JURNAL PENDIDIKAN SAINS DAN MATEMATIK MALAYSIA
VOL 11 Special Issue 2021 / ISSN 2232-0393 / eISSN 2600-9307

An Evaluation of Student's Perception Towards Learning Physics at Lower Secondary School

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Published online: 05 February 2021

To cite this article (APA): Ziad, W. K., Md Nor'Azam, M. F. A., Kaco, H., Mohd Idris, F., Zulkefly, N. R., Mohd, S. M., & Mohamad Jan, N. H. (2021). An Evaluation of Student's Perception Towards Learning Physics at Lower Secondary School. *Jurnal Pendidikan Sains Dan Matematik Malaysia*, *11*, 94-106. https://doi.org/10.37134/jpsmm.vol11.sp.9.2021

To link to this article: https://doi.org/10.37134/jpsmm.vol11.sp.9.2021

ABSTRACT

Currently, there are emerging concerns about Physics education due to the deteriorate affection in physics subject among the secondary school students. This study aimed to evaluate student's perception towards their passion on physics education which concentrated on pedagogical approach, nature of physics subject, difficulty level of physics topic and student's factor. A survey questionnaire was executed to 146 gifted students in Nilai, Negeri Sembilan, Malaysia which were studied physics starting at lower secondary school. Students were found to have different ways in leaning style in which teachers may use differentiated learning method to separate between different student's intelligences based on cognitive level and different suitable assessment. In addition, 90% of the students agreed that the nature of physics topics induced the difficulty of physics. Despite the difficulty nature of physics with enclosed by awfully tough topics, however some topics were easily learnt by the students. Interestingly, 49% realized that physics is important subject to be learnt and yet, 48% of the students disagree that they are not doing homework which indicated that most of the students only study while doing their homework. This justified the 68.5% of students spend their time for learning physics in the range of 0-4 h a week just to complete their homework. Ultimately, these finding will give some awareness and advice to the teachers to change teacher's learning style and boost student's interest in learning physics. Consequently, their knowledge serves as the backbone for science and technology.

Keywords: 7th grade education; gifted students; intelligence; pedagogical approach; physics

INTRODUCTION

It is a high time for Malaysia, as we are so far behind our target in 60:40 policy between stream and art students. Through many initiatives and assessments have been done, majority of the students expressed an utter lack of interest in STEM education (MOE, 2013; MOE 2017; Shahali et al., 2017; Radzi & Sulaiman, 2018; Sabudin et al., 2018). As physics being the backbone of STEM education, it creates a negative impression in learning STEM since, physics known as one of the difficult subjects in STEM. Although the substantial role of our educators and their teaching method are on par with the international level, however, the difficulty level in understanding the basic principle of physics even at the beginning of their study has demotivated student in pursuing STEM and specifically in physics education. Besides, the interest of a new generation is even remotely incoherent with educator expectation is creating more dilemma in delivering complex topic to be taught in the classroom (Meng et al., 2014; Zainudin et al. 2015).

Therefore, the aim of this study is to evaluate the student's perception towards learning physics at lower secondary school through a given questionnaire to the students of the age of 13 to 16 years old. This study focusing on the student's framework from the pedagogical approach, nature of physics subject, difficulty level of physics topic and student' factor. Consequently, the deliberation of each viewpoint was investigated to reveal why physics is perceived as difficult by students and the relationship between the difficulty level of physics topics and the student's perspective was also investigated. Hence, teachers may realize their students' ability and weaknesses, thus take precautions for their instructions and teaching tools and methods to improve the students' interest for physics. Besides, teachers and students can recognize the level of difficulty for each chapter and the topics in the chapters to be focused on, and hence, spend more time to increase the students' cognitive level especially among students who study physics starting from the lower secondary education which is unusual in the Malaysian education system.

LITERATURE REVIEW

The Malaysian education system has been emphasizing on the importance of knowledge in Science and Technology for secondary school students. In 1970, the National Science and Technology Enrolment Policy was launched to attain a 60:40 ratio of science to non-science students (MOE, 2013; MOE 2017; Shahali et al., 2017; Radzi & Sulaiman, 2018; Sabudin et al., 2018). Similarly, this initiative has also been incorporated into the Malaysia Education Blueprint 2013-2025, which is aimed at ensuring the equipment of students with sufficient knowledge and skills in line with the ever-increasing demands of the contemporary industrial world (Zainudin et al., 2015; Shahali et al., 2017; Radzi & Sulaiman, 2018; Khalid et al. 2020). Individuals who are well-versed in Science, Technology, Engineering, and Mathematics (STEM) education will be able to understand and solve complex problems as well as invent. These attributes are particularly crucial since STEM knowledge mastery is one of the strong indicators of a nation's ability to generate innovative products and services.

Learning Physics is a study of the real world and a significant subject for all students. Hence, Physics, being an elemental science subject in STEM, serves as the backbone for science and technology, making it paramount for humans to study it (Suhendi et al. 2016; Suhendi et al. 2018). Physics is also adequate to explain the intrinsic knowledge as it is essential for understanding the physical world and beyond, which comprises of the universe, nature, and the complex socio-economic systems in our daily lives, and which also contains facts, concepts, principles, laws, theories, and models (Price 2006; Erinosho 2013; Prahani et al. 2016; Suhendi et al. 2018). Therefore, the evolution of physics knowledge can be attained by providing a strong foundation of cognitive and practical skills in the basic knowledge of physics. Accordingly, physics knowledge can be utilized for computing technologies, aerospace, communication, biosciences, and medicine, with specializations in the engineering field (Price 2006). The inventiveness, the new concepts, and the theories may result in a tremendous exploration which can change people's lives (Price, 2006; Agommuoh & Ifeanacho, 2012; Atwa et al., 2016).

Currently, there are emerging concerns with regards to the teaching and learning of Physics considering the decline in secondary school students' interest in physics (Erinosho, 2013; Ekici 2016; Kapucu 2016). This becomes more challenging to the teachers and the students to determine the student's interest in learning physics. Secondary school students are likely to view physics as irrelevant to their life, hence, dislike it. Interestingly, physics has been the most disliked discipline among other science disciplines such as chemistry and biology (Kapucu, 2016). There were studies carried out to identify the factors affecting the decreasing interest in physics. It was found that the pedagogical approaches among the teachers obtained the highest rate followed by the difficulty of the subject itself, which are affecting this phenomenon. Studies have shown that a lack of effective teaching strategies leads to a poor performance in physics among students in secondary schools (Agommuoh & Ifeanacho., 2012; Kapucu 2016). Learning physics also creates boredom because it only adopts the teacher-centered approach and students do not participate (Rodrigues & Oliveira, 2008). Mathematics serves as prerequisite teaching and learning materials for physics (Redish, 2005), and mathematics also serves as an essential element in the problem-solving efforts for physics (Retnawati et al. 2018). Hence, poor knowledge in mathematics also contributes to the low interest in physics (Kapucu 2016). However, perceiving physics as a difficult subject might also result in physics learners' low interest in physics (Aina, 2013; Kapucu, 2016; Kurniawan et al. 2019; Adeyemo 2020). Consequently, it negatively affects students' liking for physics (Kapucu, 2016).

METHODOLOGY

Surveying

A 5-point scale (Likert-type) survey questionnaire was established which consists of few elements on pedagogical approach, nature of physics subject, difficulty level of physics topic and student's factor. The content of the questionnaire was evaluated to ensure its significant towards the respondents. Responses to the instrument items were measured using a 5-point Likert scale construct, from 'Strongly Agree' (SA) indicated by "1" to 'Strongly Disagree' (SD) which is indicated by "5". The survey instrument contains 39 items consisting of 4 Sections of the elements that influence the student's perspective towards learning physics starting from lower secondary education, which are listed in Table 1. The survey questionnaire was given to 146 students.

Table 1: Elements influence student's perspective towards learning physics starting lower secondary school

Section	Element
A	Pedagogical Approach
B	Nature of physics content
C	Difficulty level of physics subject
D	Student's Factor

In Section C (Difficulty level of physics content), the questions were focused on each chapter of the physics topics learnt for the secondary school education level in Malaysia and their subtopics, to investigate the relationship between the students' perspective and the level of difficulty of each subtopics and chapters. Table 2 shows the chapters in Physics syllabus which will be learnt for each grade level. Hence, the respondents answered the questions in Section C, corresponding to the chapters learnt for their grade.

Table 2: Syllabus topics in Physics learnt based on grade level

Chapter	(F1)	(F2)	(F3)	Level 1 (L1)
Introduction to Physics	√			Revision
Forces and Motion	√			
Forces and Pressure		√		
Heat		√		

Light		√		
Waves		√		
Electricity			√	
Electromagnetism			√	
Electronics			√	
Radioactivity			√	

Research Sample

Data was collected from a sample of 146 secondary school students, from lower secondary education, which is summarized in Table 3. The respondents are from a school located in the Nilai District, Negeri Sembilan, Malaysia, who have been offered to study physics from lower secondary education. The total number of male and female respondents were 72 and 74, which contributes to 49.3% of males and 50.7% females, respectively. The respondents were categorized according to their level at lower secondary education consisting of Foundation 1 (F1), Foundation 2 (F2), Foundation 3 (F3), and Level 1 (L1) as the first batch from upper secondary education. Table 3 shows the characteristics of the respondents.

Table 3: Characteristics of the respondents

Class (Grade)	**Gender and percentage**				**Total**	
	M	**%**	**F**	**%**	**No. of respondents**	**% by grade**
Foundation 1 (F1)	19	38.0	31	62.0	50	34.2
Foundation 2 (F2)	14	43.8	18	56.2	32	21.8
Foundation 3 (F3)	16	48.5	17	51.5	33	22.6
Level 1 (L1)	23	74.2	8	25.8	31	21.2
Total	72	49.3	74	50.7	146	100

Data Analysis

The data was collected from 146 physics respondents from a school for gifted students. Data analysis employed in this research was the quantitative data analysis, to obtain the descriptive statistics. Descriptive statistics is a description or presentation of data in a big number, consisting of mean, median, and standard deviation (Cohen & Manion, 2001).

RESULT AND DISCUSSION

Pedagogical Approach

Table 4 and Table 5 show the survey questions developed for pedagogical approach and the percentage of responses based on the Likert scale items, respectively. These questions were favoured towards the positive pedagogical approach applied by the teachers. It shows positive responses by the students, where 40.3 % of the total respondents agreed to the pedagogical approach practiced by their physics teachers which are visual, aural, reading, writing and hands-on methods which is related to the student's interest. However, there were 0.8% of the respondents who strongly disagreed towards their teacher's method, and this 0.8% 'Strongly Disagree' were recorded from items A(I), A(V) and A(VIII).

The element in the pedagogical approach which leverage the students' perspective towards their interest in learning physics at lower secondary school is presented in Figure 1. It shows the percentage responses chosen by the respondents for question A(I) on "stimulated my interest in the subject", which contributes to the total of 0.8% 'Strongly Disagree' in pedagogical approach elements stated in Table 5. It was found that 3%, which is equivalent to 4 respondents, stated that their teachers do not give significant impact towards their interest in physics. This finding corresponded to the teacher's pedagogical approach used during their teaching and learning process. It shows that the teachers mostly used aural/listening method during their teaching and learning session (30%), followed by writing style (24%), and hands-on which contributed to 20%. The least method utilized by their physics teacher was visual/video (10%), as shown in Figure 2

Table 4: Question on Pedagogical approach

Question	Survey Question
A(I)	The teacher stimulated my interest in the subject.
A(II)	The teacher managed classroom time and pace well.
A(III)	The teacher was organized and prepared for every class.
A(IV)	The teacher encouraged discussions and responded to questions.
A(V)	The teacher demonstrated in-depth knowledge of the subject.
A(VI)	The teacher appeared enthusiastic and interested.
A(VII)	The teacher used a variety of instructional methods to reach the course objectives
A(VIII)	The teacher challenged students to do their best work.

Table 5: Number of responses based on scale determined for pedagogical approach

Likert Scale	No. of responses	Percentage (%)
Strongly agree	369	31.6
Agree	470	40.3
Neutral	257	22.0
Disagree	62	5.3
Strongly disagree	9	0.8

Nevertheless, all the respondents who chose 'Strongly Disagree' had also chosen aural /listening as the pedagogical approach used by their teachers. The reason why these respondents think that their teachers do not improve their interest in physics may be due to the pedagogical approach which may not suit the respondents' learning style. The teaching and learning approaches that the teachers used in the classroom could possibly decrease their interest towards physics which is a major determinant of students' engagement with success in school subjects (Shahali et al. 2019). The frequency of various teaching and learning activities in the classroom also contributes to the students' motivation towards science, enjoyment of science and future orientation towards science (Hampden-Thompson and Bennett 2011; Shahali et al. 2019).

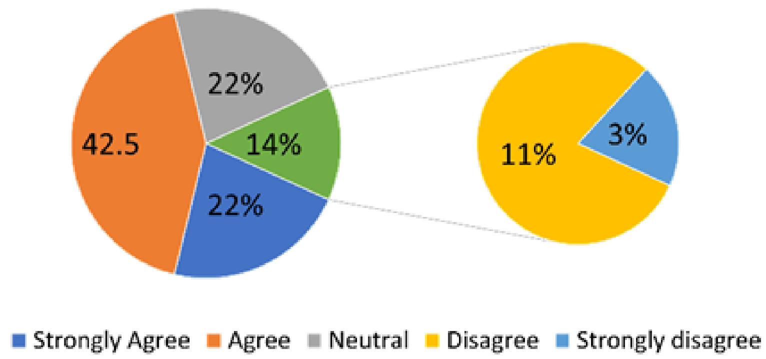

Figure 1: Percentage of responses on student's perception based on question A(I)

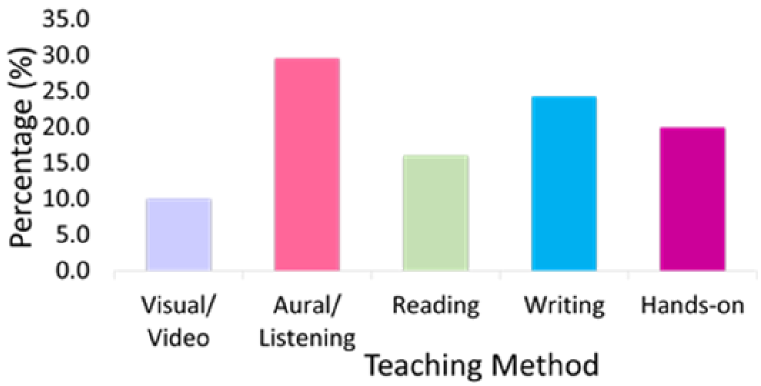

Figure 2: Type of pedagogical approach used by physics teacher

Furthermore, a teacher influences by demonstrating an in-depth knowledge of the subject which also gives a significant impact on student's interest, as asked in question A(V), which is presented in Figure 3. The highest percentage of 34.2% shows that students are agree that their teacher demonstrated in-depth knowledge during the physics class. Research has shown that if students are successful in one subject based on the deep concept knowledge, the students will also develop higher self-concepts, and consequently, develop a deeper interest in that subject (Sorge et al. 2019). However, it was found that 2.7% of the respondents had chosen 'Strongly Agree' on the statement, "The teachers demonstrated in-depth knowledge of the subject". This little percentage of respondents were anticipated from students who obtained higher scores in their examination in the range of B+ with 33% to A- which contributes to 67%. This may be due to the fact that these students most likely think, and study differently compared to the other students. Teachers who are unaware of their students' learning styles will likely teach in a manner that prevents students from doing their best work (Shahali et al. 2019). Hence, teachers may use differentiated learning method to separate between different students' cognitive levels and give the same treatment with different assessment suitable to each cognitive level. This may encourage the higher scorer students to learn more according to their cognitive ability and at the same time promote and cherish the other students accordingly. Students tend to comprehend little and lose focus of classroom instructions when their teachers fail to use strategies that match their learning styles (Shahali et al. 2019). Differentiated instruction is a way of recognizing and teaching according to differences in student talents and learning styles, that shows students learn through various intelligences. This form of teaching is designed to meet the needs of diverse learners and emphasizes student's responsibility where different students learn in different ways and through many intelligences (Handa et al. 2019; Westbroek et al. 2020). Most importantly, this approach involves modifying instructions in terms of content, process, or product so that all students can be successful (Griful et al. 2020).

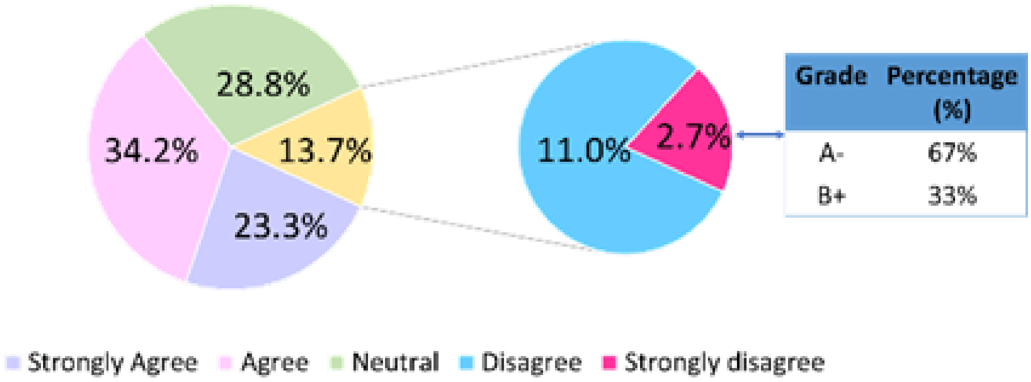

Figure 3: Percentage of responses on student's perception based on question A(V)

Nature of Physics Subject

Table 6 shows the survey questions developed for nature of physics subject based on the 5-point Likert scale items. It showed that 91 % chose 'Strongly Agree' and 'Agree' options while another 9 % had chosen 'Strongly Disagree' and 'Agree' to the questions asked, with the highest mean value of the total score being 55 for 'Agree', with a median value of 32. This finding demonstrated that, from the student's point of view, physics is cumulative, difficult, with too many concepts, theory, and laws. Moreover, mathematical knowledge and skills are required to excel in this subject. Even though the students expressed physics negatively, they find that this subject is interesting as can be seen from the relationship between attractiveness of physics and its difficulty (Figure 4). The 'Disagree' option shows the highest percentage of participants who chose physics as not being interesting enough, while 37% of students viewed physics as a difficult subject. This can eventually reveal that teachers should captivate students' interest in learning and proportionally improve their excitement. This again correlates with the pedagogical approaches used by the teachers which should also be varied (Hampden-Thompson and Bennett 2011; Shahali et al. 2019).

Table 6: Question on Nature of Physics Subject

Question	Survey Question
B(I)	Physics is cumulative. If you miss one concept, it is hard to grasp the next one.
B(II)	Physics is considered as a difficult subject in my environment.
B(III)	There is too many subjects and concepts in physics.
B(IV)	Physics is very abstract.
B(V)	Physics requires good mathematics.
B(VI)	Physics has too much theory.
B(VII)	Physics has too many formulas to be learned.
B(VIII)	Physics has too many laws and rules.
B(IX)	Physics is not interesting enough.
B(X)	Physics cannot be learned without mathematics background.
B(XI)	Physics is a memorization-based subject

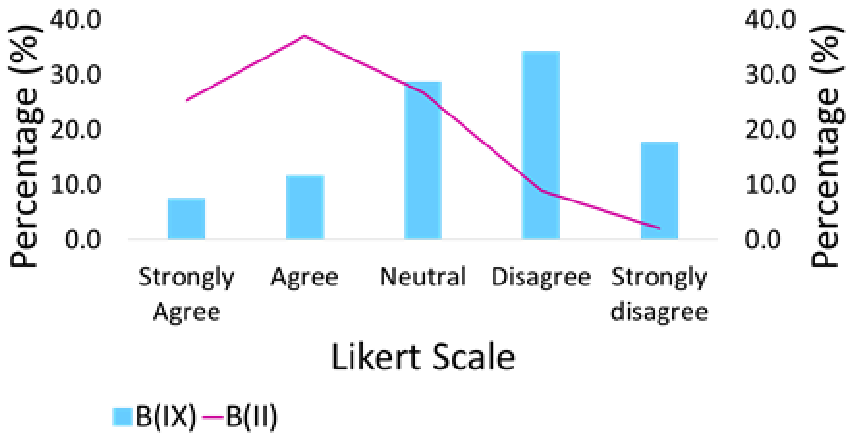

Figure 4: Relationship between physics attractiveness and difficulty level

Difficulty level of Physics Topics

Figure 5 shows the difficulty level in each chapter of physics by percentages from the total score. It demonstrates that chapter 1 is the easiest chapter with 42.3% of students chose, 'Very Easy'. While 5 chapters are regarded as 'Neutral' from the students' perspective. However, chapter 8 (Electromagnetism) has 'Difficult' as the highest percentage on the scale which is 30.8%. Chapter 9 (Electronic) has the same percentage of scores for both 'Easy' and 'Difficult' with 27.7%, respectively.

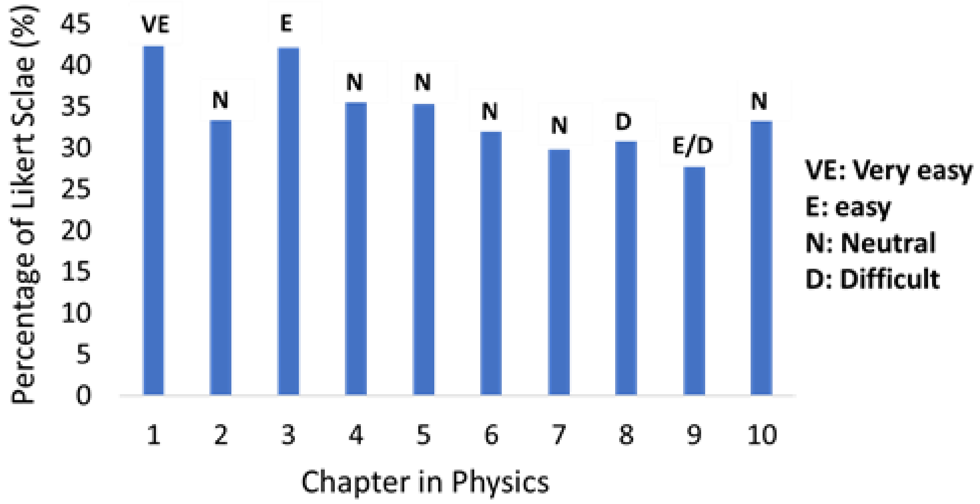

Figure 5: Highest percentage of responses based on difficulty level of Physics topics

The result presented in Figure 5 is supported by Figure 6. A test was carried out to Foundation 3 students and the number of respondents was 33. The questions given consisted of all chapters that they have been studied and the scores were analysed using Difficulty Index (DIF) and Discrimination Index (DI). The DIF represents the percentage of students who correctly answered the questions. A lower DIF value shows that fewer students gave the correct answer. It indirectly proves that questions are difficult to attempt (Wajiha et al., 2018). Hence, from DIF analysis presented in Figure 6, it shows that chapter 9 has the lowest value of DIF (showing most difficult questions to be answered). This correlates with the result presented in Figure 5 and Table 6 where students viewed physics as a cumulative and difficult subject. However, the questions were acceptable since the DIF value is 0.4 and 43% of students can answer the given questions correctly. Therefore, teachers should give more exercises on this topic so that the students become familiar with all sorts of questions.

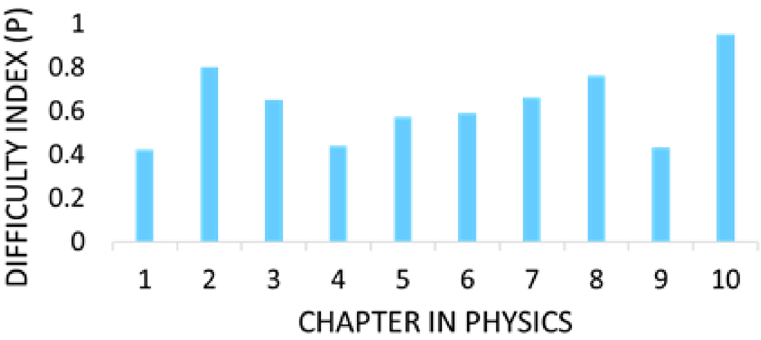

Figure 6: Difficulty Index Value for Each Chapter in Physics

Table 7 shows the analysis of the subtopics in Chapter 8 (Electromagnetism), which demonstrated that each subtopic was difficult for the students to understand except for subtopic 8.1 (Analysis of Magnetic Effect), and the most difficult subtopic selected by the students in Chapter 8 was 8.3 (Analysing Electromagnetic Induction), with an almost consistent mean (17) value for each subtopic, respectively. This subtopic mainly involved laws and applications which students must well understand. The median values ranged between 15-25.

Table 8 shows the analysis of the subtopics in Chapter 9 (Electronics). The analysis demonstrated that the subtopic of 9.1 was the most difficult subtopic in Chapter 9, and it is also the only subtopic that was selected as a difficult topic by most of the students. From both Tables 8 and 9, it can be suggested that teachers should emphasize on this topic and focus more on the difficult subtopic during their teaching and learning sessions.

Table 7: Analysis Subtopic in Chapter 8

Sub-topic	**VE**	**E**	**N**	**D**	**VD**	**Mean**	**Median**	**SD**
8.1	9.2	29.2	27.7	23.1	0	17.8	23.1	12.7
8.2	7.7	24.7	24.7	30.8	0	17.5	24.6	13.0
8.3	6.2	15.4	21.6	40.0	0	16.6	15.4	15.5
8.4	7.7	20.0	27.7	29.2	0	16.9	20.0	12.7
8.5	9.2	21.5	21.5	30.8	0	16.6	21.5	12.0

Table 8: Analysis Subtopic in Chapter 9

Sub-topic	VE	E	N	D	VD	Mean	Median	SD
9.1	7.7	20.0	30.8	33.9	0	18.5	20.00	14.6
9.2	3.1	35.4	24.6	27.7	0	18.2	24.62	15.76
9.3	4.6	29.	30.	27.	0	18.5	27.69	14.9

		2	8	7				
9.4	37.6	25. 0	12. 5	17. 5	0	18.5	17.50	14.0

Student's Factor

Table 9 shows the questions asked regarding the element of student's factor in learning physics and Figure 7 shows the percentage responses based on the student factor question in Table 9. There were 10 questions analysed and the result found that the highest percentage response was on question D(VIII), in which 49% of the students strongly disagreed that physics is an unnecessary subject. The students realized that physics is an important subject to be learnt. The trend is the same for questions D(II), D(III), D(III) and D(IV) where the highest percentage chosen was, 'Agree'. These questionnaires based on the student's ability in self-study and doing extra tutorial and practice. However, the trend is vice versa for question D(VII) where 48% of the students disagreed that they are not doing homework. This suggests that most of the students only study when they are given homework without doing extra tutorial. They agreed that they are not studying more but only doing homework and this result correlates with the student's self-study time in learning physics (Figure 8). There were 68.5% of the students who spend their time for learning physics in the range of 0-4 hours in a week only, which means that this is the time used to complete their homework. This is due to the students' high workload which has affected their time for self-study. The percentage decreased as increasing time is spent on self-study and only 2 % spend their time for more than 13 hours a week. Therefore, the teachers should give exercise questions which simulates the examination questions together with higher order thinking skill questions for the students because their homework time is their self-study time.

Table 9. Question on Student Factor

Question	Survey Question
D(I)	I am lacking motivation and interest.
D(II)	I am not studying more.
D(III)	I am not reading the textbook.
D(IV)	I am not doing practice many problems.
D(V)	I only working on the assigned problems.
D(VI)	I cannot associate the terms included in Physics with daily life.
D(VII)	I am not doing homework.
D(VIII)	I think that Physics subject is unnecessary
D(IX)	I think physics is not interesting enough.
D(X)	Physics cannot be learned without mathematics background.

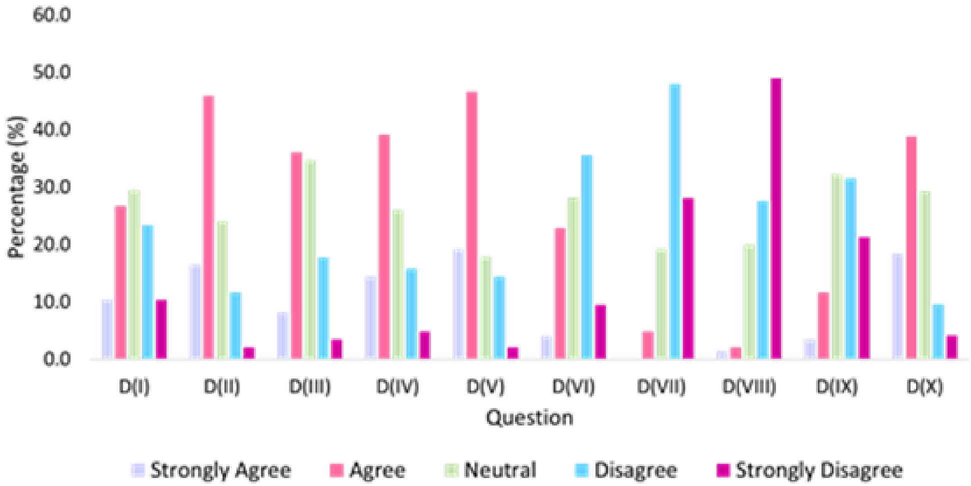

Figure 7: Percentage of responses based on student's factor questions

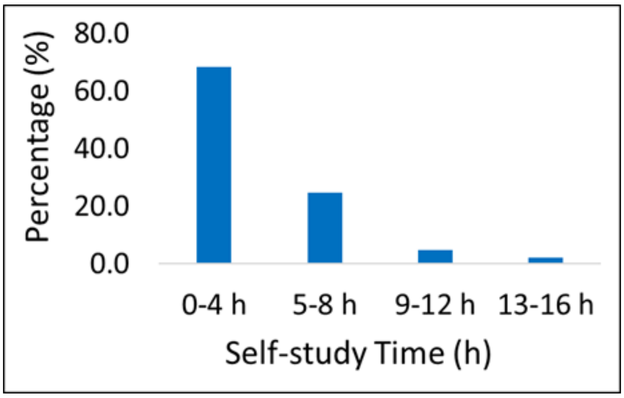

Figure 8: Students weekly self-study time in learning physics

CONCLUSION

At the present study, it can be summarized that the elements that affected the students' perspective in learning Physics at lower secondary school were pedagogical approaches, nature of physics content, difficulty levels of physics subject, and student's factor. The results show that the physics teachers are encouraged to use a variation of teaching methods to cater for the students' different learning styles. The students had also selected that the nature of physics subject as cumulative, difficult, conceptual, theory, and laws, but nonetheless an interesting subject to be learnt. Basically, the attractiveness of the subject is also affected by the teacher's approach even though it is difficult. Based on the difficulty level, Chapter 9 (Electronic) was found to be the most difficult chapter, and this was proven when a test was carried out. The students themselves also play an important role in determining their own perspective in learning physics at the lower secondary school level. The students must have the ability to conduct self-study and it was analysed that their homework time is their self-study time. Therefore, stakeholders must indulge to improve students' interest and attract them in learning Physics, and consequently, promoting the Malaysia Education Blueprints to obtain 60% science stream students.

ACKNOWLEDGEMENTS

This research was supported by research grants from Universiti Sains Islam Malaysia (PPPI/KGI/0119/051000/16019). The authors want to acknowledge Kolej GENIUS Insan, Universiti Sains Islam Malaysia for their facility support.

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