Investigating SATS-36 for a Matriculation Sample

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Article Info	ABSTRACT
	Students' attitudes towards statistics have been more often negative due to many factors such as initial perception of the subject, low ability in mathematics and lack of motivation to study statistics. Studies involving SATS-36 included investigation of the different factors in relation to students' attitude towards statistics. Other studies have investigated the structure of SATS-36 and the relationship between the different components of SATS-36. The research investigated the reliability and validity of SATS-36 for a sample of matriculation students. Results showed that while reliability and validity is maintained for the instrument, it is not the case for the sample of respondents.

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1. INTRODUCTION

Over the past 60 years, different survey instruments, with varying dimensionality, items and constructs, have been developed with the intention to measure students' attitude towards statistics [1]. The number of items in these instruments are as minimum as fourteen items (e.g., Attitudes Toward Quantitative Concepts (ATQC) [2]) or as many as fourty-four items (e.g., Students' Attitudes and Conceptions in Statistics (STACS) [3]). Some used the 5-point scale (e.g., Students' Attitudes Toward Statistics Questionnaire (SATSQ) [4]) while others used the 7-point scale (e.g., Survey of Attitudes Toward Statistics – 28 (SATS-28) [5]) and so on. Further, some of these survey instruments are available for use (e.g., STACS and SATS-28) while others are not readily available (e.g., Attitudes Regarding Graduate Statistics Scale (ARGSS) [6]) and Bad Attitudes Toward Statistics (BATS) [7]).

In Table 1 can be seen the Survey of Attitudes Toward Statistics that was first designed in 1995 (SATS-28) and contained twenty eight items and four subscales [5]. The four subscales are affect, cognitive competence, difficulty and value. The 2003 version (SATS-36) was updated with another two subscales that are interest and effort and contained thirty six items altogether [8]. Table 1 provides the description for the subscales in SATS-28 and SATS-36.The six subscales in SATS-36 measures six different aspects of undergraduate students' attitude towards statistics. There are two versions of SATS-36 that is the pre-course version and the post-course version. It is a Likert-type instrument with seven options for each item ranging from strongly disagree (code 1) to strongly agree (code 7). The instrument and scoring guides can be obtained from http://www.evaluationandstatistics.com.

Table 1. SATS-28 and SATS-36

First version SATS-28 (28 items)	Four subscales	Affect (6 items)	Students' feelings about statistics, whether positive feelings or negative feelings.
		Cognitive competence (6 items)	Students' attitudes about intellectual knowledge and skills applied to statistics that is how well they are able to mentally comprehend statistics.
		Difficulty (7 items)	Students' attitudes about the difficulty of statistics as a subject.
		Value (9 items)	Students' perceptions about the usefulness, relevance and worth of statistics in personal and professional life.
Second version SATS-36 (36 items)	Additional two subscales	Interest (4 items)	Individual student's interest in statistics.
		Effort (4 items)	Amount of work needed in learning statistics.

2. LITERATURE REVIEW

SATS-36 has been used to investigate the influence of biographical variables on students' attitudes towards statistics [9], the relationship between students' conceptualization of statistics and their attitudes towards statistics [10], and students' attitudes towards statistics that function as barriers for acquiring quantitative skills in the long run [11]. On the other hand, past studies on SATS-36 as an instrument have included investigating the reliability and validity of SATS-36 on a sample of students [9], and investigating the underlying structure of SATS-36 and the functioning of individual items in this survey questionnaire [12].

Studies have employed various analysis methods and techniques including confirmatory factor analysis [9],[12], ordinary least squares regression [11], tight data analysis approach [10] and Mardia's test for multivariate normality [13]. Besides investigating different groups of students such as the educational sciences students [12], industrial and organizational psychology students [9] and political science students [14], past studies have involved students from various countries such as South Africa [9], United States [10] and Australia [13].

Among the important findings from these studies is that students are interested in statistics and believe statistics is worth studying despite having perceived statistics as a difficult subject [9]. In addition, it was found that interest in statistics is influenced by the extent to which quantitative material is used [11]. Interestingly, study by Slootmaeckers (2012) revealed that although attitudes towards statistics have an effect on the learning of statistics, negative attitudes are not always a barrier for learning [11]. The findings of two separate studies on the attitudes of male students and female students showed that male students displayed more positive feelings [9] and male students are more confident [15].

The results of the past studies led to the need to conduct other studies involving different aspects with respect to the use of SATS-36 and students' attitude towards statistics. For instance, Coetzee and Van der Merwe (2010) [9] suggested investigating the relationship between gender and age in influencing statistics attitudes while the study by Bond, Perkins and Ramirez (2012) [10] investigated if students' attitude towards mathematics influences their attitude towards statistics. Further, Coetzee and Van der Merwe (2010) [9], and Vanhoof et al., (2011) [12] feel that more studies involving students from other academic fields and statistics courses need to be conducted besides studies to investigate the reliability and validity of SATS-36.

3. METHOD

3.1. Objective of Study

The objective of this study is to determine the reliability and validity of SATS-36 for a Malaysian sample. This is primarily since past studies involving a Malaysian sample of students (e.g., [16]-[18]) have not attempted to investigate the reliability and validity of SATS-36.

3.2. Sample of Respondents

This study involved 67 students from a matriculation program from a higher learning institution in Malaysia. The Malaysian students in this program would have completed year eleven of their schooling period while students from other countries will have an equivalent entry requirement. The sample of respondents in this study consists of Malaysian students only. The mathematics syllabus in concern contains ten chapters. Statistics is covered in two chapters and is taught in the second semester. Most students in this program found the topic to be challenging particularly because they are required to interpret the results of their statistical analyses in the contexts of the problem. Moreover, a number of students exhibited negative attitude towards mathematics in general.

3.3. Data Analysis

Rasch Model was used to determine the reliability and validity of SATS-36 in this study. The authors have discussed the reasons for using Rasch analysis in investigating the quality of an instrument, and the criteria to establish reliability and validity of an instrument using Rasch analysis in earlier publications (e.g., [19]-[21]).

4.   RESULTS

Table 2 displays the summary statistics which has been obtained using the Winsteps companion to Bond and Fox (2007) [22]. With reference to Fisher's (2007) [23] instrument quality criteria, analysis of data showed good item reliability (between 0.81 and 0.90) but poor case (or sample) reliability (less than 0.67). The item separation is more than 1.00 which indicated that there is enough spread of items. However, the case separation value of 0.98 (less than 1.00) suggested that the instrument is not able to distinguish high and low performers for this sample of respondents.

Table 2. Reliability and fit indices

	Item	Case
Reliability	0.90	0.49
Separation	3.06	0.98
Infit MNSQ	1.01	1.01
S.D.	0.00	-0.50

The item infit mean square and the case infit mean square which are between 1.00 and 1.20 indicated that there is no presence of redundant items in the instrument whereby an infit mean square value in this range implies that the response pattern is suitable and that there is enough variation in the responses. In addition, the standard deviation values of 0.00 and -0.50 for the items and the sample respectively fulfilled the criteria of reliability and validity that is the values are less than 2.00.

5.   DISCUSSION AND CONCLUSION

In this study, the reliability and validity of SATS-36 have been established using Rasch analysis. To the best of the authors' knowledge such study has not been conducted yet. This result is consistent with previous studies using the original version of SATS-36 (e.g. [9]) and the adapted version of SATS-36 (e.g., [14]). However, conditions of reliability and validity were not met for the sample of respondents in this study. Two factors could have contributed to this. First, SATS-36 was developed to investigate undergraduate students' attitudes toward statistics but the sample of respondents in this study is from a pre-university program that is an external matriculation program. Second, the pre-test was not conducted in this study whereas comparing the results of pre-test and post-test versions of SATS-36 would have given a better insight into this respondents' attitude towards statistics. Another factor to be considered is that although there is no restriction on the number of students in conducting the Rasch analysis, previous studies involved larger number of students (e.g., [15],[24],[25]). In addition, statistics were taught to the sample of respondents in this study over a period of one week or two weeks whereas in other documented studies, the courses last from few weeks (e.g., [24],[26]) to fewsemesters (e.g., [15],[27]) for instance.

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