Investigating Students Attitudes in Engineering Science Course: An Analysis using the Tripartite Model

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ABSTRACT

The research aimed to gain insights into the attitudes of first-semester Engineering Science students towards their Engineering Science classes, as well as to investigate whether gender has an impact on these attitudes. A total of 182 students were involved in the data collection process, which included completing a comprehensive questionnaire comprising 20 items rated on a Likert scale. The questionnaire covered affective, behavioral, and cognitive components across five distinct sections.Following this, the gathered responses underwent quantitative analysis using Statistical Package for the Social Sciences (SPSS) version 25, including computations of mean values, standard deviations, percentages, and frequencies. The results revealed that the majority of students displayed positive attitudes towards learning physics, with significant variations observed based on the students' gender.These findings have the potential to inform targeted interventions aimed at addressing the underlying barriers to achieving quality physics education for all students especially in context of Polytechnic Malaysia.

Keywords: attitude, physic, gender, analysis,positive

ABSTRAK

Penyelidikan ini bertujuan untuk mendapatkan pandangan tentang sikap pelajar semester pertama Sains Kejuruteraan terhadap kelas mereka serta menyiasat sama ada faktor jantina mempunyai kesan terhadap sikap ini. Seramai 182 orang pelajar terlibat dalam pengumpulan data, yang melibatkan soal selidik komprehensif dengan 20 item yang dinilai menggunakan skala Likert. Soal selidik ini merangkumi komponen afektif, tingkah laku, dan kognitif yang dibahagikan kepada lima bahagian yang berbeza. Data yang diperoleh kemudiannya dianalisis secara kuantitatif menggunakan Pakej Statistik untuk Sains Sosial (SPSS) versi 25, termasuk pengiraan min, sisihan piawai, peratusan, dan kekerapan. Hasil kajian menunjukkan bahawa majoriti pelajar memiliki sikap positif terhadap pembelajaran fizik, dengan variasi yang ketara berdasarkan jantina. Penemuan ini mempunyai potensi untuk menyumbang kepada intervensi yang disasarkan bagi menangani halangan dalam mencapai pendidikan fizik yang berkualiti untuk semua pelajar, khususnya dalam konteks Politeknik Malaysia.

Kata Kunci: *sikap, fizik, jantina, analisis, positif*

INTRODUCTION

The Engineering Science course, offered by the Mathematics, Science, and Computer Department (JMSK) at the Polytechnic of Malaysia, is a practical and theoretical program that applies engineering concepts. It is mandatory for first-semester Diploma in Engineering students. It covers six physics

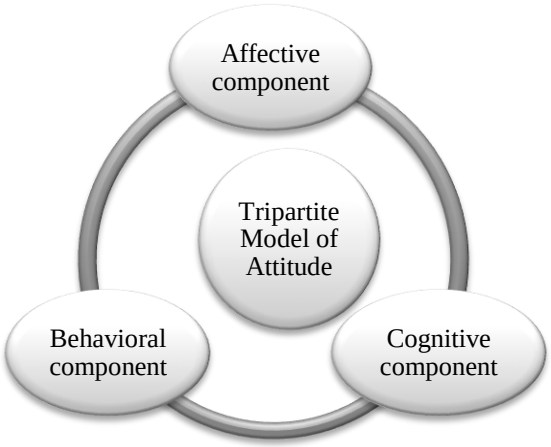
topics: physical quantities and measurement, linear motion, force, work, energy and power, solids and fluids, and temperature (Mamat, 2023; Nik Yusuf et al., 2017; Wicaksono et al., 2019). The course assumes that students have previously learned and covered almost all the topics in their secondary education during their science or physics classes.

Physics was introduced to Malaysian students in Form Four and taught until Form Five. The aim of teaching physics is to give students a comprehensive understanding of concepts and principles and their practical application in everyday situations. It is considered the foundation of every engineering topic and is essential for every engineering student. Despite its significance, physics is often perceived as the least exciting and least captivating discipline among students compared to chemistry and biology (Ananda et al., 2019; Devy et al., 2022; Karuru et al., 2021; Reddy & Panacharoensawad, 2017). However, it is crucial to acknowledge that students' comprehension of physics is essential to their success in engineering. In Malaysia, there is a notable gap in the level of education in physics. Unfortunately, the lack of interest among Malaysian students in studying physics has hindered their ability to excel in the subject (Dixit & Shukla, 2021; Markus et al., 2021; Offordile et al., 2021; Saleh, 2021; Sheldrake et al., 2019; Wafa & Jatmiko, 2022). As students' progress through their academic journey, their enthusiasm for physics wanes. This is primarily due to the learning methods involved, which require students to understand various forms of representation, including formulas, calculations, graphical depictions, and abstract conceptual understanding. Many students need help with these concepts and require assistance in improving their comprehension of the subject(Maison et al., 2021; Pelobillo, 2018). As a result, students are confronted with a significant knowledge deficit and require assistance in comprehending subjects within the curriculum. These subjects are typically distinguished by their reliance on concrete illustrations and extensive mathematical computations or visualizations. The learning difficulties and students' perceptions of physics topics make them dislike the subject or course (Fulmer et al., 2019; Kurniawan et al., 2019; Reddy & Panacharoensawad, 2017; Veloo et al., 2015). This hinders their attitude, which is a critical determinant that influences academic achievement. The current attitudes of students towards physics and science learning pose a significant challenge to Malaysia's ambitious efforts to modernize its education system. As Malaysia strives to enhance its educational framework to align with global standards and compete effectively with industrialized nations, the role of student attitudes becomes increasingly critical. Malaysia aspires to cultivate a workforce capable of thriving in the global marketplace. However, if student attitudes towards science education remain indifferent or negative, it undermines these aspirations (Baskaran & Abdullah, 2020). Attitude is widely recognized as a crucial factor influencing science performance levels, particularly in physics, by many academics. It refers to an individual's acquired inclination to react favourably or unfavourably towards an item, situation, concept, or another individual (Ayanwale et al., 2023; Maison et al., 2021; Mansor et al., 2018).

Attitude consists of three main components: affect, cognition, and behaviour, which are interrelated and involve various aspects of the attitude toward learning mathematics. This study utilized the Tripartite, the ABC Attitude Model, to investigate students' attitudes toward Engineering Science(Kane et al., 2016; Mazana et al., 2018; Wong & Atan, 2021). Our study investigates different aspects of students' attitudes, such as science anxiety, self-confidence in their scientific ability, science enjoyment, intrinsic motivation, and perception of the usefulness of science(Kurniawan et al., 2019; Mamuda & Peni, 2022; Xavier et al., 2016). The Tripartite Model of Attitude, which is illustrated in Figure 1, is a theoretical framework used to analyse and understand students' attitudes towards the acquisition of engineering scientific knowledge. This study aims to examine the emotional, behavioural, and cognitive aspects of student attitudes within the context of an engineering science course (Phương & Dũng, 2022). As part of the Affective Component, this study investigates students' emotional responses and feelings towards the engineering science course. By analysing the affective component, valuable insights can be gained about how students' emotions affect their level of engagement and subsequent learning outcomes in the engineering science course. The Behavioural Component of the engineering science course analyses students' behaviours and actions. The evaluation of the Behavioural Component yields several behavioural patterns that indicate students' attitudes towards learning and their degree of engagement in the course. The Cognitive Component examines the engineering science course by exploring students' beliefs, thoughts, and knowledge. The analysis of the Cognitive Component contributes to a deeper understanding of the impact of students' cognitive processes on their attitudes and academic achievements in engineering science courses. This study aims to

comprehensively understand engineering science students' attitudes by using the Tripartite Model of Attitude as a framework for analysis. The model facilitates the examination of the dynamic relationship between emotion, behaviour, and cognition in creating student attitudes, as well as the identification of the impact of gender on their attitudes towards the acquisition of engineering scientific knowledge.

Figure 1: Tripartite Model of Attitude



Attitudes can change over time; once a positive attitude is established, it can help acquire knowledge efficiently. On the other hand, a negative mindset can impede learning and impact academic performance. Therefore, attitude is a crucial factor that should be considered in scientific education. Although there is a considerable body of literature on student attitude and its influence on overall student achievement, more studies must be conducted, especially examining student attitudes among engineering science students in technical and vocational education and training (TVET) institutions (Hamdan et al., 2021; G. Subramaniam & Mohd Fadzil, 2021; M. Subramaniam et al., 2020; Wafry Khairul Ziad et al., 2021; Wong & Atan, 2021) =. This study on student attitude among engineering science students at Polytechnic Sultan Idris Shah aims to bridge the gap in science education within technical and vocational education and training (TVET) institutes. Focusing on this student cohort and their challenges in learning engineering science, this study aimed to address the student attitude and the influence of gender on contributing to their attitude based on the Tripartite Model. This study also aimed to inform targeted interventions to enhance positive student attitudes toward their learning. This research gap is significant as it enhances the current understanding of student attitudes and holds practical implications for science education instruction in TVET institutions. By filling this research void, the results of this study can enhance the current body of knowledge and bolster the quality of science education in TVET institutions, eventually benefiting engineering students and their future professional endeavors. Gender differences have been frequently studied in scientific education. There is a documented disparity in physics achievement between genders at the university level (Atasoy et al., 2014; Kedir, 2020; Saleh, 2021; Sukariasih et al., 2019). Gender has been found to harm students' physics performance. Our research aims to evaluate the attitudes of students taking Engineering Science courses and examine the influence of gender on their attitudes towards these classes.

PROBLEM STATEMENT

The effective imparting and acquisition of engineering science courses within the Malaysian Polytechnic education system play a pivotal role in preparing students for professional engineering careers. The mandatory inclusion of engineering science courses in the curriculum for first-semester Diploma in Engineering students presupposes their prior exposure to and comprehension of nearly all the subject matter during their secondary education, particularly in the context of science or physics classes (Ling, 2017; Mamat, 2023). However, the attitudes of students significantly influence the perception of physics topics as a potentially uninteresting subject. If students perceive physics as overly intricate or believe they lack the capacity to grasp its concepts, they are prone to developing a negative

disposition toward the subject. Students who have encountered unfavorable experiences with physics, such as receiving poor grades, grappling with concept comprehension, or finding the lessons unstimulating, may harbor a enduring aversion to the subject. These past encounters have the capacity to shape their attitudes and diminish their enthusiasm for further exploring physics (Hernánez-Suarez et al., 2021; Soeharto et al., 2019). When students fail to recognize the relevance of physics in their daily lives or future careers, they are likely to regard the subject as inconsequential. This perspective can lead to a dearth of motivation to engage with the course material. The attitudes of students toward physics can be influenced by their peers (Martinko & Vorkapić, 2017; Reddy & Panacharoensawad, 2017; Trisniarti et al., 2020; Zakaria et al., 2019).

In the event that a majority of their peers express disinterest or harbor negative views about physics, this collective mentality can further dissuade individual students from discovering the subject's appeal. An unvarying or rigid learning environment lacking in interactive and captivating activities can precipitate boredom and disinterest. Students who derive no enjoyment from their physics classes will likely perceive the subject as unstimulating. The attitudes of students toward these courses can exert a considerable impact on their learning outcomes and academic performance. Despite the significance of comprehending these attitudes, additional research is warranted to comprehensively examine them within the realm of engineering science in polytechnic education. This study aims to bridge this gap by scrutinizing students' attitudes toward engineering science courses utilizing the Tripartite Model of Attitudes, which encompasses cognitive, affective, and behavioral components. The cognitive component encapsulates students' beliefs and thoughts about the course, the affective component encompasses their emotions and feelings, and the behavioral component encompasses their actions and intentions with respect to the course.Understanding these attitudes is imperative for educators and curriculum developers to formulate and execute effective teaching strategies that augment student engagement and learning outcomes. Through the application of the Tripartite Model of Attitudes, this study endeavors to furnish an intricately detailed analysis of students' attitudes, furnishing invaluable insights for the refinement of engineering science education.

OBJECTIVES

1. To identify students' attitudes towards the Engineering Science classes.
2. To determine the influence of gender on their attitudes the Engineering Science classes.

METHODOLOGY

A descriptive survey was employed in this study, which comprised a population of 239 engineering science students from Polytechnic Sultan Idris Shah from intake of Session I 2023/2024 and Session II 2023/2024. However, the study employed the sampling method proposed by Krejcie and Morgan to ascertain the optimal sample size (Godden, 2004). A total of 182 students needed to complete responses to the questionnaire. The study's efficacy was determined using convenient sampling approaches. The study examines students' attitudes toward learning Engineering Science. 20 Multiple choice format questionnaires were developed and distributed to gather information on students' attitudes toward the Engineering Science course. Five sections of the questionnaire evaluated affective, behavioral, and cognition components. This design methodology was selected based on its ability to accurately portray and examine the present condition of students' attitudes toward Engineering Science.

(Gunawan et al., 2021; Mamuda & Peni, 2022). The attitude measurement scale comprised twenty statements. The attitude components were evaluated using a 5-point scale, where 5 represented strong agreement, and 1 represented significant disagreement. The data analysis for this study was conducted using the Statistical Package for the Social Sciences (SPSS) software. Descriptive statistics were utilized to examine the students' attitudes toward the study of engineering science, with a particular emphasis on the mean and standard deviation. In addition, the demographic data was assessed and described. The inferential statistics of T-test analysis were employed to investigate any disparities and relationships among the variables evaluated in this study. The use of these analytical methods facilitated

a thorough and comprehensive analysis of the data, resulting in a comprehensive and accurate understanding of the results.

Table 1: Description of the scale items

	Attitude aspect	**Description**
Affect	Student-Self Confidence	Assessing students' self-perceived aptitude in science is crucial to improve their academic outcomes (J. Sirait et al., 2017; Kaya & Boyuk, 2011; Maison et al., 2021; Soomro et al., 2011)
	Science Anxiety	Assessing students' experiences with adverse reactions to science concepts and testing (Aflalo, 2021; Casinillo et al., 2020; Downing et al., 2020)
	Enjoyment of Engineering Science Class	Assessing students' joy from and acquire knowledge in the field of science. (Karuru et al., 2021; Trisniarti et al., 2020)
Behaviour	Intrinsic Motivation	Assessing students' interest and the desire to learn mathematics (Guy, Cornick, & Beckford, 2015).
Cognition	Perceived Usefulness	Assessing students' perception about the importance of science in the present everyday life and in the future (Adelson & McCoach, 2011).

RESULTS

The study's findings are derived from an analysis of students' attitudes towards Engineering Science and the impact of gender on their perceptions. These results are visually represented in Figure 2.

Figure 2: Overview of the findings

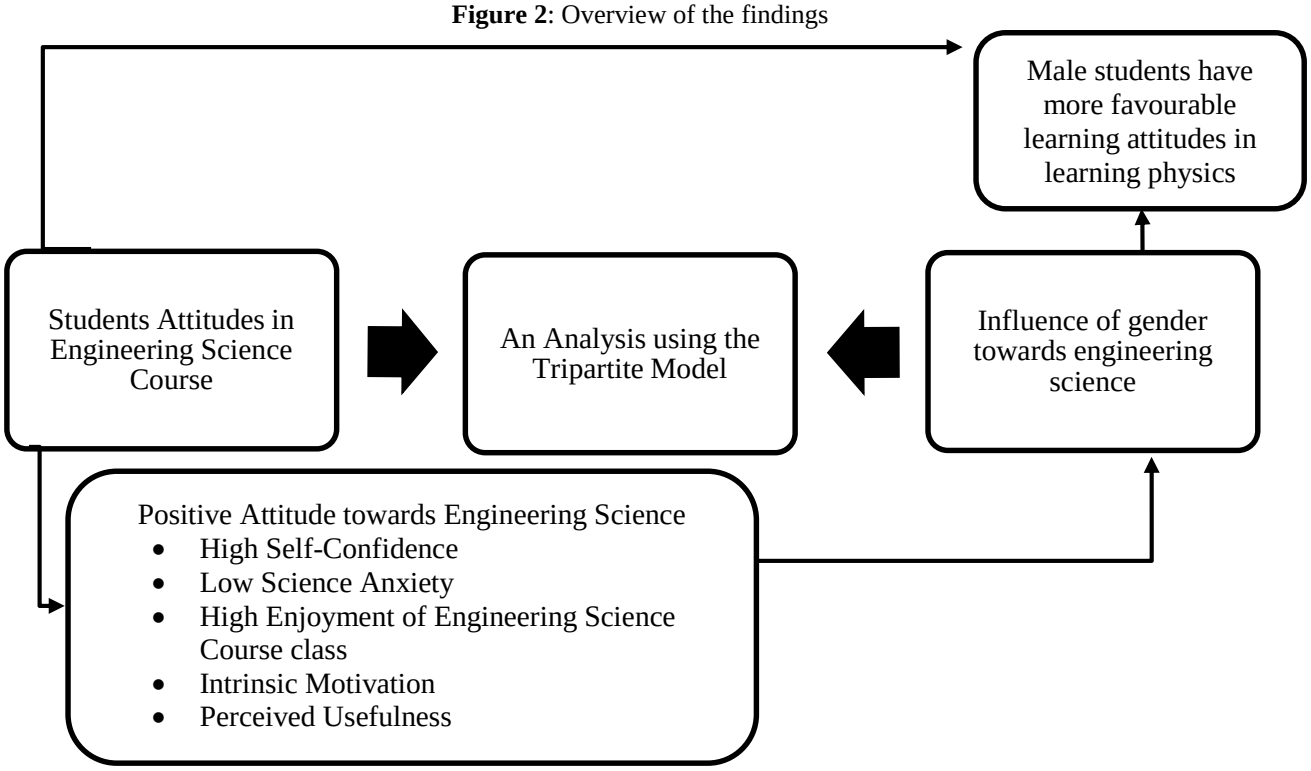


Table 1: Descriptive statistics for the overall students' attitude towards Engineering Science

N=182	Mean	SD
Attitude	4.20	3.60

In assessing a student's attitude towards Engineering Science course, a mean score exceeding 3.0, which represents the midpoint of the scale, is considered indicative of a positive disposition. The data presented in Table 1 demonstrates that the attitude scores surpass 3.0, signifying an overall positive attitude among students towards Engineering Science, with students exhibiting an even more pronounced positive attitude (mean: 4.20).

Table 2: Descriptive statistics regarding Students' Self-Confidence

N=182	Mean	SD
Attitude	3.59	3.22

Scores exceeding 3.0 on this aspect denote high self-confidence, whereas scores below 3.0 indicate low confidence. The data presented in Table 2 reveals that students demonstrated greater confidence in Engineering Science, with an average score of 3.59.

Table 3: Descriptive statistics for Science Anxiety

N=182	Mean	SD
Attitude	3.98	3.64

High scores in this context indicate lower anxiety, whereas a low score signifies higher anxiety levels. Referring to Table 3, students exhibited the following anxiety levels: lower anxiety (mean =), moderate anxiety (mean =), and high anxiety (mean: 3.98).

Table 4 : Descriptive statistics for Engineering Science class enjoyment

N=182	Mean	SD
Attitude	4.05	3.61

A student achieving a score above 3.0 demonstrated an affinity for Engineering Science course, whereas a score below 3.0 indicated a lower level of enjoyment. As illustrated in Table 4, the mean scores surpassed 3.0, signifying an overall positive attitude towards the subject, with a mean score of 4.05.

Table 5: Descriptive statistics for Instrinsic Motivation

N=182	Mean	SD
Attitude	3.97	3.56

In Table 5, the data indicates that the mean scores for the subject were 3.97, which is well above 3.0. This suggests that students had a positive experience and found the subject enjoyable.

Table 6: Student's Attitude in learning Engineering Science between Genders

	Gender	N	M	SD	t	df	p-value
Attitude	Male	95	3.85	0.92	3.1266	94	.002*
	Female	87	3.79	1.02	2.2561	86	.027

In Table 6, the analysis of attitudes between male and female students is presented. The findings reveal that male students (M=3.85, SD: 0.92) achieved higher mean scores than their female counterparts (M=3.79, SD: 1.02). Furthermore, the overall t-test analysis of engineering science learning attitudes demonstrated a statistically significant difference in learning attitudes between male and female students. The examination of attitudes towards science has received considerable attention in recent years due to its significance in comprehending scientific concepts. A positive attitude towards science is influenced by various factors, including the content being taught, instructional methods and materials, educators' academic competence, and the supportive interpersonal, physical, and social learning environments.

Attitude, being a hypothetical construct not directly observable, is inferred from observable reactions to the subject of attitude, as demonstrated in our investigation of physics learning. In our study, we adopted the Tripartite model, incorporating self-confidence, anxiety, enjoyment (affect), intrinsic motivation (behavior), and perceived usefulness (cognition) components to grasp students' attitudes towards Engineering Science courses. Our findings suggest that first-semester students exhibit positive attitudes towards their courses, indicating that a positive attitude throughout the learning process may lead to improved learning outcomes. This is consistent with previous research suggesting that favorable atitude identified among first semester students towards their physic course(Hernánez-Suarez et al., 2021). Additionally, the study observed that male students exhibited a more positive attitude towards physics than their female counterparts, aligning with prior research. Male students, in general, are found to be more interested in the aspects of physical sciences, while female students' interests in science are focused more on the biological and environmental. Therefore, male students tend to be more motivated in learning Physics than female students. However, the results are contradict with another previous studies that observed students gender does not influence their attitude towards physics (Xavier et al., 2016).

CONCLUSION

According to the findings of this study, students have shown a positive attitude towards the Engineering Science course. The results reveal a notable difference in the attitudes of male and female students towards learning Engineering Science. These findings have provided valuable insights into how students' attitudes towards engineering science courses change over time, using the Tripartite Model to assess their cognitive, affective, and behavioral dimensions. The findings have uncovered significant cognitive and affective shifts in students' attitudes towards these courses, which significantly impact instructional practices and curriculum design in engineering science. The results suggest that educators should create a supportive learning environment that encourages active engagement and facilitates a thorough understanding of the subject matter. By incorporating effective teaching strategies that accommodate students' diverse learning styles and backgrounds, educators can significantly improve students' attitudes and enhance their academic achievements. Future research could focus on the precise impact of customized teaching interventions on students' attitudes and examine individual factors such as personality and learning preferences. This study contributes to a more nuanced understanding of students' attitudes towards engineering science courses and emphasizes the need for ongoing research and innovation in education.

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