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Assessing Students' Attitudes and Perception towards Statistics Subject

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ABSTRACT

Statistics has always been regarded as one of the most difficult subjects for students to master. There are several factors that cause difficulties in understanding the statistics subject, including attitude, perception, expectation, motivation, as well as students' intellectual capability to do well in this subject. Basically, students will have difficulty in learning the subject effectively if they have a negative attitude or perception towards that subject. On that note, a study on assessing students' conceptual understanding, attitudes, and perceptions towards statistics subjects among Universiti Teknologi MARA (UiTM) students was conducted. Primary data is collected by distributing questionnaires to the respondents. Findings revealed that most of the respondents agreed with all statements regarding attitudes and perceptions towards the subject of statistics. Moreover, attitudes and perceptions have a significant relationship with their

conceptual understanding of Statistics. Students who have positive attitudes and perceptions have a moderate level of conceptual understanding of statistical concepts. However, this study found that only the students' perceptions contributed to the conceptual understanding of statistical concepts among UiTM students. As for recommendations, it is suggested that a similar study be done to estimate the students' perceived ability and empirical understanding relating to basic statistics concepts, along with enhancing what is still in the ongoing studies.

Keywords: *Statistics; attitudes; perception; conceptual understanding*

INTRODUCTION

Statistics is a field of study that focuses on developing and studying ways to collect, organize, present, analyze, and make sense of numerical data to help people make better decisions. Nowadays, Statistics plays a vital role in almost every field, including business, information technology, accounting, economics, sciences, communication, industry, banking, and others. The application of statistical techniques is also widespread. This has led to Statistics becoming a very useful subject due to the knowledge and skills gathered that can be applied in different fields (Asmat et al., 2020). Due to high demand from the government and the private sectors, Statistics is made a core subject at the Higher Education Institutes in Malaysia in which students from other courses are required to take this subject in their studies (Maat & Rosli, 2016; Ashaari et al., 2011). Based on de Oliveira Júnior et al. (2018), teaching and learning Statistics are becoming an increasingly important part of higher education. This is because this subject teaches students how to deal with a large amount of information, solve problems, and make good decisions based on what they can infer from a small sample of data.

In general, the majority of students from various fields must learn and study this subject because they must use statistical ideas in their final written report (Male & Lumbantoruan, 2021). Statistics subject is very important in business studies because it can help business students project sales figures, assess production processes, create and modify organizational structures, and many other things. Besides that, the Statistics subject also plays an important role in the management field. Using statistics can also

help the management students make better decisions by allowing them to set numerical benchmarks, track and assess program progress to make sure it is accomplishing its goals, and highlight any areas that need improvement. Based on Egghe and Rousseau (2001), statistics are used in management for reporting, supporting decisions, and predicting changes in the future.

In the Faculty of Computer and Mathematical Sciences (FSKM), Statistics is a required course that aims to expose students to the fundamental statistical concepts and methods that are used in both research and industry. The content of the Statistics subject covers the elements and concepts that deal with the dataset, including probability distribution, regression, correlation, data description, sampling distribution, time series, and hypothesis approximation and testing. This subject also exposes the students to skills to analyze and run the data using statistical packages such as the Statistical Package for the Social Sciences (SPSS), Microsoft Excel, MINITAB, and others. Statistics is thought to be a hard and killer subject because its ideas are so complicated, difficult to understand, and hard to score (Asmat et al., 2015). This subject has always been seen as one of the hardest by students (Saidi & Siew, 2019). Male and Lumbantoruan (2021) stated that university students may find it hard to use statistics and understand the results. Some of them stated that reading statistics tables was difficult. They needed more time to focus on calculations and figure out how to put the numbers into words.

The way a student thinks about and approaches a subject is a big part of how well he or she learns the subject's core content. Students will find it hard to learn a subject well if they have a negative view of it (Saidi & Siew, 2019). In general, students' attitudes can help or hurt their ability to learn statistics (de Oliveira Júnior et al., 2018). It could affect how much students learn to think statistically and how much they can use what they have learned outside of the classroom. Chan and Ismail (2014) stated that students are more likely to use statistics well outside of the classroom if they have a positive view of the subject. Understanding statistics can be challenging due to various reasons such as their attitude, perception, expectations, motivation, and intellectual ability. These things can make it hard to learn statistics and apply statistical skills in everyday life (Ashaari et al., 2011).

Many researchers at different levels have conducted a survey and developed several instruments to assess students' attitudes and their affective outcomes towards statistics. Even though there are many articles explaining students' attitudes towards statistics, there is scant empirical research on the basic knowledge and conceptual understanding of statistics after completing this subject. The existing studies do not provide sufficient explanations about the students' attitudes and perceptions towards statistics since most of the researchers collect their survey data from students who have just enrolled in their Statistics classes for a few weeks. This will affect the students' attitudes and perceptions towards this subject since they have just started to learn and understand the elements and concepts of statistics. Therefore, this study was conducted among students who had taken the Statistics subject during the previous semester to determine the level of attitudes and perceptions towards the Statistics subject. This study will look at the effects of students' attitudes and perceptions on their conceptual understanding of statistics. By evaluating these outcomes, it may be easier to get students to learn about statistics and improve their skills in this area.

LITERATURE REVIEW

Statistics is a "methodological discipline study of a coherent set of ideas and tools for dealing with data," according to Cobb et al. (1997). Although statistics is frequently thought of as a branch of mathematics, the field is more non-mathematical than it is mathematical. There is more than just content that separates statistical thinking and mathematical thinking because data are not just numbers, they are numbers with a context. The focus on variability naturally gives statistics a unique content that sets it apart from mathematics itself. According to Chattopadhyay and Chattopadhyay (2014), descriptive and inferential statistics are the two main branches of statistics. When describing a set of data that has simply been gathered, descriptive statistics are utilized. Using data obtained on a small portion of the population, inferential statistics is used to generate predictions or comparisons about a larger group or a population.

According to Ridgway et al. (2011), statistical literacy is a crucial and important skill for people to have to be completely effective. These abilities are valuable to all individuals, regardless of their degree or professional background, in recognizing, confronting, and resolving

problems that arise in daily life. They should not be seen as being exclusive to any one field of knowledge or career. Statistics turns out to be a very helpful subject because the knowledge and skills acquired may be applied in a variety of disciplines, including the social sciences and technology. Maat and Rosli (2016) also noted that this course is crucial in many professional sectors. Statistics also ranks among the most crucial courses at the higher education level as a result of increased demand from the public and corporate sectors.

The public has to be informed that statistics can be misrepresented and used to manipulate and deceive, for example, by repeating research until desired results are produced or by utilizing biased or tiny samples. To critically evaluate the information they are given, students must be statistically literate because they are the future of adult society (Kassim et al., 2010). The students will not be able to apply the statistician's applications to a real scientific context without a deeper comprehension of the theory. In other words, since the practice should follow the theory and the theory should be applied to the practice, statistics theory and practice cannot be separated (Naccache, 2012). A lack of statistical understanding can result in mistakes in sample size selection, statistical test selection, and test interpretation. All of these could result in incorrect inferences (Rubio et al., 2018)

Related Studies on Attitudes and Towards Statistics

There are several definitions of attitude suggested by previous research. According to Al-Mamun et al. (2012), an attitude is a psychological construct that specifies a certain behavior. Mensah et al. (2013) define attitude as a way of thinking, acting, and behaving, while Zhang and Campbell (2011) view attitude as a very complex and unique idea that combines several properties and has a wide range of domains. These properties and domains, including emotion, goal, direction, strength, and consistency, may be positive, neutral, and negative (Anderson, 1994). In addition, attitudes toward any particular area of knowledge show specific characteristics. Attitudes can be positive at an early stage of studying, but they can be gradually changed over time depending on their intensity whether it is positive or negative (León-Mantero et al., 2020).

Numerous studies have been conducted on students' attitudes towards statistics. Based on Ghulami et al. (2015), the students responded that they had given their best effort to study statistics since this subject was so challenging. Therefore, it is very important to give more attention to the students' attitudes in studying Statistics subjects. It can make the learning process of statistics more satisfying, fun, less terrifying, and less frustrating for the students. It is essential to examine their attitudes towards statistics since it can be an instrument that characterizes the effectiveness of the educational process itself (de Oliveira Júnior et al., 2018). Ashaari et al. (2011) said that the students had a very good attitude and worked hard to understand the subject better. They felt that this subject was very tough and was not relevant to their course and daily life in the future. The findings are aligned with Male and Lumbantoruan (2021). They revealed that most of the students showed high emotions to learning and understanding the statistics. Most of them also agreed that to do statistics and understand them, they had to be disciplined in the way they thought.

The students also expressed that they had a positive attitude towards statistics in terms of effect, value, interest, and effort. However, they had neutral attitudes toward statistics in terms of cognitive competence subscales (Ghulami et al., 2015). This expression is supported by a study that was conducted among Arab and Malay students by Fayomi et al. (2022). They found that most of them were somewhat interested in learning statistics. Most of the Arab and Malay students tended to have moderate to highly positive attitudes towards learning the subject of Statistics where about 63 percent of students liked the statistics. Students who studied business were the most optimistic and sure that they would use these statistics at work in the future (Griffith et al., 2012).

Students' Perception Towards Statistics

Perception referred to a person's thoughts or opinions about something (Male & Lumbantoruan, 2021). Gregory (1970) stated that perception dealt with prior knowledge and experience. It had been shown that if students thought positively about their studies, they would do well. However, if the students had negative ideas, failure would happen. This was supported by the findings of a study conducted by Gunawan et al. (2020). They measured perception indicators based on three categories, which were excellent, good, and not good. Their findings concluded that a good category

of perception affected how well someone learnt. This was in line with the study conducted by Bond et al. (2012) which indicated that perception was about how cognitive and non-cognitive factors worked together. Aside from that, a study that dealt with gender differences in statistics anxiety (Mandap, 2016) concluded that Mathematics and perception belonged to the statistics anxiety components. It means that the way people think is important because it can affect how well they learn any subject.

Male and Lumbantoruan (2021) revealed that perception was important since it could influence how well students learnt the subject of Statistics. Their student respondents agreed with all the statements that dealt with perceptions in terms of perceptions towards statistics. This was clear from the fact that they were able to figure out the distribution, measurement, and method for doing statistics. Nevertheless, they disagreed on how well they could explain the results of statistics and how easy they thought statistics was to understand. Another study proved that students' self-perceptions of statistics were a significant aspect that could either positively or negatively impact their performance in statistics (Ncube & Moroke, 2015). In the future, students' perceptions of statistics can be used as a measurement to assess students' ability to solve statistical problems with ease. This also agreed with Ben-Zvi and Garfield (2004). Students' perception of statistics in their academic and professional lives may influence their usage of statistics in the future. A threat or a motivation to take a Statistics subject in the future depends on whether the student has negative or positive experiences with this subject.

Factors that Influence Students' Conceptual Understanding of Statistics

Research on students' understanding of statistical concepts had been done by previous researchers. These studies focused on the students' understanding of statistical concepts like graphs of distributions, measures of central tendency, variability, sampling variation, and distributions. Students could develop statistical knowledge and think statistically by studying Statistics subjects (Carver et al., 2016). However, for students studying this subject, achieving this intended learning outcome could be challenging as there were several factors contributing to their understanding of these statistical ideas (Fry, 2017).

Even when innovative teaching methods and software are used, most students are still struggling to get the big picture of statistics. Several studies from the past showed that most students put too much emphasis on getting good at computation and memorizing formulas when answering questions about statistics (Ismail & Chan, 2015; Reston et al., 2014). According to Ashaari et al. (2011), there were two factors, which were cognitive and non-cognitive, that influenced the understanding of statistical concepts. The non-cognitive factor dealt with attitudes, perceptions, interests, expectations, and motivation, while the cognitive factor dealt with intelligence. On the other hand, Male and Lumbantoruan (2021) stated that the factors influencing the students' achievements in Statistics subjects were attitudes, motivation, anxiety, learning achievements, aptitudes, intelligence, age, personality, and others.

Based on previous literature, several studies were conducted to identify the factors that influence students' conceptual understanding of statistics. Based on Saidi and Siew (2019), there was a small to moderate positive relationship between attitudes toward performance in statistics. Another study showed that there was no significant relationship between students' understanding of measures of central tendency and their attitude toward statistics. One of the things that made it hard for students to understand the measure of central tendency as a statistical concept was how abstract it was (Woldemicheal, 2015). These results were consistent with those obtained by Cahyawati et al. (2018) and Hannigan et al. (2013). Their findings showed that student attitudes did not influence conceptual understanding since there was no significant relationship between students' attitudes to statistics and the result of learning the subject.

Another study proved that students' perception was also identified as a factor that influenced conceptual understanding. For instance, Rubio et al. (2018) found that the students' perceptions significantly improved their statistical ability. This was also supported by Bond et al. (2012) who found that students' perceptions broaden their understanding of statistics. In another study, the students' perceptions had an impact on their ability to develop statistical thinking skills and usage outside the classroom (Songsore & White, 2018). On the contrary, a study was conducted to identify the effect of distributed practice on students' conceptual understanding of statistics (Budé et al., 2010). The findings revealed that distributed practice was one of the reasons that led to a better conceptual understanding

compared to mass practice. Students' understanding of statistical concepts showed a negative effect with the reduction of distributed practice.

METHODOLOGY

Data were collected once over a four-week period using a cross-sectional study. The sample for the study was taken from the campus population of UiTM Johor, Campus Segamat, where the study was carried out. About 130 students from four classes were selected to participate in this study since they had already completed the Statistics subject in the previous semester. Only 102 students completed the questionnaire, despite their willingness to cooperate. In order to collect information from the respondents, a survey was conducted using Google Forms and an online questionnaire. In order to reduce non-response errors, they were asked to respond to all questions.

The questionnaire was developed to assess the students' conceptual understanding, attitudes, and perceptions towards the Statistics subject. The questionnaire was developed based on previous studies on students' attitudes and their understanding of statistics. The questionnaire used was a survey adapted from several sources which were Ashaari et al. (2011), Kassim et al. (2010), and de Oliveira Júnior et al. (2018). This questionnaire contained four sections with 43 questions in total. The first section (Section A) examined the respondents' characteristics. The following sections (Section B, Section C, and Section D) examined the analysis of the research questions. It focused on the respondents' attitudes, knowledge, experience, and conceptual understanding of statistics. The interval scale matrix with pre-coded numerical scales was used to measure the respondent's degree of agreement. A 10-point scale was implemented with 10 being "Strongly Agree" to 1 being "Strongly Disagree."

Section B focused on the respondents' attitudes towards statistics subject. This domain included 10 questions. The degree to which students had positive or negative feelings about statistics is referred to as their attitude toward statistics. Positive questions consisted of B1, B2, B3, B6, and B9, while B4, B5, B7, B8, and B10 are defined as negative questions. For the positive attitude, the scoring is 10-Strongly Agree until 1-Strongly Disagree whereas for the negative attitude, the scale is 1-Strongly Agree and 10-Strongly Disagree. Then, the next section (Section C) was about students'

perceptions towards the Statistics subject, which consisted of two parts; knowledge and experience (Roessler, 2009; Gregory, 1970). In Part 1, the 'knowledge' domain consisted of 13 questions that referred to the respondents' knowledge and skills when they applied statistics. The next domain (Part 2) was about 'experience' and contained 12 questions. It concentrated on the respondents' learning experiences during their previous Statistics classes.

The last section (Section D) consisted of 8 questions that assessed the students' grasp of statistical concepts. This section assessed the respondents' comprehension of fundamental statistical concepts. The types of data, statistical terms, scale measurement, types of statistical study, statistical investigation, measures of location, and measures of dispersion were the concepts tested. These topics were selected to assess the students' basic understanding of concepts related to statistics and their knowledge of the specific topics, as well as to measure their understanding of the subject. Table 1 shows the items related to conceptual understanding.

Table 1
Items on Statistics' Conceptual Understanding

No.	Items
D1	I am able to define the statistical terms.
D2	I am able to identify the steps in statistical investigation.
D3	I am able to define the meaning of population.
D4	I am able to identify the types of variables.
D5	I am able to identify the types of statistical studies.
D6	I am able to identify the measures of location.
D7	I am able to identify the measures of dispersion.
D8	I am able to identify the scale of measurement.

Descriptive statistics, independent t-tests, correlation analysis, and multiple linear regression were employed for this study. Cronbach's coefficient alpha is also used as a test of the consistency of the respondents' answers to all the items in a measure. As the coefficients get closer to 1, it shows that the measuring tool is better. But as the coefficient gets closer to 0, it shows that the instrument is not as good. A total of 36 students were chosen at random for the pilot study. The results of the analysis showed that the attitude domain had a Cronbach's alpha reliability coefficient of 0.762, the knowledge domain had a Cronbach's alpha reliability coefficient of 0.901, the experience domain had a Cronbach's alpha reliability coefficient

of 0.888, and the student's conceptual domain had a Cronbach's alpha reliability coefficient of 0.916. These findings demonstrated the instruments' reliability.

RESULTS

Demographic Profile of The Respondents

This section examined the characteristics of the respondents, which comprised gender, faculty, and course.

Table 2
Demographic data of the respondents (n = 102)

Variables	Frequency	Percentage (%)
Gender		
Male	19	19
Female	83	81
Faculty		
Faculty of Management and Business	46	45
Faculty of Accounting	39	38
Faculty of Computer and Mathematical Sciences	17	17
Course		
Diploma in Business Studies	37	36
Diploma in Mathematical Sciences	4	4
Diploma in Accountancy	33	32
Diploma in Computer Science	14	14
Diploma in Banking Studies	2	2
Bachelor of Business Studies (Hons)	6	6
Bachelor of Accountancy (Hons)	6	6

Table 2 presents the demographic information for 102 respondents. It showed that the majority of the respondents (81%) in this study were female, while 19% were male respondents. Meanwhile, the highest percentage of the respondents was from the Faculty of Management and Business (45%). Then, it was followed by the Faculty of Accounting (38%) and the Faculty of Computer and Mathematical Sciences (17%). Furthermore, in this study, the majority of the respondents (36%) were studying for the Diploma in Business Studies, while the lowest percentage came from the course, Diploma in Banking Studies, with 2%.

Level of Students' Attitudes towards Statistics Subject

Based on Table 3, items B1, B8, and B9 were at a high level, with the mean range from 7.41 to 7.94 and the SD range from 1.492 to 1.751. Other items (B2, B3, B4, B5, B6, B7, and B10) were at medium level with the mean range being between 5.20 and 7.26 with the SD range between 1.435 and 2.053. Overall, the level of students' attitudes towards Statistics subjects was at a medium level (with a mean of 6.79 and SD of 1.795).

Table 3
Level of Students' Attitudes

No	Items	Mean	SD	Interpretation
B1	I like Statistics subject.	7.41	1.492	High
B2	I feel fun when I use elements and concepts of Statistics.	7.26	1.435	Medium
B3	I have self-assurance when confronting statistical problems.	6.44	1.564	Medium
B4	Statistics subject is the subject that I am most afraid of.	5.76	2.011	Medium
B5	I feel so stressed during Statistics class.	6.87	1.891	Medium
B6	I apply Statistics concepts in my daily life.	5.20	1.990	Medium
B7	If I had the opportunity, I would not like to take Statistics subject in my course.	6.95	2.117	Medium
B8	Statistics subject is not very useful to us.	7.94	1.751	High
B9	I think the topics in Statistics subject are very interesting.	7.41	1.643	High
B10	I am not interested to talk about Statistics with other people.	6.63	2.053	Medium
	Attitudes	**6.79**	**1.795**	**Medium**

Level of Students' Perceptions towards Statistics Subject

Based on Table 4, items C6, C16, C18, C20, C21, C22, and C24 were at a high level, with the mean range from 7.39 to 8.55 and the SD range between 1.439 and 1.684. The rest of the items (C2, C5, C7, C8, C9, C10, C11, C12, C13, C17, C19, C23, and C25) were at a medium level, with mean ranges ranging from 5.19 to 7.25 and SD ranges ranging from 1.524 to 1.935, only item C15 is at a low level (mean = 4.31 and SD = 1.807).

Table 4
Level of Student's Perception

No	Item	Mean	SD	Interpretation
C2	Statistics subject is too technical for me to understand.	5.19	1.871	Medium
C5	Statistics skills would increase my chances of working.	7.05	1.743	Medium
C6	Statistics skills help me to develop good critical thinking.	7.39	1.684	High
C7	Statistics skills help me to solve a problem and make good decisions.	7.16	1.739	Medium
C8	I am able to analyse and interpret the data.	7.13	1.565	Medium
C9	I know when to use statistical skills in my daily life.	6.03	1.691	Medium
C10	Statistics concepts are too abstract for my professional application.	5.52	1.801	Medium
C11	I understand what is going on in Statistics.	6.69	1.604	Medium
C12	I understand statistics equations.	6.66	1.680	Medium
C13	I know how to solve problems that involve statistical problems.	6.60	1.655	Medium
	Students' Knowledge	***6.54***	***1.703***	***Medium***
C15	It is so hard for me to understand statistics concepts and skills in class.	4.31	1.807	Low
C16	I have improved my statistics skills including theory and applications from lectures and tutorial classes.	7.45	1.552	High
C17	The environment in Statistics class made me feel more excited to study this subject.	7.25	1.733	Medium
C18	I was able to complete my Statistics assignments in an organized and efficient manner.	7.48	1.621	High
C19	The number of exercises and assignments for the Statistics subject given is sufficient for me.	7.17	1.935	Medium
C20	I can follow all the lectures/syllabus delivered by lecturers in Statistics class.	7.79	1.575	High
C21	It is easier for me to communicate and engage with the Statistics lecturer through class.	7.69	1.641	High
C22	The lectures for the Statistics class were properly prepared and organized.	8.25	1.480	High
C23	I feel that the Statistics class format engaged my interest.	7.14	1.629	Medium
C24	The Statistics lecturer used teaching technology effectively (e.g., audio-visuals, slides, videos, Internet etc.).	8.55	1.439	High
C25	The Statistics subject was supported by adequate library resources.	6.79	1.524	Medium
	Students' Experience	**7.26**	**1.631**	**Medium**
	Students' Perceptions	**6.92**	**1.039**	**Medium**

From the findings, both variables i.e. knowledge (mean = 6.54 and SD = 1.703) and experience (mean = 7.26 and SD = 1.631) towards Statistics subjects among UiTM students were at a medium level. Overall, students' perceptions towards Statistics subjects are at a medium level (mean = 6.92 and SD = 1.039).

The Difference between Students' Attitudes based on Gender and Course

Table 5 displays the result of the difference in attitude between male and female UiTM students. The p-value exceeds the significance level ($p = 0.327 > \alpha = 0.05$). Therefore, there was no significant difference between students' attitudes and gender among UiTM students. The attitude of UiTM female students was not different from UiTM male students towards statistics' conceptual understanding.

Table 5
The Difference between Students' Attitude and Gender

Gender	N	Mean	Standard Deviation	t	P-values
Female	83	6.841	1.109	0.985	0.327
Male	19	6.558	1.217		

The difference between attitude and course among UiTM students is depicted in Table 6. The p-value exceeds the significance threshold ($p = 0.69 > \alpha = 0.05$). Therefore, there was no difference between attitude and course among UiTM students. UiTM students' attitudes towards statistics' conceptual understanding are similar among the different course groups.

Table 6
The Difference between Students' Attitude and Course

Model	Sum Squares	df	Mean Square	F	P-values
Between Groups	5.074	6	0.846	0.649	0.690
Within Groups	123.731	95	1.302		
Total	128.806	101			

The Difference between Students' Knowledge based on Gender and Course

Based on Table 7, the p-value is greater than the significance level ($p = 0.650 > \alpha = 0.05$). It revealed that there was no difference in knowledge between male and female UiTM students. Therefore, the knowledge of UiTM female students is not different from that of UiTM male students towards statistics' conceptual understanding.

Table 7:
The Difference between Students' Knowledge and Gender

Gender	N	Mean	Standard Deviation	t	P-values
Female	83	6.514	1.219	-0.456	0.650
Male	19	6.653	1.059		

Table 8 shows the result of the difference between knowledge and the course taken by UiTM students using one-way ANOVA. The results indicated that the p-value exceeds the significance level ($p = 0.874 > \alpha = 0.05$). Therefore, there was no difference between their knowledge and the course they are majoring in. This means that the knowledge of UiTM students does not differ between courses in terms of their conceptual understanding of statistics.

Table 8
The Difference between Students' Knowledge and Course

Model	Sum Squares	df	Mean Square	F	P-values
Between Groups	3.557	6	0.593	0.406	0.874
Within Groups	138.849	95	1.462		
Total	142.405	101			

The Difference between Students' Experience based on Gender and Course

Table 9 shows the result of the difference between students' experience and gender among UiTM students. Since the p-value is greater than the significant level ($p = 0.177 > \alpha = 0.05$), there was no difference between students' experience and gender among UiTM students. Therefore,

the experience of UiTM female students is not different from those of UiTM male students towards statistics' conceptual understanding.

Table 9
The Difference between Students' Experience and Gender

Gender	N	Mean	Standard Deviation	t	P-values
Female	83	7.333	1.125	1.360	0.177
Male	19	6.952	0.983		

Table 10 shows the difference between students' experience and the courses they are majoring in. The p-value is higher than the level of significance ($p = 0.248 > \alpha = 0.05$). So, there was no difference between the experiences of UiTM students and those of their course. Thus, there is no difference between the students' experiences regardless of the course they are majoring in towards conceptual understanding of statistics.

Table 10
The Difference between Students' Experience and Course

Model	Sum Squares	df	Mean Square	F	P-values
Between Groups	9.621	6	1.603	1.338	0.248
Within Groups	113.872	95	1.199		
Total	123.492	101			

The Relationship between Students' Attitude and Perception Towards Students' Conceptual Understanding

Table 11 shows that both independent variables have significant relationships with statistics' conceptual understanding. The relationship between students' attitudes and statistics' conceptual understanding among UiTM students is at 0.444, which indicates that there is a moderate positive correlation between these two variables. This means that students with a positive attitude tend to have a moderate level of conceptual understanding towards statistical concepts. The relationship between students' perceptions and statistics' conceptual understanding among UiTM students meanwhile is at 0.668, which indicates that there is a moderate positive correlation between these two variables. It suggests that students with a positive perception have a moderate level of conceptual understanding of statistical concepts.

Table 11
Correlations between Independent and Dependent Variables

Variables	Students' Conceptual	Students' Attitude	Students' Perception
Students' Conceptual	1	0.444**	0.668**
Students' Attitude		1	0.649**
Students' Perception			1

** Correlation is significant at the 0.01 level

The Influence Between Students' Attitudes and Perceptions on Conceptual Understanding Towards Statistical Concepts

Table 12 shows that the independent variables (students' attitudes and perceptions) and the dependent variable (statistics' conceptual understanding) have a positive relationship, with the R-value equal to 0.668. The R-squared value is 0.446, which indicates that 44.6% of the total variation of the statistics' conceptual understanding can be explained by the students' attitudes and perceptions. The other 55.4% is explained by other factors which are not included in this study. The model was significant since the F-test value is 39.858 with a p-value less than 0.01 ($p = 0.000 < \alpha = 0.001$). This result indicated that at least one of the independent variables can be used to predict the students' conceptual understanding of statistical concepts. The coefficient of regression analysis is used to identify which independent variables influence the students' conceptual understanding of statistical concepts. From the findings, students' perception is significant towards the students' conceptual understanding of statistical concepts ($t = 0.672$, p-value $= 0.000 < \alpha = 0.01$), while students' attitudes were not significant towards the statistics' conceptual understanding. Therefore, it can be concluded that among UiTM students, only their perceptions influence the conceptual understanding of statistical concepts.

Table 12
Coefficient of Regression for The Association of Independent and Dependent Variable

	Unstandardized B	t-value	Sig.
Constant	0.680	1.037	0.302
Students' Attitude	0.020	0.189	0.851
Students' Perception	0.777	0.672	0.000
R value (Pearson)	0.668	R^2 value	0.446
F-test value	39.858	Sig.	0.000

Dependent variable; Statistics' Conceptual Understanding

DISCUSSION

Based on the data analysis and discussion of the findings, it can be concluded that, in terms of attitudes towards the subject of Statistics, the majority of students indicated that they largely agreed with all attitude-related statements since the attitude level of the students was moderate. The result was consistent with Rosli and Maat (2017) and Maat et al. (2016) who also found that students' attitudes toward statistics were often considered to be of a moderate level. In addition, from the findings, we could see that the students expressed that they liked statistics and that they thought the topics in statistics were very interesting. Additionally, it was discovered that the students were highly interested in statistics and thought that this was not the subject that they were most afraid of (Saidi & Siew, 2019). Even though they found this subject to be challenging, they have worked very hard to understand the concept of statistics (Ashaari et al., 2011). de Oliveira Júnior (2018) claims that the study of attitudes is important because it helps to describe the educational phenomenon more accurately or broadly, as well as because it serves as a tool for assessing the efficacy of the educational process related to the teaching of statistics in higher education.

Besides that, this study showed that the medium level of students' perceptions indicated that the majority of students agreed with all knowledge- and experience-related statements. This result supported Male and Lumbantoruan (2021), where a majority of the students agreed with all of the claims about their perceptions of statistics. It was evident that the majority of students displayed strong attitudes regarding statistics when it came to their views on statistics. Most of them agreed that comprehending statistics required a lot of discipline and that doing statistics required a strong attitude towards cognitive competency. Perceptions of statistics may comprise beliefs and attitudes taken together (Bond et al., 2012). Students' attitudes and opinions concerning statistics were found to be correlated with their prior knowledge and reasoning skills. The students' attitudes may be influenced by their beliefs, which may be made up of their statistical knowledge and conceptual understanding (Lawton & Taylor, 2020). When concepts in statistics could be applied to the students' daily lives or their academic and professional interests, they are considered to be relevant (Songsore & White, 2018).

This study also determined that there was no difference in the attitude, knowledge, and experience of UiTM students regarding their conceptual understanding of statistics based on gender or course. In terms of statistics' conceptual understanding, UiTM female students had the same attitudes, knowledge, and experience as UiTM male students. At the same time, the attitudes, knowledge, and experience of UiTM students towards statistics' conceptual understanding were not different regardless of the course they were majoring in. These findings were consistent with Saidi and Siew (2019) who found that the attitudes of students about statistics were not significantly different based on gender. In addition, there was no evidence of a gender difference in the components. However, this was not relevant to the finding by Chiesi and Primi (2015), where their result showed there was a significant difference in students' attitudes towards statistics based on gender. The female students had a more negative opinion and lacked confidence when learning statistics. As compared to male students, female students tended to underestimate their talents and had less favorable opinions toward quantitative fields.

Aside from that, this study found that both variables, attitudes, and perceptions, had a significant relationship with students' conceptual understanding of statistical concepts. Many students with a positive attitude had a moderate conceptual understanding of statistical concepts. Conversely, students with a positive perception tended to have a moderate conceptual understanding of statistical concepts. The results were in agreement with those reported by Slootmaeckers et al. (2014). According to this study, there was a relationship between attitudes and statistical concepts. The students who had positive attitudes towards statistics did well in this subject. On the other hand, the correlation analysis between perceptions and attitudes indicated that students who generally had negative views toward statistics had low self-perceptions (Ncube & Moroke, 2015). From the findings, we could also conclude that among UiTM students, only their perceptions contributed to the conceptual understanding of statistical concepts, while their attitudes were not a significant factor. This was in line with findings from other studies by Hannigan et al. (2013) and Saidi and Siew (2019) that students' attitudes did not contribute to their statistics' conceptual understanding. Instead, it was the perception that having strong statistical ability contributed to excellence in statistics (Saidi & Siew, 2019).

CONCLUSION

As the present study serves to assess the students' conceptual understanding, attitudes, and perception towards Statistics subjects, the lecturers should encourage their students and try to implement various methods that are simple but interesting while teaching Statistics subjects so that the difficulties may be minimized. The lecturers also need to be aware of how students' behaviors change in response to their learning experiences, the results of their accomplishments, their attempts to learn more, and their attempts to use their statistical knowledge and skills in daily life. The students demonstrated a very positive attitude by making the necessary efforts to comprehend the subject matter better. Determining the influences between the attitudes and perceptions towards conceptual understanding is vital because it will serve as a guide for creating an engaging teaching and learning strategy that will draw attention to the subject. This will help the students to stay positive in learning something new in any subject. This study also sheds light on the significance of students' attitudes and perceptions when they struggle to comprehend the Statistics subject. In addition, it will be useful to determine whether the students understand the meaning of the term "statistics" and how it can be applied to their daily lives. It assists researchers and statisticians in comprehending how students define statistics and can be utilized for guiding future statistical research and instruction.

It is also suggested that a similar study be conducted to assess the students' perceived ability and empirical understanding of fundamental statistical concepts, such as data types, data representation, measures of spread, and measures of central tendency. At the same time, it is worth comparing the differences between the students' perceived ability versus performance or their ability in the basic statistical concepts.

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The authors confirm the equal contribution in each part of this work. All authors reviewed and approved the final version of this work.

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CONFLICT OF INTERESTS

All authors declare that they have no conflicts of interest.

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