

Anxiety Analysis on Thermodynamics Subject Among Engineering Technology Students in UNIKL, MIMET

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ABSTRACT

The main objective of this research was to find out the level of test anxiety among engineering technology students in Universiti Kuala Lumpur Malaysian Institute of Marine Engineering Technology (UniKL MIMET), Lumut, Perak, Malaysia. It also considered examining the possible differences among the variables of test anxiety and study performance, the learners' characteristics of gender, course and current semester. Test Anxiety Questionnaire which consisted of 10 items of five-point Likert scale was used to collect data from 65 engineering technology students in UniKL MIMET. These participants were selected from 5 engineering technology courses. The data collections were analyzed by using descriptive statistics and mean analysis. The findings of the research revealed that students were found to be the most anxious learners.

KEYWORDS: anxiety test, thermodynamics, engineering technology

INTRODUCTION

One of the foundations for engineering courses is thermodynamics. Engineering students need to understand thermodynamics in terms of the laws of thermodynamics, the concept of energy, mass and entropy, pure substance properties, etc. Thermodynamics is reported to be not-so-interesting or even boring and of average or higher difficulty compared to other courses and can be challenging to learn [4].

Thermodynamics course major aim is to develop students' capability in solving engineering problems that involve thermodynamic principles. It is a common phenomenon that most students have trouble in solving thermodynamics problem and do not know how to start. Student struggled when solving thermodynamics problem when the student are not familiar with the fundamental thermodynamics principles and continue answering using problem-solving techniques which results in the problems become more complicated. Students that understand the thermodynamics concept would be able to solve a typical thermodynamics problem using a proper systematic approach. Usually, in teaching thermodynamics courses, this systematic approach has been demonstrated through illustrative examples. However, this approach does not promise much positive effect [7].

In some courses, for example at Diploma level at Universiti Kuala Lumpur Malaysian Institute of Marine Engineering Technology (UniKL MIMET), thermodynamics are taught in stages such as Fundamental Thermodynamics being the prerequisite before the student can take up Applied Thermodynamics. Also, Thermodynamics 1 is the prerequisite for Thermodynamics 2 at Bachelor level. If the student cannot grasp the fundamental concept in the prerequisite subjects, the student might have difficulties solving problems in the later subjects. Poor achievement in the prerequisite subjects will psychologically influence the students' performance and can be determine through Test Anxiety (TA). Test anxiety refers to cognitive and affective reactions to the possibility of negative consequences resulting from the performance on a test or in an evaluative situation [23]. It is normal to feel some anxiety before a test, but too much anxiety may be harmful to you. Test anxiety has many symptoms which include loss of sleep or appetite, sweaty palms, food cravings and an inability to concentrate to name a few.

Sometimes anxiety serves to motivate learning by increasing interest, the desire for information and information-gathering itself. Whereas, in [8] identify anxiety as one of the most widespread emotional conditions that students experience in any learning situation. According to [12], the specific factors that cause anxiety are not explicit, but there is confirmation that younger people have a tendency to have high levels of common anxiety that further increase during evaluations. There is substantial evidence that some learners have biological tendencies to

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have high levels of anxiety, which make them more susceptible to TA. According to [21], the main causes of anxiety are (a) low self-esteem, (b) competitiveness, (c) state (situation-specific) anxiety or personality characteristics, (d) lack of group membership, (e) overt, explicit error correction, (f) speaking English in front of the class, (g) little declarative (explicit) knowledge, (h) lack of class preparation and (i) uneven allocation of turns.

Learners with high confidence can achieve better than learners who have low confidence. Excessive test anxiety and poor study behavior are two specific areas that have been shown to have an impact upon academic success of students. According to [18], TA is one of the most important factors that lead learners to score poorly in tests. One of the problems of the educational and academic system and learners is the test format [17]. In their study, in [20] reveal that TA usually influences learners before and especially during tests. In [1] states that TA refers to the kind of anxiety which makes a person hesitant and uncomfortable about his or her own abilities and as a result to decrease the ability to manage with the stress of the exam and evaluation process. In this regard, in [2] describes TA as a serious problem for learners because it hinders with their ability to think and do well throughout the exams. Moreover, in [22] note that test anxiety can be explained as physiological, cognitive and emotional responses produced by stress experienced throughout the measurement and it is a sense has a negative role in the learners' feelings towards cures. In [15] claims that TA decreases learners' educational achievement, life quality and internal enthusiasm and it makes difficult for them to concentrate.

Previous research on students at university level indicates that students has serious conceptual difficulties, particularly in the first and second law of thermodynamics and these difficulties seem to be perceived by students around the world. In [5] developed Representational Conceptual Evaluation (RCET) to investigate student consistency in understanding the first law of Thermodynamics whereby 95 second-year students who have completed thermodynamics course at the end of the second semester involved in the survey. Criterion validity and expert validity were measured in this study and the validity as well as reliability of RCET show that this instrument can be used to measure the intended concept in the first law of thermodynamics and produced consistent results.

In [14] conducted a cross-sectional survey under the Conceptual Understanding Test (CUT) to evaluate students' conceptual understanding level of energy, heat, temperature and enthalpy to a randomly selected sample of 418 public high school student in Istanbul and the results indicated that students' understanding of the above mentioned concepts was generally either wrong or incomplete. Problem with concepts in thermodynamics continue at university level where the undergraduates were found to misunderstand the fundamental thermodynamics concepts and make it so challenging for the students. This shows that the problem students face when studying the concepts of thermodynamics that these concepts are not easy for them to grasp and the student need to be handled explicitly during teaching and learning process.

Thermodynamics is a subject that deals with energy. It also one of the most advanced tools for understanding the physical universe. Engineering students' difficulties in learning thermodynamics occur globally as indicated by the literature. In UniKL MIMET, this subject contributes to the high failure rate for every semester. There are various studies reporting on efforts made to overcome the deficiencies and suggestions of teaching approaches to enhance students learning such as blended learning approach, active learning techniques, computer-based instruction, virtual lab-a web-based student learning tool for thermodynamic concept related to multi-staging in compressors and turbines, TESTTM software in design projects and laboratory and so on [10]. By determining the factors and root caused to this issue, the suggestions for improvement will be proposed. The criteria for analysis include the characteristics of the learning system, the effectiveness based on students' performance; the skill developed using the learning system and students' feedback. In addition, this research is also designed to suggest the improvement to enhance in teaching and learning Thermodynamics subjects in UniKL MIMET.

Therefore, the aim of this study is to determine the factors/root caused that contributes to high failure rate in teaching and learning of Thermodynamics subjects in UniKLMIMET and to suggest improve the teaching and learning approaches to enhance students learning in Thermodynamics subjects.

METHODOLOGY

Research Design

The current study was designed as a survey study with a quantitative methodology. Test Anxiety Questionnaire [11] which consisted of 10 items of five-point Likert scale, was used to collect data from 65 engineering technology students in UniKL MIMET to find out the levels of Test Anxiety (TA) among them. The participants involved had taken the Thermodynamics subjects that were offered in the third semester onwards.

Population, Sampling and the Sample

Participants in the present study were selected randomly among five engineering technology courses namely Diploma of Engineering Technology in Ship Construction (DSC), Diploma of Engineering Technology in Ship Design (DSD), Diploma of Engineering Technology in Marine Engineering (DME), Bachelor of Engineering Technology in Naval Architecture and Ship Building (BNASB) and Bachelor of Engineering Technology in Marine Engineering (BME). The overall distribution of participant is shown in Table 1.

Table 1: Distribution of participants based on gender, courses and current semester of learners

	Item	Frequency	Percent
Gender	Male	53	81.5
	Female	12	18.5
	Total	65	100.0
Courses	DSC	11	16.9
	DSD	10	15.4
	DME	18	27.7
	BNASB	21	32.3
	BME	5	7.7
	Total	65	100.0
Semester	3	10	15.4
	4	23	35.4
	5	8	12.3
	6	4	6.2
	8	20	30.8
	Total	65	100.0

The participants were asked to fill out all three parts of the questionnaire and to answer the question truthfully. Participants were to complete Section A on the Respondent Background. Section B was designed to determine whether the student experience a mild or severe case of TA. Participants were to read through each statement and reflect upon past tests experience. While, Section C was designed to collect participants opinion on the Thermodynamics subject itself, how the lecturer can improve the teaching methods, the participants effort to improve their understanding etc.

Statistical Analysis

The data gathered were presented in graphical and tabular form to interpret the results, descriptive statistics such as frequency distribution and weighted mean were also used. Frequency distribution and weighted mean were utilized to determine the performance of students and students’ test anxiety. All data were treated using SPSS version 21.

RESULTS AND DISCUSSION

Table 2 summarizes the student performance for Fundamental Thermodynamics that was taken by engineering technology students at Diploma level for all three courses DSC, DSD and DME. This subject covers topics such as first and second law of thermodynamics, mass and energy balance, open and closed systems as well as entropy. Students are allowed to repeat the subject for 2 times should the student fail the subject in the 1st attempt. 60% of respondent took the subject and 30.8% of students fail the subject in the 1st attempt. The failed students then repeat the subject for the first time and 62.5% of the repeating students pass the subject. The 3rd attempt recorded 100% pass with the lowest passing grade D. It is obvious from the students’ performance that students perceive test and examination as a source of increase in anxiety and unfair situation for them to demonstrate their true achievements. According to [12], such feelings among students’ limit their potential performance during the test which results in higher TA. It is important for the student to understand that test and examination are not meant to measure student achievement under intimidating situation but more to knowing their level of achievement in a fair environment to let them demonstrate their abilities to the fullest.

As for in Table 3, the students’ performance in Applied Thermodynamics which is also a subject at Diploma level but only taken by DME student shows better results since the student already understand the fundamental concept of thermodynamics and have no problem applying it to solve a more complicated problem related to gas, vapor and refrigeration cycles. Also, at this stage the student already master the proper systematic problem solving technique as discussed by [7]. Even though, there are still student who fails the subject, this is probably due to it is influenced by the student lower score in Fundamental Thermodynamics. Student who pass Fundamental

Thermodynamics with good grade tend to pass Applied Thermodynamics also with good grade. It is clear that in the Applied Thermodynamics subject the students show a much lower TA due to the students already familiar with the organization of the questions in test and examination and this boost their confident level. This finding agrees with the discussion by [12] that student with academic achievement have low TA scores and vice versa.

Table 2: Fundamental Thermodynamics performance (Diploma)

Fundamental Thermodynamics	Grade	Frequency	Percent
1st Attempt	F	12	30.8
	D	3	7.7
	C-	2	5.1
	C	7	17.9
	C+	5	12.8
	B-	1	2.6
	B	2	5.1
	B+	4	10.3
	A	3	7.7
	2nd Attempt	F	3
C		1	12.5
B		2	25.0
B+		1	12.5
A-		1	12.5
3rd Attempt	D	1	33.3
	C	1	33.3
	B	1	33.3

Table 3: Applied Thermodynamics performance (Diploma)

Applied Thermodynamics	Grade	Frequency	Percent
1st Attempt	F	2	22.2
	C+	1	11.1
	B	4	44.1
	A-	1	11.1
	A	1	11.1
2nd Attempt	F	1	100.0

Table 4 summarizes the students' performance for Thermodynamics subject taken only by BNASB student offered at Bachelor level. At least 23.8% of students fail this subject in the 1st attempt. The same trend is recorded at Diploma level but at higher percentage. This suggests that the TA among the engineering technology students at both level are the same. In the 2nd attempt, the number of student failing the subject reduced and all students pass in the 3rd attempt. The students' performance for Thermodynamics 1 is tabulated in Table 5 and this subject is taken by BME students. There are still student who failed the subject but not many due to this is a newly introduced course. It is hard to see any trend yet since it is still considered new. Student who passed this subject is now taking Thermodynamics 2. Other researchers that investigated TA relationship to student's performance include [3, 6, 12, 19].

Table 4: Thermodynamics performance (Bachelor)

Thermodynamics	Grade	Frequency	Percent
1st Attempt	F	5	23.8
	D	6	28.6
	C	1	4.8
	C+	3	14.3
	B	2	9.5
	B+	3	14.3
	A	1	4.8
	2nd Attempt	F	3
C		1	20.0
B		2	20.0
3rd Attempt	D	3	100.0

Table 5: Applied Thermodynamics performance

Thermodynamics 1	Grade	Frequency	Percent
1st Attempt	F	2	40.0
	D	3	60.0

Table 6 presents the mean score of the TA of students in thermodynamics. It can be seen that respondents sometimes felt TA in thermodynamics with a mean between 2.3 to 3.3. The items registered high to very high mean ranging from 3.06 to 3.24 are interpreted as “sometimes” and “often” revealed that difficulties of choosing answers in thermodynamics are the highest in rank with a weighted mean of 3.24 interpreted as “sometimes to often”. Most of the respondents feel like they need to put more effort before any thermodynamics tests than for other subjects and thermodynamics tests are much more worrying to them than other tests which obtained 2.58 and tend to do very poorly on thermodynamics tests with weighted mean of 3.18. However, among the thermodynamics TA, the lowest and rarely felt by the respondents is “feeling nauseated before thermodynamics test/examination” with weighted mean of 2.35. This implies that the students have find thermodynamics test an anxiety and they really encountered difficulty in learning thermodynamics. According to [13], TA is a physiological condition in which people experience extreme stress, anxiety and discomfort during and/or before taking a test. These responses can drastically hinder an individuals’ ability to perform well and negatively affects their social, emotional and behavioral development and feelings about themselves and school.

Table 6: Mean score of the Thermodynamics test anxiety

Indicators	Mean	Std. Deviation
I have visible signs of nervousness such as sweaty palms, shaky hands and so on right before thermodynamics test/examination.	2.58	1.14
I have "butterflies" in my stomach before thermodynamics test/examination.	2.92	1.12
I feel nauseated before thermodynamics test/examination.	2.35	1.09
I read through the test/examination question and feel that I do not know any of the answers.	3.21	0.93
I panic before and during thermodynamics test/examination.	2.83	1.08
My mind goes blank during thermodynamics test/examination.	2.95	1.00
I remember the information that I blanked on once I get out of the testing situation.	3.06	1.25
I have trouble sleeping the night before thermodynamics test/examination.	2.86	1.32
I make mistakes on easy questions or put answers in the wrong places.	3.18	1.09
I have difficulty choosing answers.	3.24	1.13

The overall score of the anxiety test are summarizes in Table 7. 7.7% of students obtained points in between 10 to 19 which indicated that the students’ do not suffer from TA. In fact, a little anxiety may be healthy to keep the student focused and to get their blood flowing during exams if the students’ score was extremely low (close to 10). Most students obtained points in between 20 to 34 that is 73.8% which shows that although student exhibit some of the characteristics of TA, the level of stress and tension is probably healthy. However, 18.5% of students obtained 35 to 50 points which suggested that students’ are experiencing an unhealthy level of TA. Student should evaluate the reason(s) for the distress and identify strategies for compensating. Often, students become anxious about test taking when they are not as prepared as they could be. High TA is considered as one of the main factor for low performance of students at university level according to [12, 16].

Table 7: Overall score of anxiety test

Point	Frequency	Percentage	Description
10-19	5	7.7	Indicate that you do not suffer from test anxiety. In fact, if your score was extremely low (close to 10), a little more anxiety may be healthy to keep you focused and to get your blood flowing during exams.
20-34	48	73.8	Shows that although you exhibit some of the characteristics of test anxiety, the level of stress and tension is probably healthy.
35-50	12	18.5	Suggest that you are experiencing an unhealthy level of test anxiety. You should evaluate the reason(s) for the distress and identify strategies for compensating. Often, students become anxious about test taking when they are not as prepared as they could be.

CONCLUSION

Findings of this study indicate that the students obtained a poor performance rating in Thermodynamics subject especially for diploma level students. The students moderately felt test anxiety in Thermodynamics. Test anxiety is considered a factor that might affect the students’ Thermodynamics performance. A plan of action for the enhancement of Thermodynamics achievement to improve the passing rate in the university examination is proposed. Lecturers may develop different learning strategies in all Thermodynamics subjects as the same strategies of teaching approach should also be revised for other basic subjects related to Thermodynamics for example Technical Mathematics and Engineering Science. Lecturers may provide relaxation techniques before the exam to overcome students’ anxiety on Thermodynamics. One of the student outcomes should be required for students to

accomplish their academic pursuit is the ability to apply knowledge of mathematics and science to solve problems. The proposed plan of action may be implemented and evaluated for mathematics achievement enhancement. Future researchers may conduct similar study using other variables that are covered in this paper. Future studies should evaluate the role of stress/time management programs to reduce stress and anxiety.

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