Epistemological Beliefs and Attitudes towards Physics and Physics Learning among Malaysian STEM Students in Selangor, Malaysia

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Abstract: The poor achievement of students in STEM related subjects especially physics is considered somewhat less satisfactory mainly due to the learning processes and the students' epistemological belief towards Physics. The purpose of this study is to evaluate the epistemological beliefs and learning attitudes among Malaysian STEM students in Selangor towards Physics and Physics learning. The study identified 120 Malaysian STEM students who undertook Physics from a few schools in Selangor to participate in this research. This is descriptive quantitative research. In order to monitor their beliefs towards Physics and Physics learning, an instrument called The Physics Epistemological Beliefs & Attitudes Test was developed. A valid and reliable measuring instrument was adapted and modified from two previous well-known and validated tools namely, Colorado Learning Attitudes about Science Survey (CLASS) and Maryland Physics Expectations Survey (MPEX). The findings of the study indicated that Malaysian STEM students possess highly sophisticated epistemological beliefs with the mean score of 72.61% and were favourable in learning Physics with the mean score of 74.29%. In this study, substantial differences in both tests were absent in between male and female students. However, significant differences between Form 4 and Form 5 students in epistemological beliefs as well as learning attitudes existed. Pearson correlation gathered shows that the relationships between the epistemological beliefs and learning attitudes among the students were high, positive and very significant ($r = .672$, $p < .05$). The results of this study are vital in conducting effective teaching and learning approaches particularly to upgrade the students' performance and achievement in Physics at schools. Hence, based on this, it would be interesting to further explore the following aspects of epistemological beliefs which focuses on the learning approach used by the students in schools and higher institutions of learning in Malaysia with different variables.

Keywords: Epistemological beliefs, Gender, Learning attitude, Learning Physics, STEM students

1. Introduction

In Malaysia, the Ministry of Education (MOE) is optimistic that the ratio of 60:40 between STEM (Science, Technology, Engineering and Mathematics) stream and non-STEM students can be achieved by 2020 through students' early exposure towards integrated science. MOE has also created initiatives in the Malaysian Education Blueprint (2013- 2025) that aim to increase teachers' and students' competencies in Science, Technology, Engineering and Mathematics (STEM) subjects and create learning experiences that will prepare students for the considerable array of STEM career fields (Rasid et al. 2020). However, in most Malaysian schools, the number of students pursuing STEM fields is still far behind as most schools only achieve about 20% to 40% enrollment for the science stream where STEM subjects are offered (Hoon et al. 2020).

In this current era, the world is facing challenges where future communities are losing interest in science subjects especially Physics (Salmiza, 2014). Physics is introduced to Malaysian students during their upper secondary school. Physics is taught in two years starting from Form Four and ends when the students are in Form Five. Physics is taught to enable students to grasp its concept and principles in depth along with how this knowledge can be applied in their daily lives. However, along the way, Physics has been perceived as a difficult subject and it is a common occurrence for students to have different conceptions and understanding related to the subject (Kiong, 2010). Majority students consider Physics as a difficult subject, mainly due to the learning processes and the students' epistemological belief towards Physics. Epistemological beliefs about Physics and Physics learning constitutes knowledge in Physics and how it is developed. Kortemeyer (2007) highlighted that the various levels of epistemological beliefs about Physics and Physics learning affect the ways students handle the aspects of knowledge sources as well as build the knowledge in Physics. Students' lack of understanding and poor mathematical skills in solving Physics problems are among the major obstacles in enrolling in the STEM stream.

Students' negative attitudes about Physics and limited interest in STEM is translated into low student enrollments and consequently in university Physics courses. Ibrahim (2019) and Guido (2013) reported that among the crucial factors affecting students' academic excellence are their attitudes towards their learning institutions, the lessons learnt and their perceptions towards academic success. They stated that the students' attitude and interests dominantly decide whether the students favour, disfavour or have neutral reactions towards science subjects. Favourable learning attitudes are vital for a STEM discipline since currently the declining number of students enrolling in STEM programmes is at a worrying state (Salleh, Nasir & Ismail, 2020). Therefore, the epistemological beliefs and attitudes towards Physics and Physics learning seem to influence learners in many aspects. It also triggers abundant Physics Education scholars to examine multiple dimensions of epistemological beliefs and attitudes among low to advanced learners. For instance, Zhang and Ding (2013) and Tang and Donnelly (2016) evaluated the possible associations between students' learning behaviour and their epistemological beliefs of conceptual comprehension and behaviour. Many researches have been carried out extensively about students' epistemological beliefs and attitudes towards Physics and Physics learning in correlation with different variables such as gender, age, grade level. On the other hand, it is important to note that the previous research did not possess any conclusive report on all the factors related to epistemological beliefs and attitude since each factor was evaluated separately. Based on these circumstances, it is best to determine the epistemological beliefs and attitude towards Physics and Physics learning held by the Malaysian STEM students in schools. Hence, this study intends to answer the following research questions:

1. What is the level of Malaysian STEM students' epistemological beliefs?
2. Is there any significant difference in mean score between grade level of Form 4 and Form 5 Malaysian STEM students?
3. Is there any significant difference in epistemological beliefs between male and female students?
4. What are Malaysian STEM students' learning attitudes in Physics?
5. Is there any significant difference in learning attitudes between Form 4 and Form 5 Malaysian STEM students?
6. Is there any significant difference in learning attitudes between male and female students?

7. Is there any significant correlation between epistemological beliefs and learning attitudes of Malaysian STEM students?

2. Literature Review

Investigations on epistemological beliefs and learning attitudes in Physics and learning Physics have been evaluated by many renowned Physics educators globally since a long time ago (Dreyfus, Hoehn, Elby & Finkelstein, 2019; Lin, Deng, Chai & Tsai, 2013; Ozkan & Tekkaya, 2011). Both the world of epistemological beliefs and learning attitudes are continuously dissected till today in many educational researches since the beliefs and attitudes crucially influence students' learning processes. They can possibly provide some overall predictions on many aspects of the students' learning styles.

In general terms, epistemology can be defined as a branch of philosophy that revolves around knowledge studies. On the other hand, scientifically, epistemology revolves around related issues in science that describe the processes of i) acquiring knowledge, ii) creating new knowledge, iii) drawing inferences, and iv) making sense of the knowledge (Sharma et al., 2013). The educational researchers have defined epistemological beliefs from various angles. Schommer (1994) began by merely describing epistemological beliefs as how individuals explore and create knowledge. These beliefs are normally related to the thinking processes such as reading for understanding as well as learning in complex, and ill-structured domains. Hofer and Pintrich (1997) later reminded that these epistemological beliefs are significant as they can influence students' cognitive developments. In parallel, as cited by Chen et al. (2019) in Adam et al. (2008), they further highlighted the importance of epistemological beliefs in shaping how individuals perceive the aspects of knowledge of nature and their productions.

For the purpose of this study, epistemological beliefs by students are commonly referred to as personal beliefs or assumptions that students hold towards Physics and Physics learning. It is believed that the students' epistemologies about the nature of knowledge may influence his/her learning and achievements. All individuals seem to hold different levels of beliefs which range from naïve to sophisticated hierarchy. For example, Hofer and Pintrich (2002), Ryan (1984) and Schommer et al. (1992) mentioned the levels of beliefs that have indirect impacts on students in understanding Physics which include their learning processes, textual understanding, and meta comprehension strategies. In addition, as for Settle and Knobloch (2004), they agreed that the different levels of epistemological assumptions and beliefs about Physics and Physics learning among students decide how the students acquire, structure and process the knowledge about Physics and Physics learning.

As for learning attitudes, they mean the ways students perceive or view things. Rosenberg and Hovland (1960) explained the theory of attitude by categorising it into three components of reactions namely emotion, cognitive and behaviour. Gagne (1979) elaborated attitude as a primary factor in preferring a subject and considered that attitude as a mental preparation for actions. He said that the actions are achieved through experiences and cause prompt influences upon the individual's responses towards all objects and situations connected to them. In the present study, attitude is generally regarded as the individual's prevailing tendencies to respond favourably or unfavourably towards Physics and Physics learning. Veloo and Khalid (2015) reported that individuals with a favourable attitude towards a subject, have more interests and subsequently put extra efforts to better excel in the subject. In contrast, negative attitudes towards the subject can possibly affect the learning processes as well as future career choices. Similarly, Godwin and Okoronka (2015) also suggested that positive attitudes towards certain subjects correlate extremely with their achievements.

Many researches have been carried out extensively by prominent researchers all over the world on epistemological beliefs and attitudes towards Physics and Physics. According to Kiong (2010) who researched on undergraduates, discovered that students' epistemological beliefs correlate profoundly with their learning attitudes towards Physics education which include interests, motivations and learning readiness. Furthermore, as stated by Paulsen and Feldman (2005), their findings tallied with much earlier reports which found that students' epistemological beliefs are significantly correlated to their learning motivation. As stated by Cano (2005), Tsai (2000), Lodewyk (2007), Milnerbolotin (2011), Zhang (2013) and Abraham (2015), the studies revolved around the students' epistemological beliefs and attitudes towards Physics and Physics in correlation with their gender, age, grade level, ethnicity, socioeconomic status, academic disciplines, academic performance, learning styles,

classroom settings, attitudes towards science, self-regulated learning techniques, and self-efficacy beliefs.

The present study therefore hopes to further extend the research particularly on gender. To illustrate the previous research, Abraham (2015) devoted to studying the correlations between students' gender and their beliefs about Physics and learning Physics. The study carried out by Kiong (2010) found the academic scores in Physics learning among female undergraduates are higher in comparison with the male undergraduates. Meanwhile, Abraham and Barker (2015) concluded that the gender roles do not determine the students' levels of capabilities and self-reliant learning. In addition, Fatoba and Aladejana (2014) discovered that the attitudes of female students are more positive than male students when learning Physics.

Besides, students' grade and education levels are also instrumental to influence students' epistemological beliefs and attitudes in learning Physics. As for the grade levels, Kiong (2010) concluded that final year undergraduates who reign higher grading than their first year juniors have higher epistemological beliefs and learning attitudes respectively too. In addition, Kurt (2009) found that tenth grade students possess more prominent epistemological beliefs and learning attitudes than their sixth and eighth grade counterparts since the former have more advanced beliefs in basic knowledge, knowledge certainty and knowledge development. Similarly, Schommer (1994) discovered the students' epistemological beliefs grow accordingly as students develop in grade levels. As for education levels, Schommer (1998) determines that the higher education levels among adults may impact their epistemological beliefs more significantly as they progressively undergo knowledge evolution and complexity.

To examine the students' epistemological beliefs and attitudes towards Physics and Physics learning, several reliable and validated tools have been used (Kiong, 2010; Chen, 2019). Somehow, there are only four most widely utilised instruments in assessing students' beliefs regarding physical science as well as student learning. They are Maryland Physics Expectation survey (MPEX) developed by Redish et al. (1998), Colorado Learning Attitudes about Science Survey (CLASS) discovered by Adams et al. (2006), Epistemological Beliefs Assessment about Physical Science (EBAPS) built by Elby et al. (1999), and Views About Science Survey (VASS) set by Halloun and Hestenes, (1985). As for assessing students' attitudes and beliefs, an instrument known as CLASS seems to dominate many research choices. CLASS instrument, which was built on three existing instruments of MPEX (Redish et al., 1998), EBAPS (Elby et al., 1997), and VASS (Halloun & Hestenes, 1985) are widely manipulated by science education researchers (Douglas, et al. 2014). Consequently, so as to achieve the objectives of this present study, two instruments have been chosen which are MPEX and CLASS, developed by Redish et al. (1998) and Adams et al. (2006). The two tools are believed to provide clear overviews regarding students' epistemological beliefs and learning attitudes towards Physics and its learning as a subject.

Even though the epistemological beliefs and attitudes have been extensively studied for numerous years in Western countries, similar patterns are still absent in Asian countries. As in Malaysia, there are only a few studies or educational researches conducted to gauge students' epistemological beliefs towards learning Physics among the local STEM students in schools based on their gender and grade levels. Therefore, it is interesting to conduct a study on the epistemological beliefs and learning attitudes among Malaysian STEM students towards Physics and Physics learning based on their demographic background namely gender difference and grade levels. This study may provide significant findings about the epistemological beliefs of secondary school students and its effects on the students' performance and their comprehension.

3. Methodology

Research Design

For the purpose of this study, the research employed descriptive research design in which a set of questionnaires was used as the instrument in analysing the students 'epistemological belief and students 'attitude in learning Physics.

Population and sampling

This present study is conducted to investigate the epistemological beliefs and learning attitudes among Malaysian STEM students in Selangor, Malaysia towards Physics and Physics learning. The population in this study consisted of Form 4 and Form 5 science stream students who took Physics in schools. However, there is a limitation on getting a larger sample size due to the declining number of science stream classes in most schools in Selangor. Hence, 120 Malaysian STEM students who enrolled in Physics classes from various secondary schools in Selangor were randomly selected.

Research Instrument

An instrument regarding students' epistemological belief and students' attitude towards learning physics were designed and disseminated to the schools to be given to the respondents. The respondents are ready to cooperate with the researchers and agree to join the study. Respondents were required to answer the questionnaires honestly within 30 minutes during school hours, arranged by the school administrators. The questionnaires were then collected after the respondents had completed their answers. An instrument consisting of two parts was used in the study, one for measuring the epistemological beliefs and the other, for determining students' attitudes towards Physics and Physics learning. As for the instrument, items from two well-known and validated instruments namely, Colorado Learning Attitudes about Science Survey (CLASS) and Maryland Physics Expectations Survey (MPEX) were adapted. However, the respective items were constructed and designed to suit secondary level students. The constructs of epistemological beliefs were categorised based on four subscales namely Structures of Physics Knowledge (10 items), Applications of Physics Knowledge (7 items), Acquisitions of Physics Knowledge (10 items) and Problem Solving in Physics (9 items). Subsequently, the subscales for measuring the students' attitudes in learning Physics comprise three components which are Interests (9 items), Motivation (9 items) and Learning Readiness (9 items). The statistical reliability of the two variables of epistemological beliefs and learning attitudes were identified as high (0.77, 0.87) respectively. Based on literature, α=0.70 is acceptable and shows that its reliability is quite good (Altunışık, Coşkun, Bayraktaroğlu et al., 2007) as cited in Sü Eröz (2019). The 5-point Likert-scale in the questionnaires was used to measure the students' epistemological beliefs and attitudes towards Physics and Physics learning.

Data Analysis

The Statistical Package for the Social Sciences (SPSS) programme version 21 was utilised in the data analysis. Descriptive statistics such as means and standard deviations were calculated to describe the students' degree of epistemological beliefs and attitudes towards both Physics and Physics learning. Meanwhile, inferential statistics such as independent sample t-test and Pearson correlation were used in this study. Independent sample t-test was further performed to determine if there is any significant difference between gender and grade levels respectively with epistemological beliefs and learning attitudes towards Physics and Physics learning. The study also conducted Pearson correlation in measuring the correlations between epistemological beliefs and learning attitudes among Malaysian STEM students towards Physics and Physics learning.

In this study, the levels of epistemological beliefs among Malaysian STEM students were compared to the range of scores suggested by Hestenes and Wells, and Swackhamer (1992). A score range of (68-100%) is classified as "High", (34-67%) is classified as "Moderate" and (0-33%) is classified as "Low". As for the learning attitudes variable, the score range of (50-100%) is categorised as "Positive" learning attitudes while score range of (0-49%) is classified as "Negative" learning attitudes.

4. Results

4.1 Malaysian STEM students' epistemological beliefs

The results of the study are reported according to the research questions in this section. The first research question is "What is the level of Malaysian STEM students' epistemological beliefs?" and the results are presented in Table 1. In this study, epistemological beliefs are classified into three sophistication levels, namely high level (68%-100% score), moderate level (34%-67% score) and low level (0%-33% score). As shown in Table 2, the mean score for the four subscales of epistemological beliefs calculated shows that there was a high level of sophistication beliefs for all the subscales with the overall mean score of 72.61%. This shows that Malaysian STEM students had high sophisticated beliefs about Physics knowledge. The mean scores for each subscale are 74.35%, 75.21%, 71.18% and 70.22% respectively. The "Application of Physics knowledge" has the highest mean score (75.21%) among the Malaysian STEM students in epistemological beliefs for Physics and Physics learning. The respondents agreed that knowledge in Physics is very important and useful in their real life.

Table 1. Levels of epistemological beliefs among Malaysian STEM students (N=120)

Epistemological Beliefs Score	Levels
0 – 33%	Low
34 – 67%	Moderate
68 – 100%	High

Source: Adapted from Hestenes, Wells, and Swackhamer (1992)

Table 2. Mean score for epistemological test

Subscales	Mean Score (%)	Levels
Physics Knowledge Structures	74.35	High
Physics Knowledge Applications	75.21	High
Physics Knowledge Acquisitions	71.18	High
Problem Solving in Physics	70.22	High
Overall	72.61	High

4.2 Epistemological beliefs between grade level of Form 4 and Form 5 Malaysian STEM students

H_0: There is no significant difference in epistemological beliefs between grade level of Form 4 and Form 5 Malaysian STEM students.

H_1: Form 5 Malaysian students have higher epistemological beliefs towards Physics compared to Form 4 Malaysian students.

The second research question was "Is there any significant difference in mean score between grade level of Form 4 and Form 5 Malaysian STEM students?" Table 3 shows that by grade levels, Form 5 Malaysian STEM students obtained higher mean scores (M=3.78; SD=0.44) in comparison to Form 4 Malaysian STEM students (M= 3.55; SD=0.34). From the t-test analysis, it can be interpreted that the two grade levels; Form 4 and Form 5 STEM students, differed significantly in epistemological belief towards Physics and learning Physics with $t(118) = 3.18$, $p < 0.05$. Consequently, it can be deduced that, Form 5 Malaysian STEM students own higher sophistication of epistemological beliefs in Physics as compared to the lower grade level Form 4 students, making the null hypothesis rejected.

Table 3. Independent sample t-test for epistemological beliefs between Grade Levels of Form 4 and Form 5 Malaysian STEM students

Variable	Form	N	Mean	Std. Deviation	t	Df	Sig. (2-tailed)
Epistemological Beliefs	Form 4	80	3.55	0.34	-3.18	118	.00
	Form 5	40	3.78	0.44			

4.3 Gender difference in epistemological beliefs

H_0: There is no significant difference in epistemological beliefs between male and female students.

H_1: Male students have higher epistemological beliefs towards Physics compared to female students.

The third research question was "Is there any significant difference in epistemological beliefs between male and female students?" The findings in Table 4 shows that female Malaysian STEM students (M= 3.63; SD=0.38) generally had higher epistemological beliefs in comparison to the male learners (M=3.62; SD=0.40). In other words, female students are more mature and developed mentally as based on the epistemological beliefs towards learning Physics. The independent sample t-test was conducted in order to determine the significant contribution based on gender differences in epistemological belief towards Physics and learning Physics between these students. The overall t-test revealed that there was no significant difference in epistemological beliefs towards Physics and learning Physics between male and female students, $t(118) = 0.08$, $p > 0.05$. Thus, it can be presumed that both groups undergo similar Physics learning experiences, hence it is experience that greatly influences their epistemological beliefs rather than their gender. Accordingly, the null hypothesis is somehow accepted.

Table 4. Independent sample t-test for Malaysian STEM students' epistemological beliefs based on gender differences

Variable	Gender	N	Mean	Std. Deviation	t	Df	Sig. (2-tailed)
Epistemological Beliefs	Male	53	3.62	0.40	-.08	118	.93
	Female	67	3.63	0.38			

4.4 Malaysian STEM students' learning attitudes in Physics

The findings in Table 5 were analysed based on the research question "What is Malaysian STEM students' learning attitudes in Physics?" It presents the calculated mean score for each subscale in the Physics learning attitude test. Based on the findings, it can be seen that "Motivation in learning Physics" subscale obtained the highest mean score of 75.37%, followed by "Interest in learning Physics" (74.33%) and "Readiness in learning Physics" (73.16%). The overall mean score for Malaysian STEM students' learning attitude is 74.29% which means that the majority of the students had a positive or favourable attitude towards Physics learning. It can be concluded that in general, the attitude towards learning Physics was good among the Malaysian STEM students based on interests, motivation and readiness to learn Physics.

Table 5. Malaysian STEM students' learning attitudes on Physics (N=120)

Subscale	Mean Score (%)	Learning attitude
Interests in Learning Physics	74.33	Positive
Motivation in Learning Physics	75.37	Positive
Readiness in Learning Physics	71.16	Positive
Overall mean score for students' attitudes towards Physics and learning Physics is 74.29%		

4.5 Learning attitudes between grade level of Form 4 and Form 5 Malaysian STEM students

H_0: There is no significant difference in learning attitude between grade level of Form 4 and Form 5 Malaysian STEM students

H_1: Form 5 Malaysian STEM students have more favourable attitudes in learning Physics compared to Form 4 Malaysian STEM students.

Next research question was "Is there any significant difference in learning attitudes between Form 4 and Form 5 Malaysian STEM students?" Table 6 shows that Form 5 Malaysian STEM students (M=3.85; SD=0.48) achieved higher mean scores in comparison to Form 4 students (M= 3.64; SD=0.42). Higher mean score indicates better interests, motivations and readiness in learning the subject. Moreover, an independent sample t-test highlighted the significant contribution of differences in learning attitudes between the Form 4 and Form 5 Malaysian STEM students. The overall t-test results revealed that learning attitudes between Form 4 and Form 5 students differed prominently, $t(118) = 2.36$, $p < 0.05$. Apparently, Form 5 Malaysian STEM students acquired more positive or favourable attitudes in learning Physics compared to Form 4 students. Hence, the null hypothesis was again rejected.

Table 6. Independent sample t-test for learning attitudes between Form 4 and Form 5 Malaysian STEM students

Variable	Form	N	Mean	Std. Deviation	t	Df	Sig. (2-tailed)
Learning Attitudes	Form 4	80	3.64	0.42	-2.47	118	.01
	Form 5	40	3.85	0.48			

4.6 Gender difference in Physics learning attitudes

H_0: There is no significant difference in learning attitudes between male and female Malaysian STEM students.

H_1: Male students have more favourable learning attitudes in learning Physics compared to female students.

Table 7 shows the analysis of findings based on the research question "Is there any significant difference in learning attitudes between male and female students?" The finding shows that female Malaysian STEM students (M=3.76; SD=0.48) obtained higher mean scores in comparison to male Malaysian STEM students (M= 3.65; SD=0.41). Higher mean score represents favourable attitudes towards learning Physics. In other words, female Malaysian STEM students showed more favourable learning attitudes, more interest and motivation in learning Physics as compared to the males. As for the overall t-test for Physics learning attitudes, it reveals that there are no statistically substantial differences across gender in learning attitudes, $t(118) = 1.38$, $p > 0.05$. That means, in terms of significant differences across gender, an independent sample t-test proves that male and female Malaysian STEM students shared the same favourable attitudes in learning Physics. Hence, the null hypothesis is somehow accepted.

Table 7. Independent sample t-test for gender differences in Physics learning attitudes

Variable	Gender	N	Mean	Std. Deviation	T	Df	Sig. (2-tailed)
Learning attitudes	Male	53	3.65	0.41	-1.38	118	.16
	Female	67	3.76	0.48			

4.7 Relationship between epistemological beliefs and learning attitudes of Malaysian STEM students

H_0: There is no significant relationship between epistemological beliefs and learning attitudes of Malaysian STEM students.

H_1: There is a significant relationship between epistemological beliefs and learning attitudes of Malaysian STEM students.

The last research question was "Is there any significant correlation between epistemological beliefs and learning attitudes of Malaysian STEM students?" The Pearson Product Moment Correlation results in Table 8 shows that there was a high, positive and very substantial correlation identified between epistemological beliefs and learning attitudes ($r=.67$, $p<.01$). Hence, the null hypothesis was rejected.

Table 8. Pearson Correlations between epistemological beliefs and learning attitudes towards Physics among Malaysian STEM students

Variable		Epistemological Beliefs	Learning Attitudes
Epistemological Beliefs	Pearson Correlation	1	.67**
	Sig. (2-tailed)		.00
	N	120	120
Attitudes	Pearson Correlation	.67**	1
	Sig. (2-tailed)	.00	
	N	120	120

**.Correlation is significant at the 0.01 level (2-tailed).

5. Discussion

5.1 Malaysian STEM students' epistemological beliefs and learning attitudes in Physics

This section discussed the findings of this study. In this study, the overall mean score obtained by Malaysian STEM students in epistemological beliefs was 72.61%. This shows that Malaysian STEM students had high sophisticated beliefs about Physics knowledge. As stated by Pullmones (2010), he describes such findings of students' high sophisticated beliefs as related to their higher sophisticated thinking, problem-solving skills, motivation, and persistence. Meanwhile, Kaymak & Ogan-Bekiroğlu (2013) explained the reason for students to possess low sophisticated epistemological beliefs may reflect them having difficulties in their learning in comparison to those higher performers.

The overall mean score for Malaysian STEM students' learning attitude is 74.29% which means that the majority of the students had a positive or favourable attitude towards Physics learning. It can be concluded that in general, the attitude towards learning Physics is good among the Malaysian STEM students based on interests, motivation and readiness to learn Physics. The findings were similar to the earlier studies instructed by Ali and Awan (2013), Narmadha and Chamundeswari (2013) and Ibrahim et al. (2019). Positive learning attitudes are generally very important and impactful to STEM learning subjects like Physics. Veloo and Khalid (2015) reported that individuals with a favourable attitude

towards a subject, have more interests and put extra effort in learning in and score better. In contrast, negative attitudes towards the subject cause learning to be more challenging.

5.2 Epistemological beliefs and learning attitudes between grade level of Form 4 and Form 5 Malaysian STEM students

From the t-test analysis in Table 3, it can be interpreted that the two grade levels; Form 4 and Form 5 STEM students, differed significantly in epistemological belief towards Physics and learning Physics. Consequently, it can be deduced that, Form 5 Malaysian STEM students own higher sophistication of epistemological beliefs in Physics as compared to the lower grade level Form 4 students. This finding is consistent with Kurt's (2009) where he found the students at Grade 10 had higher beliefs than the students at Grade 6 and 8. The present study also seems to be consistent with the previous ones that documented positive trends across ascending graders in middle schools as well as universities (Marzooghi et al. 2008; Mason et al., 2006). Schommer (1994) supported such findings by stating that epistemological beliefs change over growing biological years as the age and education level increase. As students' grade levels move up, they are likely to have higher sophisticated beliefs about the knowledge of nature and acquisitions. In other words, they become more mature and tend to think more critically and creatively. The students can possibly perceive knowledge in more tentative and complex manners. Therefore, the results from the present study which indicates higher graders of Form 5 students holding higher levels of epistemological beliefs as compared to the lower grader of Form 4 students are indeed consistent. The former perhaps understood Physics knowledge to relate with the real life setting significantly more abundant than the latter.

The t-test analysis in Table 6 also revealed that learning attitude between Form 4 and Form 5 students differed prominently. Apparently, Form 5 Malaysian STEM students acquired more positive or favourable attitudes in learning Physics compared to Form 4 students. This present study is parallel to Chan (2003) who suggested that as students grow in age, they tend to seek for comprehension rather than merely memorising facts or formulas. The significant difference in epistemological beliefs and learning attitude also might be due to sample size effect as the number of Form 4 students is double the Form 5 students. According to Rusticus & Lovato (2014) reported that unequally sized groups are common in research and may be the result of simple randomization, planned differences in group size or study dropouts. Unequal sample sizes can lead to unequal variances between samples which affects the assumption of equal variances in tests. Having both unequal sample sizes and variances in this study dramatically affects statistical power and Type I error rates of the t-test.

5.3 Gender difference in epistemological beliefs and Physics learning attitudes

The finding in this study shows that female Malaysian STEM students generally had higher epistemological beliefs in comparison to the male learners. In other words, female students are more mature and developed mentally as based on the epistemological beliefs towards learning Physics. The overall t-test also revealed that there was no significant difference in epistemological beliefs towards Physics and learning Physics between male and female students. Thus, it can be presumed that both groups undergo similar Physics learning experiences, hence it is experience that greatly influences their epistemological beliefs rather than their gender. The present results are similar to Abraham and Barker (2015) who reported that gender differences do not emerge in students' epistemological thinking. They seem to demonstrate the same levels of capabilities and learning confidence revolving Physics. However, the present results and the ones collected by Abraham and Barker as mentioned, are contrary to the much previous study conducted by Kiong (2010). He gathered that there is a disparity in epistemological beliefs between female and male undergraduates. As further explained by Tan (2007), Malaysian female students usually put in extra effort as compared to male students when learning science subjects which include Physics. Thus, in the aspects of gender, female students may possibly perform better than male students when learning Physics as a result of their more positive epistemological beliefs.

The finding also shows that female Malaysian STEM students obtained higher mean scores in comparison to male Malaysian STEM students. Higher mean score represents favourable attitudes

towards learning Physics. In other words, female Malaysian STEM students showed more favourable learning attitudes, more interest and motivation in learning Physics as compared to the males. In terms of significant differences across gender, an independent sample t-test proves that male and female Malaysian STEM students shared the same favourable attitudes in learning Physics. The present results are similar to Guido (2013), Mushinzimana and De La Croix Sinaruguliye (2016) and Ibrahim et al. (2019) who described that gender differences do not emerge in Physics learning attitudes. However, their findings are not in line with an earlier study conducted by Narmadha and Chamundeswari (2013) who found that female students perform better than male students in the aspect of attitude towards science learning. Interestingly, Fatoba and Aladejana (2014) discovered that it is the male students who are more favourable in learning Physics than the female group. They termed the female students as reflecting their feminine nature in which they claim the subject to be masculine, problematic and quite challenging.

5.4 The relationship between epistemological beliefs and learning attitudes of Malaysian STEM students

The finding shows that there was a high, positive and very substantial correlation identified between epistemological beliefs and learning attitudes. It can be concluded that Malaysian STEM students with higher levels of epistemological beliefs tend to embrace meaningful learning approaches as supported by Cano (2005). The finding is in line with Liang et al. (2010) which stated that when a student believes that the scientific knowledge is an evolving and changing subject, the students start expressing a strong desire to truly understand the scientific knowledge. In other words, the students may meaningfully engage with the process of scientific inquiry and thus stimulating their interests as well as motivating their science learning.

6. Conclusion

Epistemological beliefs and learning attitudes can possibly affect students in perceiving a positive outlook of Physics as a subject and learning it. On the whole, this research depicted that Malaysian STEM students possess high levels of epistemological beliefs and positive or favourable attitudes in learning Physics. As a matter of fact, there is a significant relationship between the students' epistemological beliefs and learning attitudes. Both their epistemological beliefs and learning attitudes react positively in parallel.

It is also believed that epistemological beliefs stimulate students' learning attitudes in Physics and learning Physics. In terms of grade levels, there is a difference between students' grade levels and their epistemological beliefs as well as learning attitudes. Form 5 students with higher grade level than Form 4 students have more positive epistemological beliefs and learning attitudes. A year ahead than the Form 4 graders in learning Physics at schools, boosts the Form 5 students to acquire more positive epistemological beliefs as well as learning attitudes in improving their knowledge and learning skills in Physics.

However, gender does not play any significant role among the students in terms of both epistemological beliefs and learning attitudes tests. On the whole, the findings proved that positive epistemological beliefs and learning attitudes towards Physics and Physics learning are purposeful for the Malaysian STEM students so as to learn the subject or perhaps other science disciplines effectively whether at schools or later when they pursue higher studies.

For future study, the research can be repeated on a larger sample by establishing correlations with different variables and more detailed results can be obtained. In addition, it is suggested for similar research to be adapted for graders higher than Form 5 particularly among the undergraduates at tertiary level. Perhaps, as suggested by Eagly and Chaiken (1995), for learning attitudes, a more comprehensive study of cognitive development can also be evaluated to specifically target the affective, cognitive, and behavioural items. Hence, it is hoped that the present study supports the many teaching and learning programs of Physics at all levels so that the aspects of students' epistemological beliefs and attitudes are always given priority. As a means to further improve students' performances in Physics, all teachers and educators are advised to continuously upgrade their students' positive epistemological beliefs and learning attitudes towards Physics and Physics learning.

7. Co-Author Contribution

The authors affirmed that there is no conflict of interest in this article. The first author carried out the overall plan for the writing and contributed to the findings and discussion, the second author edited the manuscript and checked grammatical errors, the third author did the data entry, the forth wrote research methodology and the fifth author made an overall checking.

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