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POSTGRADUATE STUDENTS' ATTITUDE TOWARD STATISTICS PRE AND POST SCENARIO-BASED LEARNING METHOD IN A STATISTICS COURSE

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ABSTRACT

Teaching introductory statistics to postgraduate students from multidisciplinary background and with diverse mathematics ability is a huge challenge that many statistics lecturers do not deny. The large ability range can make it very difficult for lecturers to fine tune the right level for effective course delivery. Even though an introductory statistics course has been seen as a necessary component for many postgraduate programs, research has shown that students have come to perceive statistics negatively. One suggestion for improving students' attitude toward statistics is through the use of innovative instructional approaches. This paper investigates the extent to which scenario-based learning (SBL) method used in a Statistics for Research in Education course were related to improvement in postgraduate students' attitude toward statistics. Nineteen students who enrolled in the course during the first semester of 2019/2020 were taught using the SBL instructional method. Survey of Attitudes Toward Statistics-36 (SATS-36) was used to measure six statistics attitude components at the beginning and at the end of the course. Overall results show that there is a difference between mean score of attitude before and after exposure to scenario-based learning method. Scenario based learning has some positive effect on student attitude toward statistics.

Keywords: *Scenario-Based Learning, Introductory Statistics Course, Attitude*

INTRODUCTION

In Malaysia, the introductory statistics course is offered to postgraduate students in most universities. The course name might differ between universities, but the content is almost similar. Over the years, there have been recommendations for a shift in the teaching of introductory statistics (American Statistical Association (ASA), 2016; Enriqueta, Krishnan, & Noraini Idris, 2014; Koh & Zawi, 2015). Statistics teaching in higher education in Malaysia has long been overshadowed by the lecture method (Krishnan & Noraini Idris, 2014). However, a recent trend in teaching introductory statistics in higher education in Malaysia is focusing on student-centred learning where students take a more active role involving collaborative learning and hands-on research projects. Liau, Kiat, and Nie (2015) investigated the extent to which certain teaching approaches such as collaborative learning and hands-on research project assignments were related to changes in students' attitudes toward statistics in a Malaysian university. The study found partial support that the approaches utilized were related to positive attitude changes toward statistics as well as achievement.

Nik Suryani (2014) explored the use of data analysis project approach in an introductory statistics course for undergraduates. She found that the approach where students worked in groups, has resulted in an experiential learning process which enables the students to integrate critical thinking, technical writing, and presentation skills into an analytical course thus promoting statistical thinking. Her experience also suggested that students were more engaged in the course material and learn the material better when involved in the group project than when presented with traditional lectures. However, she cautioned that it should not be viewed as the sole method for improving instruction in a heavily concept oriented course such as statistics.

Alternatively, another method attracting interest of late is scenario-based learning (SBL) pedagogy in teaching statistics (Bartel, Figas, & Hagel, 2014). The basic idea of scenario-based learning is not new; however there has not as yet been a lot of scholarly research in this particular area of pedagogy in teaching statistics. In this method, learning happens with and through practice on prepared scenarios to give learning a context and alignment to course learning outcomes. The main aim of this study is to examine how far scenario-based learning pedagogy used in a *Statistics for Educational Research* course was related to improvement in postgraduate students' attitude toward statistics. The current study attempts to answer the following questions:

1. What is the postgraduate students' attitude toward statistics before and after being exposed to scenario-based learning approach?
2. Does a scenario-based learning approach improve students' attitude towards statistics?

This research has some limitations. It contains no randomized controls and therefore lacks the ability to make causal inferences about the effect or impact on educational experiences.

Scenario-based learning foundations

Scenario-based learning can be grouped under the broad pedagogical approach of inquiry-based learning methods (Buch & Wolff, 2000). In this study, the term *scenario-based learning* refers to any pedagogical approach involving an intentional use of scenarios to bring about desired learning intentions (Errington, 2005, p. 12). Theoretically, SBL is founded on situated learning theory (Lave & Wenger, 1991) which argues that knowledge is best acquired when situated and context-bound. This implies that any information studied using SBL should be connected to a real-life situation in which the students are more likely to use it. SBL is often associated with constructivist pedagogy which involves active learning and meaningful knowledge construction.

Attitudes toward statistics

Even though a statistics course has been seen as a necessary component for many undergraduate and postgraduate programs, research has shown that students perceive statistics negatively (Griffith et al., 2012; Keeley et al., 2008; Onwuegbuzie & Wilson, 2003; Schau & Emmioglu, 2012). Previous research has also found that attitudes toward statistics were associated with student performance in statistics classes. Thus it is very important to pay attention to students' attitudes toward statistics (Ashaari et al., 2011; Emmioglu & Capa-Aydin, 2012; Rosli, Maat, & Rosli, 2017; Nielsen, Tine, & Kreiner, 2018; Hassan Rahnaward Ghulami, Mohd Rashid Ab Hamid, & Roslina Zairimah Zakaria, 2014). Others went even further to suggest improving students' attitudes towards statistics to be one of the learning outcomes in an introductory statistics course (Wentzel & Wigfield, 2009).

METHODOLOGY

Statistics for Research in Education course

Statistics for Educational Research is an introductory statistics course offered to postgraduate students in the Faculty of Education, University of Malaya. The course is offered in two language tracks, English

and Malay (national language) and held once a week for a three-hour session. The SBL learning approach is used in the Malay Language track with 19 participants.

Generally, this course is structured in two parts, lectures on basic concepts and hands-on practice. The first hour of the session involves teaching basic concepts of the day's lesson through relevant scenarios, followed by working on the scenario assigned tasks for around 1.5 hours in groups. The next half an hour is used for discussing solutions obtained by the different groups and to clarify a few details on the concept. The course is conducted in the computer lab to provide internet access to the students.

Research design and Participants

In this study, a survey research design was used to obtain information regarding students' attitude towards statistics. The sample involved 19 students enrolled in the Malay track of the course in the first semester of the 2019-2020 academic year. Their age ranged from a minimum of 24 years to a maximum of 53 years. The mean age was 34.2 years. Most of the students were female (63%) and they came from four different academic backgrounds, namely Measurement and Evaluation (42%), Counselling (21%), Mathematics Education (26%) and Science Education (11%). About two thirds of the participants had university level mathematics (74%), about a third (21%) had matriculation level mathematics and 5% had secondary school level mathematics. Interestingly, most of the participants expected to receive grade A (84%) in the course and the lowest grade expected was a B+ (16%).

Developing Learning Scenarios

SBL approach involves the usage of scenarios to achieve learning outcomes (Stewart, 2003). Errington (2010) identified four types of scenarios used by most university educators: skills-based scenarios, problem-based scenarios, issues-based scenarios and speculative-based scenarios. Most of the scenarios designed in this study were realistic, familiar to students and content-related skills-based scenarios. Skills-based scenario is the most essential of the scenario approaches used to deliver fundamental subject content because it allows students to demonstrate acquired skills and knowledge. The scenarios in this study were designed in alignment with the topics taught in the current course structure. All the scenarios were compiled in a module called *Collections of Scenarios: Statistics for Research in Education*.

Instrumentation

Schau's (2003) *Survey of Attitudes Toward Statistics-36* (SATS-36) was used to measure six statistics attitude components at the beginning and at the end of the course. The attitude component represents important attitudes related to student's statistics achievement, as stated by Elmore et al. (1993). The instrument is comprehensive, assesses multiple components of students' attitudes and has been used widely both within the United States and in other countries. Scores from students involved in these studies have generally shown good to excellent psychometric properties (e.g., Chiesi & Primi, 2009; Hassan Rahnaward Ghulami, 2014; Mahmud, 2010; Tempelaar, Schim van der Loeff, & Gijselaers, 2007).

Besides eliciting the relevant demographic and academic background information, the SATS-36 questionnaire contains 36 items assessing six statistics attitude components of students: *Affect* (positive and negative feelings regarding statistics), *Cognitive competence* (attitudes about their intellectual knowledge and skills when applied to statistics), *Value* (attitudes about the usefulness, relevance, and worth of statistics in personal and professional life), *Difficulty* (attitudes about the difficulty of statistics as a subject), *Interest* (level of individual interest in statistics) and *Effort* (amount of effort spent on learning statistics). Students respond to each item on a 7-point Likert scale: 1 = "Strongly Disagree", 4 = "Neither Disagree nor Agree" (neutral or no attitude), and 7 = "Strongly Agree."

Internal consistency

Before interpreting scores from any sample, we need to ascertain that they exhibit at least adequate internal consistency, frequently evaluated using Cronbach's coefficient alpha. Peterson (1994) points out that acceptable value of Cronbach's alpha can vary between 0.5 and 0.95 depending on the type of research. We selected 0.6, an alpha value used in other research as an approximate lower limit for alpha that reflects the degree of error that researchers find acceptable in their studies.

The before and after SBL alpha values showed that, overall before the SBL the alpha value is 0.911 while after the SBL, the alpha value is 0.834. All six components exhibited moderate but within the range of acceptable internal consistency.

Data analysis

Descriptive analysis was used to describe the level of students' attitude toward statistics To determine the level of students' attitudes towards statistics, the mean score for each of the components in the SATS was calculated. The attitude level was categorized into three levels, which are positive (4.50-7.00), neutral (3.51- 4.49), and negative (0.00-3.50) attitude towards statistics, as interpreted in Mahmud (2010).

FINDINGS

Attitudes Before and After Scenario-based learning

The box plot in the following Figure 1 shows the students' mean score for attitude before and after exposure to SBL. Table 1 displays the median of the mean score and standard deviation of each attitude component before and after SBL.

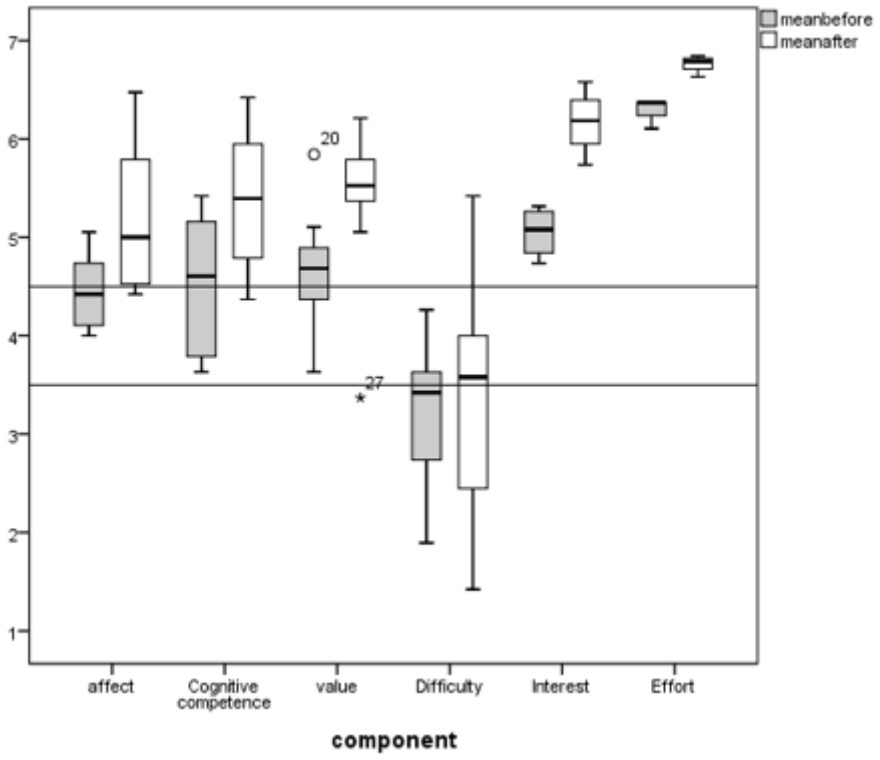

Figure 1. Students' attitudes before and after exposure to SBL

Table 1
Median for sections Mean score before and after SBL

	Pre SBL		Post SBL	
	Mean/Median	*SD*	Mean/Median	*SD*
Affect	4.456/4.421	0.405	5.202/5.000	0.792
Cognitive competence	4.535/4.535	0.715	5.386/5.395	0.750
Value	4.673/4.673	0.623	4.673/5.397	0.836
Difficulty	3.188/3.421	0.821	3.330/3.579	1.336
Interest	5.053/5.079	0.261	6.172/6.185	0.345
Effort	6.302/6.368	0.132	6.763/6.790	0.091

Overall, the box plot results show an increase in attitudes in all six attitude components after SBL. The level of attitudes toward statistics among postgraduate students was found to be 'Positive' for all components before and after SBL except for component *Difficulty* which was negative before SBL but neutral after SBL.

From Figure 1, before Scenario-based learning experience, the average section score for *Affect* was neutral. The median was within ½ point of 4 which is the neutral point. The students tended to be somewhat neutral in their response when rating their feelings regarding statistics. The mean score for affect is 4.46, indicating that students neither disagreed, nor agreed, with statements such as 'I will like statistics' or 'I will enjoy taking statistics courses'. However, some sections exhibited positive average attitudes. After exposure to SBL, great majority of the section means for *Affect* was in the positive range indicating that they were more positive in rating their feelings concerning statistics.

Cognitive competence components measure students' attitudes about their intellectual knowledge and skills when applied to statistics. Before SBL, the median section mean score for *Cognitive Competence* is more than ½ point above neutral, with about ½ of the sections in the positive range and the remainder in the neutral range. After SBL, great majority of the section means for *Cognitive competence* are in the positive range. The results indicate that students in this study were slightly more positive in rating their confidence in their own intellectual knowledge and skills when applied to statistics after SBL exposure compared to before SBL. The results indicate that most students agree with statements such as 'I can learn statistics' or 'I will understand statistics equations'.

The *Value* component focuses on students' attitudes about the usefulness, relevance, and worth of statistics in personal and professional life. Results show that before SBL, the median section mean score for the *Value* component is about ¾ point above neutral, with more than half of the section in the positive range and the remainder in the neutral range. After SBL, all section means are in the positive range for *Value*. This indicates that students value statistics more after SBL and agree on the usefulness, relevance and worth of statistics in their personal and professional life.

The mean section score for *Interest* was almost 1 point above neutral, with all the section means in the positive range. After SBL, all section means are in the positive range for *Interest* with more than 2 points above neutral. Results show that students in this study displayed interest in statistics both prior (*Mdn* = 5.079, *SD* = 0.261) and after SBL (*Mdn* = 6.185, *SD* = 0.345), indicating that most students agreed with statements such as 'I am interested in learning statistics' or 'I am interested in using statistics'.

Similarly, for *Effort,* all the section means were in the positive range before and after SBL, with the median more than 2 points above neutral. Students acknowledged that they were prepared to expend a lot of effort in learning statistics both prior and after SBL, indicating that most students strongly agreed with statements such as 'I plan to work hard in my statistics course' or 'I plan to complete all of my statistics assignments'.

Only one component, *Difficulty*, has the section mean more than ½ point below neutral and more than ½ of the sections in the negative range. However, after SBL, the average section score for *Difficulty* rose to neutral, with the section median within ½ a point of 4. Most of the section means though fell in the negative attitude. The students agreed that statistics could be viewed as difficult subject and were slightly more negative when rating the difficulty of statistics as a subject before SBL; however, they were neutral after exposure to SBL. The median for section mean score for *Difficulty* is 3.421 before SBL and 3.579 after SBL, indicating that students slightly disagreed with statements such as 'Statistics formulas are easy to understand' or slightly agreed with statements such as 'Statistics is a complicated subject'.

DISCUSSION

The purpose of this research was to examine the extent to which scenario-based learning approach used in a *Statistics for Research in Education* course was related to improvement in postgraduate students' attitude toward statistics. Changes in attitude toward statistics at the beginning of the course before exposure to SBL and at the end of the course were measured using Schau's (2003) *Survey of Attitudes Toward Statistics-36* (SATS-36). The analyses indicated that SBL has a positive impact on students' attitudes toward statistics. This is consistent with the results of a study by Jawarharlal, Shih, and Schrader (2004) which had proven the effective role of scenario-based learning practices on student attitudes. Their initial efforts in using SBL approach in teaching have clearly revealed increased learner interest in the subject and improved knowledge retention.

The analyses also indicated evidence that students entered the class with positive attitudes in most of the attitudes components, namely *Affect, Cognitive Competence, Value, Interest* and also *Effort* except for *Difficulty*. This discovery is in line with the finding in previous research by Ashaari et al. (2011) where students have displayed a positive attitude to most of the components studied. It was interesting to note that, Siti Shahirah Saidi and Nyet (2019) reported that overall, secondary school students in her study also had positive attitude towards statistics. Students were found to hold a positive attitude for all of the components, except for the *Value* component, which was reported neutral. It seemed that at the secondary school level, students were uncertain about the usefulness, relevance and worth of statistics in their personal and future professional life as compared to postgraduate students.

The positive attitudes of postgraduate students toward statistics at the beginning of the course is in contrast from earlier reports that introductory statistics courses students often have anxiety, negative attitudes, a lack of motivation, and a lack of interest (Griffith et al., 2012; Keeley et al., 2008; Koh & Zawi, 2015; Onwuegbuzie & Wilson, 2003; Krishnan & Noraini Idris, 2014; Schau & Emmioglu, 2012). Other relevant constructs related to statistics achievement such as previous statistics experience, mathematics background ability, students' efficacy, and gender may have given some impact on postgraduate students' attitudes.

In general, students in this study both before and after SBL displayed interest in statistics, conceded that they were prepared to put in a lot of effort in learning statistics and were slightly more positive in rating their confidence in their own intellectual knowledge and skills. They were, however, somewhat neutral when rating their feelings regarding statistics before SBL but were more positive in rating their feelings concerning statistics after SBL. The students value statistics more after SBL and agree on the usefulness, relevance and worth of statistics in their personal and professional life. They agreed that statistics could be viewed as a difficult subject and were slightly more negative when rating the difficulty of statistics as a subject before SBL; however, they were neutral after exposure to SBL.

Most of the findings aligned with those in a study conducted by Mahmud and Zainol (2008). The results of their study show that a majority of the respondents indicated a moderately high positive attitude toward statistics. However, several negative attitudes towards statistics were also detected. These include considering statistics as complicated, that it is a subject not easily learned by most people, that it requires a great deal of discipline, and that it involves massive computations and is highly technical.

CONCLUSION

The efforts in applying SBL approach in this study have clearly revealed increased students' attitudes towards the subject. This approach improved attitudes measured by the six components; it has been shown to increase the value students placed on the usefulness, relevance and worth of statistics and also helped them to continue maintaining an interest in statistics as the course progressed. All these findings suggest that using the SBL approach was found to be promising in influencing student attitude toward statistics and will benefit students in statistics courses. Therefore, it seems that there is a possibility to consider scenario-based learning as an effective pedagogical approach to improve statistics teaching and learning at the postgraduate level.

The results of this study, however, are limited by the use of one group of postgraduate students in a statistics class. While the study examined changes in attitudes toward statistics, no attempt was made to study changes in achievement or other relevant constructs. Further research is also needed to look critically into the continuing perception that statistics is a difficult subject. More research needs to be done to improve this aspect of student attitude.

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