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INSIGHTS IN THE IMPLEMENTATION OF A NEW SUBJECT IN STATISTICS EDUCATION

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Abstract: This study investigated the implementation of a new subject or syllabus called Statistics 4040 in Years 9 and 10, in one of the secondary schools in Brunei Darussalam. We examined firstly, the students' attitude towards Statistics 4040 and secondly, their challenges and limitations in learning the new subject. A survey on Students' Attitudes Toward Statistics (SATS with 36 items) was distributed to a sample of 42 students. Focus group interviews were also conducted to extract students' opinions regarding Statistics 4040. The results of this study indicated that students found the new subject, Statistics 4040, a rather complicated subject. However, the survey findings also showed that students were optimistic and determined to put a lot of effort into learning this subject. Moreover, students expressed that enrolling in this subject will make them more employable. The limitations faced by the students were mainly due to lack of relevant resources, which posed challenges in relation to their learning. The small case study provided valuable insights about the students' attitudes toward Statistics 4040 and how this can be used as a guide in preparing teachers' teaching plans to suit their students' needs. In addition, the positive results obtained in this study may encourage other schools to introduce Statistics 4040 in their school syllabus.

Keywords: Statistics education, secondary school, attitudes and challenges

Introduction

In Brunei Darussalam, statistics education is integrated in the national mathematics curriculum starting from the primary to the secondary education levels. According to the Brunei Primary level Mathematics Syllabus (CDD, 2006), the study of statistics is taught along with numbers and operations, algebra, geometry and measurement. While at the Secondary level (CDD, 2011), statistics education is developed further through topics such as central tendency, data representation and interpretations. Even though statistics is seen as an important part of the mathematics curriculum, it is perceived to be less important than other mathematical contents such as algebra and geometry (Ang & Shahrill, 2014; Ong & Shahrill, 2014; Sulaiman & Shahrill, 2014, 2015). Consequently, many countries including New Zealand realised that statistics should become an integral part of the educational curriculum. In 2007, New Zealand published a new mathematics curriculum, which emphasizes on statistical thinking, statistical literacy and probability (Frankcom, 2008).

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In light of this, in 2011, an experienced mathematics teacher who has been teaching statistics in Brunei secondary school since 1988 forwarded a proposal to the Ministry of Education of Brunei Darussalam. In his proposal he suggested that Statistics syllabus code 4040, an O Level statistics offered by Cambridge Examination Board, to be offered to Year 9 and Year 10 students in one of the secondary schools in Brunei. Currently, in the O Level mathematics curriculum, two mathematics-based subjects are offered to students, namely Mathematics Syllabus D and Additional Mathematics. It is well known that majority of students find Additional Mathematics challenging (Yassin et al., 2014, 2015), and thus only capable students are encouraged to take Additional Mathematics in O Level. The rationale of introducing Statistics 4040 to O Level students is to offer more Mathematics optional subjects. It was suggested that Statistics 4040 be offered to all students instead of restricting to a certain group of student abilities. Moreover, it would also give valuable opportunities to students who are inclined to study mathematics further in their secondary schooling. As was stated in the proposal, Statistics 4040 would enable the students to:

Appreciate the fact that much information that can be found in different contexts in everyday life is based on statistics;

Understand the accuracy of this information;

Acquire the understanding of statistics and probability that are useful in making relevant analysis;

Draw relevant conclusion based on the results obtained from statistical analysis;

Interpret statistical information and results of statistical analysis;

Realise the limitations and levels of accuracy of statistical conclusions and interpretations and their relevance in everyday context. (Ab Samad, 2011, p. 3).

The Ministry of Education approved the proposal and in 2012, Statistics 4040 was offered as an optional subject to Year 9 students in one of the secondary schools (referred it as School X) in Brunei Darussalam. There are currently two levels of classes taking statistics 4040 in School X, the Year 9 and Year 10 classes. The introduction of a new subject in a school is anticipated to bring several challenges that will need to be addressed. Bennie and Newstead (1999) identified the challenges in implementing a new curriculum in South Africa. The identified challenges were the nature of the topic itself, teachers' content knowledge, learners' pre-knowledge, finding the time for curriculum development and the social context of schooling. This may be the case for Statistics 4040, which was only introduced to School X in 2012. Hence, the need to investigate Statistics 4040 in order to identify and understand such challenges exists. Furthermore, some of the challenges listed out by Bennie and Newstead (1999) were also used as guidance in conducting this present study.

What is Statistics 4040?

Statistics 4040 is a subject offered by the Cambridge International Examinations Board (CIE) of the United Kingdom. According to the CIE, the syllabus of Statistics 4040 enables learners to acquire knowledge of basic statistical ideas, methods and terminology. Studying Statistics 4040 also enables learners to represent and use statistical data in graphical, diagram and tabular forms, interpret statistical statements, calculations and diagrams as well as perform statistical calculations accurately and acquires knowledge of elementary ideas in probability. The Cambridge O Level Statistics provides a suitable foundation for further study in the subject, as well as developing concepts, which are relevant in a wide range of other subjects (CIE, 2013).

The Study

This study aimed to provide useful guidelines to other secondary schools interested in offering Statistics 4040 to their students in providing educators with useful information regarding the challenges in terms of teaching and learning of Statistics 4040. It also provides useful platform for other researchers to expand research pertaining to Statistics 4040. The two research questions guiding this study are as follows, what are the students' attitudes towards Statistics 4040? And what are the challenges and limitations faced by students when learning Statistics 4040?

Brunei Darussalam's Vision 2035 aspires to bring about well-educated and highly skilled citizens. Various recommendations and changes in the curriculum are being implemented to cater for the realisation of Vision 2035. The introduction of Statistics 4040 complements such changes as it is expected to train and produce students who possess desirable traits such as critical thinking logical, quantitative analysis and communication skills. The findings from the research study will provide valuable insights on the introduction of Statistics 4040 from School X. It is hoped that the results from the research study will give useful guidance to other secondary schools in the nation that might be interested in offering Statistics 4040 to their students.

Literature Review

Statistics Education

The importance of statistics education has been recognised and is increasingly seen as an integral part of the educational curriculum. In fact, statistics education has been integrated in the educational curriculum in many countries at very early stages (Batanero & Diaz, 2012). Ben-Zvi and Garfield (2005) reported that statistical literacy is a key ability expected of citizens in the 21st century societies, and is often displayed as an integral outcome of schooling. The introduction of Statistics 4040 may be regarded as an initiative towards achieving statistical literacy in Bruneian students and eventually in the society of Brunei Darussalam. According to Watson (2013), being able to provide good evidence-based arguments and evaluate data critically are desirable life-skills that people should have and all students should learn as part of their education.

Attitudes in Statistics Education

According to Gal, Ginsburg and Schau (1997), students' attitudes towards statistics deserve the attention for three main reasons. The first is their role in influencing the teaching and learning process. The second reason is their role in influencing students' statistical behaviour after they leave the classroom and finally whether or not students will choose a statistics-based course in the future. Since Statistics 4040 has only been introduced recently in Brunei, it is worth finding out the students' attitudes toward the subject. According to Schau and Emmioglu (2012), students who had negative attitudes towards their statistic courses would not intelligently and literately use statistics in their professional and personal lives. For this present study, the introduction of Statistics 4040 in School X provides an introductory statistics course for the Years 9 and 10 students of that school. Therefore, the findings of this survey may be taken as the best opportunity to positively impact these students' attitudes towards statistics education.

In a previous research study, a 'Survey of Attitudes Towards Statistics' (Schau et al., 1995) or SATS in short, was used to investigate the attitudes of Years 9 and 10 students. SATS, contained 36 seven points Likert-typed items, were used as the research instrument. According to Schau and Emmioglu (2012), SATS (36 items) matched the Expectancy Value Theory (EVT), a theory that has been used extensively in mathematics education to explore achievement-related course outcomes. Moreover, SATS (36 items) used multiple components of students' attitudes (Schau & Emmioglu, 2012) and the scores from previous studies, which used SATS, have generally shown good to excellent psychometric properties (Bechrakisa et al., 2011; Chiesi & Primi, 2009).

Nolan, Beran and Hecker (2012) did a systematic review on the validity and reliability of surveys that assessed students' attitudes toward statistics. They found that SATS (36 items) was reliable in the sense that it assessed the 6 components of attitudes as claimed by its authors. There was also evidence that SATS (36 items) can be used to identify students who are at risk of underperforming or failing statistics courses. Furthermore the items used in SATS (36 items) are appropriate for secondary level students. The survey measures six aspects of students' statistics attitudes. The six aspects are affect, cognitive competence, value and difficulty, interest and effort. The internal reliability (alpha coefficient) of the components of the SATS (36 items) is between the ranges of 0.64 to 0.89. Figure 1 shows a summary of the six aspects, from the survey, together with the item numbers and their descriptions respectively.

Components	Item No.	Description	Components	Item No.	Description
Affect indicates students' feelings concerning statistics	A3	I like statistics	Value indicates students' attitudes about the usefulness, relevance and worth of statistics in personal and professional life	V7*	Statistics is worthless
	A4*	I feel insecure when I have to do statistics problems		V9	Statistics should be a required part of my professional training
	A15*	I get frustrated going over statistics tests in class		V10	Statistical skills will make me more employable
	A18*	I am under stress during statistics class		V13*	Statistics is not useful to the typical professional
	A19	I enjoy taking statistics courses		V16*	Statistical thinking is not applicable in my life outside my job
	A28*	I am scared by statistics		V17	I use statistics in my everyday life
Cognitive Competence indicates students' attitudes	C5*	I have trouble understanding statistics because of how I think		V21*	Statistics conclusions are rarely presented in everyday life
	C11*	I have no idea of what's going on in this statistics		V25*	I will have no application for statistics in my profession

about their intellectual knowledge and skills when applied to statistics		course			
	C26*	I make a lot of math errors in statistics		V33*	Statistics is irrelevant in my life
	C31	I can learn statistics	Interest indicates students' level of individual interest in statistics	I12	I am interested in being able to communicate statistical information to others
	C32	I understand statistics equations		I20	I am interested in using statistics
	C35*	I find it difficult to understand statistical concepts		I23	I am interested in understanding statistical information
		I29		I am interested in learning statistics	
Difficulty indicates students' attitudes about the difficulty of statistics as a subject	D6	Statistics formulas are easy to understand	Effort indicates the amount of work the students expend to learn statistics	E1	I tried to complete all of my statistics assignments
	D8*	Statistics is a complicated subject		E2	I worked hard in my statistics course
	D22	Statistics is a subject quickly learned by most people		E14	I tried to complete all of my statistics assignments
	D24*	Learning statistics requires a great deal of discipline		E27	I tried to attend every statistics class session
	D30*	Statistics involves massive computations			
	D34*	Statistics is highly technical	Note: '*' denotes negatively-worded items; 'A' denotes 'Affect' items; 'C' denotes 'Cognitive competence' items; 'D' denotes 'Difficulty' items; 'V' denotes 'Value' items; 'I' denotes 'Interest' items; 'E' denotes 'Effort' items.		
	D36*	Most people have to learn a new way of thinking to do statistics			

Figure 1. The six aspects of students' statistics attitudes

Note: '*' denotes negatively-worded items; 'A' denotes 'Affect' items; 'C' denotes 'Cognitive competence' items; 'D' denotes 'Difficulty' items; 'V' denotes 'Value' items; 'I' denotes 'Interest' items; 'E' denotes 'Effort' items.

Students responded to each of the 36 items from the survey on a 7-point Likert scale. The scale ranges from 1 (Strongly Disagree) to 7 (Strongly Agree). Some items are positively worded and some items are negatively worded. The responses from the negatively worded items will be reversed before scoring. For example, if a student chose a point 7 for item V7* (refer to Figure 1), the response will be reversed to 1. Therefore a student who gives a higher numerical score has a more positive attitude towards statistics than a student who gives a lower numerical score. This applies to all components in the survey except for 'Difficulty'. Higher scores on 'Difficulty' items indicate that the student think that statistics is easier and that student who get lower scores think that statistics is difficult. The permission to use the SATS for this study was granted by Dr Candace Schau herself, and she holds the copyright for SATS.

SATS uses a 7-Likert scale because more scale point increases sensitivity in terms of getting the right responses from the respondents. Stennet (2002) stated that research has shown that variance and reliability of rating is normally highest when a 5 or 7 rating scales were used and rater bias was minimised when 5 rating points or above were applied. Meanwhile, Symonds (1924) made a conclusion that the optimal number of categories to maximise scale reliability is seven. Together with the survey, student interviews were also conducted in this present study to find out about the students' challenges and limitations that they might face during their course of studying Statistics 4040. Furthermore, Roulston (2013) stated that interviews provided opportunities for interviewees to give detailed descriptions of particular experiences.

Trends in the Statistics Education

We encounter statistics in our everyday lives and in every social discipline for example in economics, biological and political setting. Students not only learn statistics in their mathematics lessons but also in their daily live (Batanero & Diaz, 2012). Garfield (1995) stated that a major concern of those who teach statistics is how to ensure that the students understand statistical ideas and are able to apply what they learn to real life situation. According to Khalid (2006), as students are only taught to memorise, it is feared that students will end up not being able to think intelligently. According to Gal and colleagues (1997), by taking up statistics, it may help prepare the students to deal effectively with statistical situations in the real world outside their classrooms, and also to attain the know-how and the dispositions needed to act as a smart citizen or consumer in a modern society.

The main question is ‘can our students make sense out of the statistics that they are learning in school or they are just learning it for the sake of passing the exams?’ The real challenge in statistics education is to prepare our students to interpret statistical data in their academic or professional discipline (Watson, 2013). To achieve this, teachers must have good conceptual knowledge on statistics so that they have the necessary skills needed to teach the students accordingly. Teachers who teach in areas in which their own conceptual knowledge is weak have shown to revert more readily to those methods they themselves experienced as a learner (Sedlmeier & Wassner, 2008). Teachers play an important role in making sure that their classrooms are conducive and effective in developing students’ understanding of statistics as well as assisting them in their ability to think and reason statistically. Sharma (2013) suggested that teachers use practical ideas and learning activities to enhance statistical literacy in the classroom. This present study however will focus more on the students’ attitudes towards Statistics 4040. Informal interviews with the teachers revealed the challenges and limitations that they faced when teaching Statistics 4040.

Methodology

Research Design

This study involved collecting quantitative and qualitative data. The first research question, which involved quantitative data, aimed to investigate the students’ attitudes towards Statistics 4040. Statistical Product and Service Solution (SPSS) version 15 was used to calculate the mean and standard deviation of each of the six aspects of attitudes as measured by SATS (36 items). Focus group interviews of the students were also conducted to support the findings from the SATS (36 items).

Participants

The population sample involved in this present study was students in School X; two Year 9 classes and one Year 10 class, all taking Statistics 4040 as their option subject. There were 33 students from Year 9 and 9 students from Year 10 who participated.

Research Instruments

Two research instruments were used in the collection of both quantitative and qualitative data. To measure students’ attitudes, Survey of Attitudes Toward Statistics (SATS) was used. There are 36, 7-point Likert type items in SATS with 6 aspects namely, affect, cognitive competence, value, difficulty, interest and effort. All the 36 items in the survey were used and no changes were made to any of the items.

Focus group interviews were carried out with the students of Year 9 and Year 10 respectively. The interviews were done to investigate the challenges and limitations that they encounter in the teaching and learning of Statistics 4040. A total of 8 students were interviewed from Year 10, as one student was absent during the interview day. For the Year 9 students, the interviews were conducted to 5 students, who were randomly chosen by their teacher. Both interviews were conducted in an empty classroom, and both on different days. It was assured that the students’ names and other information would be kept confidential. The students who were interviewed were asked individually, and they were given ample time to answer the questions. Below are some excerpts of the interview transcripts.

Researcher: *Why do you choose to take statistics 4040?*

Yr10 A: *Actually it was not my opinion my parents chose it for me. It will help me to study Maths even better in A level.*

Yr10 B: *Actually I didn’t choose it. My brother said it is a good subject and can help me in my studies and give me an A. It will give me a good result.*

Yr10 C: *I myself chose statistics coz I’m really interested in maths plus I believe that it will give me a better understanding of how maths works.*

After all the students have answered the first question the next question was then posed.

Researcher: *Do you think statistics 4040 is an interesting subject? If so, why?*

Yr10 A: *Hmm... yes. Because there are some topics I’ve never learn before. And some of them are challenging. It helps to think before you do something.*

Yr10 B: *Yes because you can actually see some of the questions in a new way that you’ve never seen*

Yr10 C: *before and you learn about new ideas of getting the solution and all that.
Yes I find statistics interesting as it teaches us ..ehh ..it actually shows us how the world applies this subject and in our daily lives which we never knew about.*

Results and Discussions

Table 1 below shows the mean, mode and standard deviation of all the affect items. At a glance, the mode for all the affect items is 4. The value 4 denotes the Likert scale of 4, which means ‘neither disagree nor agree’. This may indicate that the students were still unsure regarding their feelings concerning statistics.

Table 1. The mean, mode and standard deviation of the ‘affect’ items

		Affect items					
		A3	A4*	A15*	A18*	A19	A28*
Mean		5.07	3.76	3.45	4.33	4.57	4.4
Mode		4	4	4	4 ^a	4	4
Std. Deviation		1.332	1.303	1.533	1.493	1.516	1.901

Note: ‘*’ denotes negatively worded items. 4^a indicates multiple modes exist. The smallest value is shown.

Table 2 shows item A3, A4*, A15* and A19 together with the Likert scales, frequencies and percentages. For item A3, even though Likert scale 4 accounts for the highest percentage (35.7%), there were only 3 students who disagreed with the statement ‘I like statistics’. This can be seen as an optimistic sign that the students perceived positively to the new subject.

Table 2. The Frequencies of students’ Likert scale responses

		Likert scale						
		1	2	3	4	5	6	7
		Item A3						
Frequency		0	1	2	15	7	9	8
Percent		0	2.4	4.8	35.7	16.7	21.4	19
		Item A4*						
Frequency		1	2	14	15	3	3	2
Percent		2.4	9.5	33.3	35.7	7.1	7.1	4.8
		Item A15*						
Frequency		5	6	9	16	1	3	2
Percent		11.9	14.3	21.4	38.1	2.4	7.1	4.8
		Item A19						
Frequency		2	2	3	14	19	6	5
Percent		4.8	4.8	7.1	33.3	23.8	14.3	11.9

Note: Item A3 denotes “I like statistics”; Item A4* denotes “I feel insecure when I have to do statistics problems”; Item A15* denotes “I get frustrated going over statistics tests in class”; Item A19 denotes “I enjoy taking statistics courses”

For item A4*, 35.7% of the students were undecided whether they were insecure or not when attempting statistics questions. There were a total of 45.2% (Likert scales of 1, 2 and 3) who did not feel insecure when attempting statistics problems and 19% of the students (Likert scales of 5, 6 and 7) felt insecure when attempting statistics problems. For item A15*, 47.6% of the students (Likert scales of 1, 2 and 3) did not get frustrated going over statistics tests in class and 38.1% of them were undecided on this matter. Moreover, the results from Table 2 also showed that for item A19, 50% (Likert scales of 5, 6 and 7) of the students enjoyed taking statistics class even though 33.3% (Likert scale of 4) of them were undecided regarding this matter.

Table 3 below shows the mean, mode and standard deviation of all the cognitive competence items. It is worth noting items C11*, C31 and C32 where their modes are 7 (for both C11* and C31) and 5 respectively. This will be discussed further.

Table 3. The mean, mode and standard deviation of the ‘cognitive competence’ items

		Cognitive competence					
		C5*	C11*	C26*	C31	C32	C35*
Mean		4.07	5.31	3.4	6.07	5.38	4.21
Mode		4	7	4	7	5	4
Std. Deviation		1.716	1.456	1.466	0.997	1.103	1.353

Note: ‘*’ denotes negatively worded items

Table 4 below shows the students' Likert scale responses for item C11*, C31 and C32. For item C11*, 28.6% of them strongly disagreed (Likert scale 7) with this statement. About 19% of the students each chose a Likert scale of 5 and 6 respectively. Thus, we can deduce that the students have an idea of what is happening in their statistics classes. Moreover, for item C31, there are 19 out of 42 students (45.2%) who chose Likert scale of 7. Notably, there were no students who chose Likert scales of 1 to 3. This is a rather positive sign that student was more likely be able to learn statistics. Similarly in Table 4, majority of the students' responses were positive with regards to item C32. There was only one student who made a negative response to item C32, 9 of the students were undecided but the rest of the students agreed with the statement that they could understand statistics equations.

Table 4. The frequencies of students' likert scale responses

	Likert scale						
	1	2	3	4	5	6	7
Item C11*							
Frequency	1	0	2	11	8	8	12
Percent	2.4	0	4.8	26.2	19	19	28.6
Item C31							
Frequency	0	0	0	3	10	10	19
Percent	0	0	0	7.1	23.8	23.8	45.2
Item C32							
Frequency	0	0	1	9	13	11	8
Percent	0	0	2.4	21.4	31	26.2	19

Note: Item C11* denotes "I have no idea of what's going on in this statistics course"; Item C31 denotes "I can learn statistics"; Item C32 denotes "I understand statistics equations"

Another aspect that measures the students' attitudes toward statistics is 'Difficulty'. Table 5 below shows all the difficulty items. It can be seen that the mean for item D8* is 3.95. The breakdown of the percentages for item D8* can be found in Table 6.

Table 5. The mean, mode and standard deviation of the 'difficulty' items

	Difficulty						
	D6	D8*	D22	D24*	D30*	D34*	D36*
Mean	4.67	3.95	4	2.93	3.26	3.31	2.9
Mode	4	4	4	3	4	4	3 ^a
Std. Deviation	1.541	1.561	1.397	1.421	1.289	1.158	1.284

Note: 4^a indicates multiple modes exist. The smallest value is shown

Table 6 shows that 33.3% of the students were undecided whether statistics was a complicated subject or not. Interestingly, 40.5% of them agreed on the item D8* (Likert scales of 1, 2 and 3). For item D30*, 52.4% of the students were not sure if statistics involves massive computation or not but 40.5% of them did agree with the statement (Likert scales of 1, 2 and 3). On top of that, the students believed that they had to adopt a new way of thinking to do statistics. This is evident from Table 6 that even though 31% of the students were undecided whether to agree or not on item D36*, 61.9% of the students agreed on that statement (Likert scales of 1, 2 and 3).

Table 6. The frequencies of students' likert scale responses

	Likert scale						
	1	2	3	4	5	6	7
Item D8*							
Frequency	2	4	11	14	3	4	4
Percent	4.8	9.5	26.2	33.3	7.1	9.5	9.5
Item D30*							
Frequency	7	4	6	22	2	1	0
Percent	16.7	9.5	14.3	52.4	4.8	2.4	0
Item D36*							
Frequency	10	3	13	13	3	0	0
Percent	23.8	7.1	31	31	7.1	0	0

Note: Item D8* denotes "statistics is a complicated subject"; Item D30* denotes "statistics involves massive computations"; Item D36* denotes "most people have to learn a new way of thinking to do statistics"

Value is also another aspect that measures students' attitudes toward statistics. Table 7 below shows all the items for value. It can be seen that for all the items under value, item V7* has a mode of 7.

Table 7. The mean, mode and standard deviation of the 'value' items

	Value								
	V7*	V9	V10	V13*	V16*	V17	V21*	V25*	V33*
Mean	5.81	4.29	5.05	5.19	4.48	3.9	3.71	4.29	4.88
Mode	7	4	4	4	4	4	4	4	4
Std. Deviation	1.38	1.45	1.103	1.273	1.348	1.59	1.486	1.15	1.626

From Table 8 below, it shows that 71.4% (Likert scales of 5, 6 and 7) of the students disagreed with the statement that statistics is worthless (item V7*). Moreover, a significant proportion of students believed that acquiring statistical skills would make them more employable (item V10). Although, 35.7% of the students were not sure if statistical skills would make them more employable, there was only one student who disagreed on that statement whereas the rest of the students felt that having statistical skills would benefit them. To further support result from item V10, result from the analysis of item V33* in Table 8 also revealed that 52.3% (Likert scales of 5, 6 and 7) of the students felt that statistics was relevant in their lives.

Table 8. The frequencies of students' likert scale responses

	Likert scale						
	1	2	3	4	5	6	7
Item V7*							
Frequency	0	0	1	11	5	3	22
Percent	0	0	2.4	26.2	11.9	7.1	52.4
Item V10							
Frequency	0	0	1	15	13	7	6
Percent	0	0	2.4	35.7	31	16.7	14.3
Item V33*							
Frequency	2	1	3	14	4	10	8
Percent	4.8	2.4	7.1	33.3	9.5	23.8	19

Note: Item V7* denotes statistics is worthless; Item V10 denotes "statistical skills will make me more employable"; Item V33* denotes "statistics is irrelevant in my life"

Interest, which is another aspect of students' attitudes, measures the students' level of individual interest in statistics. Table 9 shows all the interest items. It can be observed that the mean for each of the items is more than 4. This suggests that the students' interest in statistics can be taken as rather positive.

Table 9. The mean, mode and standard deviation of the 'interest' items

	Interest			
	I12	I20	I23	I29
Mean	4.74	4.83	4.79	4.98
Mode	4	4 ^a	5 ^a	4
Std. Deviation	1.38	1.15	1.298	1.37

Note: 4^a indicates multiple modes exist. The smallest value is shown.

Table 10 shows that only 4 students (9.5%) were not interested in using statistics (item I20). Moreover, the results in Table 10 also revealed that the students were generally more interested in understanding statistical information (item I23).

Table 10. The frequencies of students' likert scale responses

	Likert scale						
	1	2	3	4	5	6	7
Item I20							
Frequency	0	1	2	13	13	9	3
Percent	0	2.4	7.1	31	31	21.4	7.1
Item I23							
Frequency	0	2	5	10	11	11	3
Percent	0	4.8	11.9	23.8	26.2	26.2	7.1

Note: Item I20 denotes "I am interested in using statistics; Item I23 denotes I am interested in understanding statistical information"

Table 11 below shows all items under effort, another aspect of students' attitudes. The means of each item revealed that the students' effort in learning statistics could be concluded as positive since all the means are more than 5.

Table 11. The mean, mode and standard deviation of the 'effort' items

	Effort			
	E1	E2	E14	E27
Mean	5.5	5.17	5.45	6.33
Mode	5	5 ^a	5 ^a	7
Std. Deviation	1.02	1.29	1.468	0.979

Note: 4^a indicates multiple modes exist. The smallest value is shown

As shown in Table 12 that majority of the students from the survey agreed and / or strongly agreed that they spent much of their time learning statistics. In particular, 61.9% of the students strongly agreed on the item E27. On a positive note, no students disagreed with the statement from item E27.

Table 12. The frequencies of students' likert scale responses for item E27

Likert scale	Frequency	Percent
4	3	7.1
5	6	14.3
6	7	16.7
7	26	61.9

Note: Item E27 denotes "I tried to attend every statistics class session"

Summary of the First Research Question

Based on the results above, it can be concluded that the students have mixed feelings regarding statistics (Table 1) although encouragingly students were generally keen to learn statistics. Moreover, at least half of the students from the sample enjoyed taking statistics classes and 47.6% of the students stated that they did not feel insecure when they tackle statistics problems. The findings also revealed that majority of them were aware of what has been going on in their statistics classes. Based on the results presented above, most of the students were positive that they could learn and understand statistics equations. Only a small proportion of the students found statistics hard to understand due to complex formulas to remember. Some of the students interviewed find Additional Mathematics easier than statistics. Worryingly, about half of them were not sure if they could understand statistical concepts fully. Table 13 below displays some of the excerpts from the student interviews.

Table 13. Students' opinion regarding statistics 4040

Yr10 H: For me add maths is easier than statistics because my marks for add maths is much higher than statistics.

Yr9 D: For me Add maths is easier than statistics coz if add maths some of it we have learn it from last year and statistics just this year. The formulas are sometimes complex.

Yr9 B: I find Add maths easier because I can get more help.

It is also worth noting that most students were confident that they could learn statistics despite a significant proportion of students, that is around 40.5% who has pre-conceived notion that statistics is a complicated subject. One possible explanation why students perhaps felt statistics was complicated could be due learning statistics involved new ways of thinking. In addition, it was also interesting to discover from Table 8 that most students found learning statistics to be worthwhile. Students also believed that statistics is relevant in everyday lives as well as making them more employable. This clearly reflects student positive mindset towards statistics. To conclude, students generally have mixed feeling regarding the subject. However, we can deduce with fair amount of confidence that students generally find statistics useful perhaps because it enhances their employability. Thus, they are willing to learn the subjects.

Summary of the Second Research Question

Based on the interviews with the students, it can be deduced that the main challenges that the students faced were lack of resources. When the subject was first introduced, students were not provided with any proper textbooks. Instead, they were using the A Level statistics textbook. They were only provided with the proper textbook at the end of the year. However this problem still persisted with the current Year 9 students. Moreover, there were insufficient relevant resources in the school library. And online resources like 'xtremepapers.com'

was not helpful, as it did not show step-by-step solutions on how to approach the statistical problems. There was also difficulty in seeking assistance regarding statistics, as the subject is new.

An informal interview with the teachers teaching Statistics 4040 was also conducted. They stated that lack of resources and students dropping out from the subject as some of the challenges faced. Regarding the dropout issues, these students mentioned that they dropped out because they had no interest in the subject. It was their parents that requested and encouraged them to take the subject, as their parents believed it would be beneficial for them. The students dropping out due to initial parent's factor were prevalent cases.

Conclusions

As far as is known, this is the first research study conducted to investigate students' attitudes with regards to Statistics 4040. Although most of the results are inconclusive, there is significant evidence to show that most students find statistics to be a useful subject and are generally willing to learn. However, being the first cohort of students taking up a new subject, only introduced in 2012, has its challenges and limitations. Based on the focus group interviews conducted with the students, we concluded that finding the relevant resources is a major problem. Lastly, we need to ascertain why the students gave ambiguous responses that is neither agreeing nor disagreeing. A bigger sample size is also required in the future to avoid inconclusive findings.

Limitation of the Study

This study was only conducted in School X specifically since it is currently the only secondary school offering Statistics 4040. The population sample therefore was from School X and hence any findings or results would only be seen as a working hypothesis and not as a conclusion. The study was conducted within a time span of one academic year and only two research questions were addressed within the allocated time span.

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