Probability Workshop to be better in Probability Topic

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Abstract. The purpose of the present study was to examine whether statistics anxiety and attitudes towards probability topic among students in higher education level have an effect on their performance. 62 fourth semester science students were given statistics anxiety questionnaires about their perception towards probability topic. Result indicated that students' performance in probability topic is not related to anxiety level, which means that the higher level in statistics anxiety will not cause lower score in probability topic performance. The study also revealed that motivated students gained from probability workshop ensure that their performance in probability topic shows a positive improvement compared before the workshop. In addition there exists a significance difference in students' performance between genders with better achievement among female students compared to male students. Thus, more initiatives in learning programs with different teaching approaches is needed to provide useful information in improving student learning outcome in higher learning institution.

Keywords: Statistics anxiety, Probability topic, Probability workshop, Students' performance.
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INTRODUCTION

Statistics courses are mostly compulsory for university students and regarded as indispensable entry subject for postgraduate studies. Due to high-stakes nature of statistics courses, students consider them as the most anxiety inducing course (Chew & Dillon, 2014;Stalder&Olson, 2011; Chiesi et al., 2011).Freng et al. (2011) in their study stated that "if asked what course they most dread taking, many undergraduate psychology students will say statistics or research methods. Trepidation regarding statistics and research methods may come from statistics anxiety''.

Teaching statistics specifically on probability has been closely influenced by statistical anxiety. Since it is very hard for learners to understand statistics, hence they showed weaker performance on statistics compared to other educational exams (Zare et al., 2011). Bui et al. (2011) in his study stated that student's competence and performance in a statistics course were proven to be affected by statistics anxiety or generally by their attitude towards the course. A study by Zare et al. (2011) mentioned that the lower performance on statistics also can be explained by vital factors which are cognitive and motivational. Hence, it is suggested by Zare et al. (2011) that "the educational environment and classes of statistics should be built in the way in which student's anxiety level can be kept on the optimum level. In order to obtain this aim, special attention should be given to task difficulty level, professors' evaluations – emphasizing on their usages in psychological and educational research, using interesting tasks, giving responsibility to learners and making some opportunities for obtaining success and paying attention to individual's achievement and motivation".

Statistics' lecture-based classroom education in higher learning institution emphasized more on independent learning. Students should be able to adapt and learn, hence for those who failed to do so hence should invest an additional effort in learning. For some students, the conventional in-class learning is not enough for them to properly understand statistics. Therefore as discussed by Realin (2009), the alternatives to ordinary classroom instruction should be sought as additional outside classroom action-learning experience. Especially in teaching probability and statistics, a more comprehensive and diversified way should be sought to help student to learn effectively.

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Statistics Anxiety and Performance

Statistics is a specific branch of knowledge that requires skills ability includes addressing reliable ways of gathering data and making inferences based on the data obtained. Therefore a statistician is interested in determining which tools should be used or the best mechanisms in making and also correcting inferences. In educational field, there have been numerous applications of statistical techniques to use in measurement. Many studies had focused on the improving process of teaching of statistics and how to overcome the feeling of statistics anxiety.

Probability and statistics are connected to each other. The probability is a concept that has to be mastered in order to solve the statistics questions as well as to understand examples of statistics in real life. Choo-Kim et al. (2011) focused on probability topic by using Graphical Calculator, GC. This research group used GC in four main topics of probability; random variable, binomial distribution, poisson distribution and normal distribution revealed that there exists a significance difference in students attitude towards probability topic before and after used GC. Overall, students become more positive towards probability topic after using GC. Furthermore, he extended his research on 2012 to find the effectiveness by using GC on students' probability achievement. He found out those students performed better after being tested in Probability Achievement Test, PAT.

There are quite a number of study strongly suggested that statistics anxiety does influenced the student performance in statistics generally. A consistent negative relationship has been found between statistics anxiety and statistics attainment (Chew & Dillon, 2014; Stalder&Olson, 2011). Meaning to say, students who experienced lower level of statistical anxiety are prone to have high performance on a statistics examination. The crucial of statistics knowledge were acknowledged by Freng et al. (2011) suggested that a successful career in psychology majors' academic can be predicted by early enrollment and performance in statistics or research method. Therefore despite various words used to describe learning statistics as a 'painful', 'dreadful' process, it is important to actually find the most suitable and effective ways to learn statistics.

Teaching Approaches

Manalo & Leader (2007) in their study on improving student performance in introductory statistics shows that students who join the learning center program and attend the workshop had a significantly higher pass rate in their statistics course compared to those who did not attend the workshops. In other study, Bartsch et al. (2012) found that there is a significant improvement in self efficacy among students after sharing sessions with former successful students in person on how the previous experience of anxiety faced and behaviors that led to overcome it. The belief to trust their own abilities to productively perform any given academic tasks for example passing a course is defined as self-efficacy. If the self-efficacy improved then it is also reflected on academic performance level. McGrath (2014) on the other hand, also promotes academic support during office hour consultation outside lecture-based class. The results found that the students that consult and complete the task outperformed those who didn't.

Normal statistics class, students usually given a demonstration or questions to be practiced from a textbooks or lecturers. According to Castro et al. (2007), they found out that students have negative perception towards statistics and deemed it as difficult and boring subject subsequently lead them to have anxiety feeling and also lacking of self-efficacy after being exposed this learning process. This statement supported by Eric (2013) stated that learning from textbooks will bring a difficulties when the students have to collect real life data for theirs study or work purpose because currently numerous textbooks contained questions from small data size so that students can solve it easily without facing big problem. However, a large number of dataset may also result the possibility of a missing data. A study done before by Tishkovskaya and Lancaster (2010), they also make a real life example for students in developing statistical literacy so that students will have a good thinking and communication skills of statistics. In addition, Tishkovskaya and Lancaster had proposed many strategies to improve the way students learn statistics more effective. They found that technology and online resources can be used to attract students positively in learning statistics.

Nowadays, information and technology become famous among students from elementary to higher learning institution. Interactive games can be useful tools to enhance the students' knowledge and skills in achieving the intended learning outcome (Nadolski et. al, 2008). This finding encouraged Elizabeth et al. (2014) used this modern approach to teach statistics. They optimized the usage of game based approach in learning statistics. The games contain qualitative and quantitative method of statistics targeted on business and nursing students that tested students' knowledge in real life example.

RESEARCH METHODOLOGY

The sample consisted of 62 science students attending one of the public universities in Malaysia, those who enrolled in an introductory statistics course namely Probability and Statistics. The course covered the usual introductory topics of statistics as well as probability. All students participated on a voluntary basis by answering a questionnaire. Only those involved in the workshop was considered to be the participants. The result of the participants before and after the workshop was collected for further analysis.

Instruments

The data was collected through a self-developed questionnaire which included a set of demographic questions. The questionnaire contains 32-items. Likert scale were used to record the responses that ranges from 1= *Strongly Agree* to 5 = *Strongly Disagree*. The questionnaire was used to measure statistics anxiety. The questionnaire was given to the participants at the beginning of the probability class. In order to check the effectiveness of probability workshop, the result of a probability test before the workshop was recorded as well as after the workshop was held.

Procedure

The Statistical Procedures for Social Sciences (SPSS) 20.0 (SPSS Inc, 2008) was used to code and analyze the data. The assumptions of parametric statistics and also the reliability tests to signify the consistency of the internal component were tested on the data. The analysis continued with independent t-test to evaluate whether the average scores differed significantly between male and female students. The levene statistic was conducted to check the equality of variances for both samples. Finally, a paired sample t-test was conducted to check whether the result of the participant before and after the workshop different or not.

RESEARCH METHODOLOGY

In total, 36 male and 26 female participants involved in this study. The mathematic results obtained during SPM level shows that all participants got at least C. Meanwhile, only about 26 participant (37.1%) got at least C in additional mathematics. Preliminary assumption testing indicated that both the males (M= 62.58%, SD = 23.08) and females (M = 74.4%, SD = 17.88) scores were normally distributed and have equal variances (F = 2.247, p = .125). As shown in Table 1, the independent t-test result was significant, $t(60)$= 2.186, p = .033, two-tailed, d = 5.423, 95% CI [1.006, 22.700]. The value of p less than the significant level (α = .05), supported that there is enough evidence to conclude that the mean scores are differed according to participants' gender. Subsequently, females score is found to be significantly higher than males and reveals that performance of females is much better compared to males in probability topic.

TABLE 1. Independent t-test according to Gender

Variable	p-value	Mean difference	Standard error difference	95% Confidence interval of difference	
				Lower	Upper
Score	.033	11.853	5.423	1.006	22.700

Table 2 shows the results from measuring the differences in scores among five different level of anxiety; 1=very low, 2=low, 3=moderate, 4=high, 5=very high. The sample size of each group is not identical and it is also noted that the level anxiety of five is ignored from the analysis since the sample size is zero. The Levene statistic(F = 1.990, p = .126) shows that the assumption of equal variances was accepted and the variances appear to be random. The analysis of variance reveals that scores is not differ significantly among the four different level of anxiety (F=1.693, p=0.178). Thus, the result supports the hypothesis that different levels of anxiety do not affect participants' performance in probability topic.

TABLE 2. Analysis of Variance

Source of variation	Sum of squares	Degree of freedom	Mean square	F	p-value
Between groups	2315.871	3	771.957	1.693	.178
Within groups	26441.463	58	455.887		
Total	28757.334	61			

Results from performing a paired sample t-test in Table 3 reveals that the Test 1(M= 47.38%,SD = 24.20)and Test 2(M= 67.55%,SD = 21.71)scores data give a p-value of 0.000 (t(61) = 6.084, p< 0.001). The p-value is sufficiently low shows that there is statistically significant different between mean scores obtained for Test 1 and Test 2. Therefore, there is strong evidence to conclude that the participants' performance in probability topic has improved after attending the workshop. In addition, the finding also indicates that the probability workshop improved participants' scores, on average by 20 points. The results obtained have been supported by Muhammad et al. (2008) stated that an effective workshop helps in enhancing the skills among health professionals. Another study conducted by Narayan et al. (2004) stated that the quality of medical care and outcome in hospital can be improved by conducting medical workshop for medical personnel.

TABLE 3. Paired Samples t-test

Statistic	t	Degree of freedom	p-value
Test1-Test2	6.084	61	0.000

CONCLUSION AND RECOMMENDATION

This study was conducted to examine the effectiveness of workshop provided on students' performance probability topic in higher learning institution. The students' scores before and after the workshop showed the workshop is an effective tool to improve their performance, increased on the average by 20 marks. Other than that, several researchers suggested that students' performance mostly influenced by their gender and level of anxiety. Thus, this study found that students' performance much depends on their gender with female students tend to have better performance rather than male students. However, there is not enough evidence to prove that level of anxiety did affect students' performance.

Therefore, it is suggested to have more workshops in upcoming semester with the intention to help students to gain their understanding in statistics concepts. It is also suggested that, more initiatives in learning programs with different teaching approaches in order to improve students' performance. Future study may emphasize the factors influencing different performance level between female and male students. Thus, the finding from this study is hoped to provide some useful information to those involve in improving the statistics performance in higher learning institutions.

REFERENCES

A.B. Elizabeth, , W.M. Ewan, M.C. Thomas, H. Thomas, , M. Madalina, K. Anne, & R. Peter Van (2014). A narrative literature review of games, animations and simulations to teach research methods and statistics. *Computer & Education, 74*. 1-14.

A.E. Castro Sotos, S. Vanhoof, W.Van den Noortgate, & P. Onghena, (2007). Students' misconceptions of statistical inference: a review of the empirical evidence from research on statistics education. *Educational Research Review, 2*, 98–113.

A.L. McGrath (2014). Just Checking In: The effect of an office hour meeting and learning in an introductory statistics course. *Teaching of Psychology*, 41(1), 83-87.

Choo-Kim, T. (2012). Effects of the application of graphing calculator on students' probability achievement. *Computer & Education, 58*. 1117-1126.

D.R Stalder., E.A. (Olson 2011). t for two: Using mnemonics to teach statistics. *Teaching Psychology*, 38(4), 247-250.

E. Manalo, D. Leader, (2007). Learning Center and Statistics Department Collaboration in improving student performance in introductory statistics.*College Student Journal*, 41(2), 454-459.

F. Chiesi, C. Primi, J. Carmona (2011). Measuring statistics anxiety: Cross-country validity of the Statistical Anxiety Scale (SAS).*Journal of Psychoeducational Assessment*, 29(6), 559-569.

F.R. Muhammad, Z.K. Ammar, M. Arif, Y.M. Ali, M.S. Omer, M.K. Quadri (2008). Data analysis workshops to enhance analytical skills among health professionals: an experience of conducting workshop with hands-on training on SPSS. *Journal of Ayub Medical College Abbottabad,*20(2), 146-147.

H. Zare, A. Rastegar, S.M.D. Hosseini (2011). The relation among achievement goals and academic achievement in statistics: the mediating role of statistics anxiety and statisticsself-efficacy.*Procedia - Social and Behavioral Sciences,* 30, 1166 – 1172.

J.A. Raelin (2009). The practice turn-away: Forty years of spoon-feeding in management education. *Management Learning*, 40(4), 401-410.

N. H. Bui, M. A. Alfaro, (2011). Statistics anxiety and science attitude: Age, gender and ethnicity factors.*College Student Journal*, 45(3), 573-585.

P.K.H. Chew, D.B. Dillon (2014). Statistics anxiety update: Refining the construct and recommendations for a new research agenda. *Perspectives on Psychological Science,* 9(2), 196-208.

R. J. Nadolski, H. G. Hummel, H. J. van den Brink, R. Hoefakker, A. Slootmaker, & H. Kurvers, (2008). Emergo: a methodology and toolkit for developing serious games in higher education. *Simulation & Gaming, 39(3)*, 338–352.

R.A. Bartsch, K.A. Case, H. Meerman (2012). Increasing academic self-efficacy in statistics with a live vicarious experience presentation.*Teaching of Psychology*, 39(2), 133-136.

S. Eric, (2013). Improving Learning in Statistics – A pilot trial study to achieve the triple effects of depths, breadth and integration. *The International Journal of Management Educationl, 11,* 12-24.

S. Freng, D. Webber, J. Blatter, A. Wing, W.D. Scott (2011). The role of statistics and research methods in the academic success of psychology majors: Do performance and enrollment timing matter?*Teaching of Psychology*, 38(2), 83-88.

S. Narayan, S.S. Mathai, K. Adhikari, A. Bhandari, K.S.Bawa (2004). Effectiveness of teaching of Neonatal Resuscitation Programmedat a workshop for a mixed population of medical personnel. *MJAFI,* 60, 244-246.

S. Tishkovskaya, G. A. Lancaster, (2010). Teaching strategies to promote statistical literacy: Review and implementation. ICOTS-8 Contributed Paper.

T. Kim, , B.H. Madhubala, & L. Siong-Hoe, (2011). Fostering positive attitude in probability learning using graphing calculator. *Computer & Education, 57*. 2011-2014.