediate this relationship. Mastery, performance and avoidance goals mediated the relationship between certain and science achievement (z = -5.85, p <.05, z=3.90, p<0.05 and z= -2.52, p<.05 )significantly. Mastery, performance and avoidance goals also mediated the relationship between justification and science achievement (z =6.80, z= -3.55, z=2.43, p <.05) significantly. Mastery and avoidance goals mediated the relationship between development and science achievement (z =-3.05, z=2.43, p <.05) but performance goals not(z= 1.36, p >.05) mediate this relationship. These findings are also consistent with research Cano (2005) findings.

The second relationship tested in the mediational model was the relationship between epistemology beliefs and learning approach (epistemology beliefs ->learning approach->achievement). Findings were consistent with previous research. For example, the relationship between justification and deep-learning approach was positive and consistent with findings from a number of studies (e.g., Al-Emadi, 2001; Chan & Lai, 2006; Liem et al., 2008; Simons et al., 2004; Vrugt & Oort, 2008).
The present study show, deep learning approaches positively predicted Science achievement through mediation development and justification, a finding that was consistent with Liem et al. (2008) and Simons et al. (2004), while surface processing negatively predicted achievement through mediation source and certain, a finding that was consistent with Liem et al. (2008), Simons et al. (2004), and Vrugt and Oort (2008). In contrast, this finding was inconsistent with Al-Emadi (2001), who found that surface processing had a positive effect on mathematics achievement, while deep processing had no effect. Similarly, the relationship between source and surface learning strategies was negative and consistent with finding from these same studies, with the exception of Liem et al. (2008), Simons et al. (2004), and Al-Emadi (2001). This indicates that Malaysia secondary students who compete to outperform their peers do not use deep learning strategies; instead they use surface learning strategies in science. As we know secondary education is the time to develop students' critical thought and learning to learn. Students should learn to develop more meaningful learning approach and know how to use deep approach for better achievement. The findings show that students with weak result did not explore in deep approach. Although students usually have predominant or preferred learning approaches, it reflects teaching methods, students perceptions of the curriculum and assessment procedures in our education systems did not bring to learning approaches. Students prefer to focus on the substances of information and only emphasize rote learning and memorization techniques will bring to the goal of avoiding failure, instead of grasping key concepts. The deep learning is important for the students to earn higher grades, and retain, integrate and transfer information at higher rates (Ramsden, 2003). Additional, deep learning is associated with an enjoyable learning experience while the surface approach tends to be less satisfying (Ramsden, 2003).

The results of present study proposed model make three clear contributions to work carried out to date in our educational systems. First, epistemology beliefs exert a significant direct effect on science achievement. This lends support to some findings by other researchers (Schommer 1993, Wan Ismail, 2011) which suggest that students who believe that learning occurs gradually and knowledge is an organized structure. Similar to Schommer (1993) results, the factor certain knowledge has a significant effect on science achievement via goal orientation. Two facts may explain this (1) this factor was the last to emerge in the factor analysis, that is, it accounted for the lowest percentage of the variance, and (2) it obtained the lowest reliability
coefficient when high reliability is an essential requisite when analyzing variables using LISREL.

Second, learning approach also significantly influence science achievement. In keeping with conclusions reached in other investigations (Vrugt, A., & Oort, F. J., 2008; Diseth, Å., 2011), students who study with a surface approach to learning tend to perform weakly, while students with deep approach will score excellently. We would assert that these results enable us, on the one hand, to extend to all subjects. Teachers need to identify the learning preferences and learning styles of their students. The understanding of how best the students learn could then be matched with pedagogical approaches deemed appropriate for learning to take place at the optimal level. Students should be challenged with science tasks and projects of varying levels of difficulty. They need to discover science issues and uncover answers for themselves, by applying knowledge learned in class. Among the science, pedagogical approaches that teachers could use include problem-based learning, discovery learning, and constructivism.

Third, the present study brings to light the mediation of goal orientations and learning approaches. Results of a study by Cano (2005) and Tsai (1988) discovered a significant link between epistemology beliefs and learning approaches and academic achievement. By profiling individual students' goal orientation to learning science, educators will become more aware of the students' attitude, perception and ability towards science and science learning. Drawing on the students' goal profile, the teachers on the personal level, or the school on a more general ground, could come up with appropriate intervention strategies to address specific problems in aspects the students are found lacking. These include the provision of specific guidance or help such as alternative pedagogical approaches that will complement their existing learning strategies and learning styles, change of perception towards individual ability and attitude in science learning, and additional classes to improve science proficiency. Finally, relevant aspects pertaining to factors influencing science learning outcomes could and should be incorporated into the curriculum and when developing textbooks.

Two implications arise from this finding, first, it enriches Biggs (1995) theoretical model on learning. Epistemology beliefs and learning approaches are important variables to the factor characteristics of the student performance. Second, the present study confirms the existence of a link
between the two mediation. As far as course planning is concerned, it is necessary to take into account students' learning approaches and goal orientations. That way, we might avoid students' defective understanding of course contents and subsequent deterioration in achievement. Secondly, as educators, we should enhance the depth of learning approaches and the complexity of epistemology beliefs. Teachers and educators, in general, could tap into the appropriate learning activities that Science the meaning of learning concept. That is the change in students' beliefs as the progress through secondary educations, could also favor this alignment and reflection in teaching and learning.

The linkage between academic performance and epistemological beliefs has been documented previously (Schommer, 1993b) and continued work is needed to understand the mechanisms by which this occurs and the nature of the mediating variables. Further studies that explore the possible linkages between motivation, self-efficacy, learning strategies, and epistemological beliefs. In conclusion, this study provides an initial attempt to empirically test the dimensions of epistemological theories as identified across the literature (Hofer & Pintrich, 1997). More work is needed to flesh out these dimensions in self-report measures so that further studies can be done to tap the relation between epistemological theories and other aspects of academic learning.

In further research, it would be very interesting to analyse the role of other variables, namely contextual variables, in the relationships between motivational beliefs and the use of learning strategies. It is becoming evident that the effective use of such strategies is not necessarily given. It needs to be learned and fostered by adequate learning settings. More research is also needed to analyse in greater depth and increase our understanding of the multiple relations and dynamics of interactions between all these variables. This could be achieved by means of structural equation modelling, which allows the development of complex models. Another way is to adopt an in-depth qualitative approach which gives access to richer, contextualised, holistic descriptions and is more oriented to revealing complexity (Brewer & Hunter, 1989). Finally, we would like to see this type of research extended to other populations from different subject-matter areas and institutional settings.
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