Artículo de investigación

Attitudes toward learning statistics: the case of applied linguistics postgraduate students

Actitudes hacia las estadísticas de aprendizaje: el caso de los estudiantes de posgrado de lingüística aplicada

Atitudes em relação à aprendizagem estatística: o caso dos estudantes de pós-graduação em linguística aplicada

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Abstract

Researchers, students, and practitioners in the area of English language studies often avoid statistics which may be due to their fear of its numeric nature and high technicality. This paper presents the findings of a study that investigated a small group of postgraduate students' attitudes toward learning statistics. The respondents were 20 postgraduate students from the language faculty of a public university in Malaysia. Schau et al.'s (1995) Survey of Attitudes toward Statistics was used to elicit the data. The quantitative findings indicated the majority of students had moderately positive attitudes toward learning statistics. These findings also indicated how a two-day workshop could significantly improve these postgraduate students' attitude toward learning statistics. The qualitative results revealed that the students regarded statistics workshops as highly necessary and could make their results more presentable and credited. The results highlight the necessity of more and better statistics courses and workshops for students in similar areas.

Keywords: Learning-Teaching Statistics, Attitude, Applied linguistics students

Resumen

Investigadores, estudiantes y profesionales en el área de estudios del idioma inglés a menudo evitan las estadísticas que pueden deberse a su temor a su naturaleza numérica y su alto nivel técnico. Este artículo presenta los hallazgos de un estudio que investigó las actitudes de un pequeño grupo de estudiantes de postgrado hacia las estadísticas de aprendizaje. Los encuestados fueron 20 estudiantes de postgrado de la facultad de idiomas de una universidad pública en Malasia. Se utilizó la Encuesta de actitudes hacia la estadística de Schau et al. (1995) para obtener los datos. Los hallazgos cuantitativos indicaron que la mayoría de los estudiantes tenían actitudes moderadamente positivas hacia las estadísticas de aprendizaje. Estos hallazgos también indicaron cómo un taller de dos días podría mejorar significativamente la actitud de estos estudiantes de posgrado hacia las estadísticas de aprendizaje. Los resultados cualitativos revelaron que los estudiantes consideraron los talleres de estadísticas como altamente necesarios y que podrían hacer que sus resultados sean más presentables y acreditados. Los resultados resaltan la necesidad de más y mejores cursos de estadística y talleres para estudiantes en áreas similares.

Palabras clave: Estadísticas de Enseñanza-Aprendizaje, Actitud, estudiantes de lingüística aplicada.

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Resumo

Pesquisadores, estudantes e profissionais da área de estudos da língua inglesa freqüentemente evitam estatísticas que podem ser devidas ao medo de sua natureza numérica e alta tecnicalidade. Este artigo apresenta as conclusões de um estudo que investigou um pequeno grupo de atitudes de estudantes de pós-graduação em relação às estatísticas de aprendizagem. Os respondentes foram 20 estudantes de pós-graduação da faculdade de língua de uma universidade pública na Malásia. A Pesquisa de Atitudes em Relação à Estatística de Schau et al. (1995) foi usada para elucidar os dados. Os resultados quantitativos indicaram que a maioria dos estudantes tinha atitudes moderadamente positivas em relação às estatísticas de aprendizagem. Essas descobertas também indicaram como um workshop de dois dias poderia melhorar significativamente a atitude desses estudantes de pós-graduação em relação às estatísticas de aprendizagem. Os resultados qualitativos revelaram que os estudantes consideravam as oficinas de estatística como altamente necessárias e poderiam tornar seus resultados mais apresentáveis e creditados. Os resultados destacam a necessidade de mais e melhores cursos de estatística e oficinas para alunos de áreas afins.

Palavras-chave: Estatística de Ensino-Aprendizagem, Atitude, Estudantes de Lingüística Aplicada

Introduction

Knowledge of statistics is crucial particularly for university students at postgraduate levels. In social sciences, statistics is a rquired course for most postgraduate students. Universities often offer courses on statistics or quantitative data analysis methods. An understanding of basic statistical concepts is necessary to make informed and adequate decisions on fundamental issues such as the choice of appropriate sampling method and determination of suitable sample size. A lack of statistical skills at a descriptive level will often lead to simplistic, inaccurate calculations and interpretations of results. Most students who lack inferential statistics skills will miss the opportunity to present generalizable findings; not to mention the fact that this will lead to vague understanding of previous researchers' studies that reported inferential statistical results.

Attitudes toward statistics play a crucial role in students' willingness toward learning the subject (Gal et al. 1997; Ramirez et al., 2012; Zhang et al., 2012, Escalera-Chávez et al., 2014, Hu et al., 2017). Attitudes "derive from positive or negative experiences overtime devoted to learning" (Estrada et al. 2011, p. 165). According to Ajzen (1989, p. 241) attitude is defined as "an individual's disposition to respond favorably or unfavorably to an object, person, institution, or event, or to any other discriminable aspect of the individual's world." According to Schau, Stevens, Dauphinee, and Del Vecchio (1995), attitudes toward learning statistics is comprised of four categories, including affect, cognitive competence, value and difficulty. It was based on this view that they constructed their questionnaire, called the Survey of Attitudes Toward Statistics (SATS-28). This instrument included 28 items. Later it was developed to SATS-36 by adding the two aspects of interest and effort (Keshtkar 2017). Thus, the six components of attitudes (Shau et al., 1995; Shau 2003) are as follows: (1) affect, which shows students' willingness toward learning statistics; (2) cognitive competence, which represents students' knowledge and skill regarding statistics; (3) interest, which indicates students' level of interest; (4) value, which shows students' attitude regarding the usefulness of statistics in their professional life; (5) difficulty, which indicates whether students perceive statistics as difficult or not; and, (6) effort, which refers to the amount of effort that students put into the learning of statistics.

-Objective and Research Questions. Due to insufficient emphasis on language postgraduates' statistical skills and lack of useful, comprehensible, and relevant statistics courses for these postgraduate candidates, the present study investigated applied linguistics students' attitudes toward statistics and the role of prior knowledge on statistical concepts that may help them appreciate and value the subject and promote their positive attitudes. To address this objective the following questions were posed:

1. To what extent do applied linguistics postgraduate students indicate positive attitude toward statistics in research?
2. Does a two-day workshop make any significant difference between the postgraduates' pre- and post-test attitude scores?

-Limitations and Scope. The present study was a small scale survey whose findings may not be generalized since its sample was not randomized and its sample size was very small. The scope of the study covers the particular case of postgraduate students in the area of applied linguistics in a public university in Malaysia.

Literature Review

Albeit with their obvious significance, statistics courses are generally perceived as unpleasant and demanding subjects (Hogg, 1991; Berk & Nanda, 1998) which create anxiety among students (Roberts & Bilderback, 1980; Cruise et al., 1985).

Berk and Nada (1998) illustrated the effects of using fun to improve attitudes, anxiety and achievements for undergraduate and graduate statistics course. The participants in their study were 142 students in three accidental groups who registered in one undergraduate or two graduate statistical course in School of Nursing, John Hopkins university. Different instruments were used to collect data such as BATS (Bad Attitude Toward Statistics), ATMS (Anxiety Toward Mathematical Statistics), PMP (Perceived Mathematics Proficiency), BAP (Basic Algebra Proficiency), PCP (Perceived Computer Proficiency) and SA (Statistics Achievement). One-tailed t-test, ANCOVA and Pearson intercorrelation matrix were used for analysing the data. The results presented that low level of anxiety, positive attitudes and performing fine in basic algebra at the beginning, and of course, improved achievement in the end.

Water et al. (1988) evaluated the attitudes toward statistics using ATS (Attitude Toward Statistics) and SAS (Statistics Attitude Survey) instruments. The participants (55% females) in their study were 302 students. They registered for introductory statistics course in Psychology Department at Midwestern University. ATS scale with its two subscales was used on the first and last days of the class and SAS scale was used on the last day of the class. According to the results, male students had more positive attitudes than female students. ATS and SAS were highly correlated and attitudes toward statistics were unrelated to sex and correlated to course grade. Also, a significant positive change was reported in attitude toward the course from the first day to the last day.

Some studies have indicated that students tend to view statistics negatively which can be related to poor performance, anxiety, or difficulty (Waters et al., 1988; Benson, 1989; Hannigan et al., 2014). These negative attitudes, according to Gal and Ginsburg (1994), can hinder learning of statistics. Benson (1989) employed the Statistical Test Anxiety (STA) to measure students' anxiety in learning statistics. The main objective of this survey was to evaluate the anxiety when taking a statistics course. The participants in this study were 219 students (125 undergraduate and 94 postgraduate, 57% females). The undergraduate students were from different majors while graduate students were from educations major who were not required to take math course as a part of their study. Five instruments were used which were mid-term examination in statistics, math self-concept, general test anxiety, self-efficacy and statistical self-anxiety. The data of math self-concept, self-efficacy and general test anxiety and demographic data were collected during the first week of class. The data of second measure of anxiety were collected after the mid-term. LISER software was used for analysing data and it was found that there is a negative relationship between students' anxiety and their achievement in statistics; that is, their negative feelings of anxiety and fear could negatively influence their statistics course grade. Benson's (1989) also reported that female students had higher general and statistical test anxiety and self-efficacy scores than male students. In this respect, others have also shown that male students have more positive attitudes toward statistics than female students (Roberts & Saxe, 1982; Waters et al., 1988). Furthermore, Benson (1989) reported a positive relationship between test anxiety and statistical test anxiety. A positive relationship was also found between math self-concept and achievement.

Moreover, focusing on 166 graduate students within the colleges of educations in the United State, Perepiczka et al. (2011) examined the relationship between students' statistics self-efficacy, anxiety, social support and their attitudes toward statistics. A demographic questionnaire was applied for collecting data related to personal characteristic and prior experiences. According to the personal characteristic data, 136 students were female and 30 students were male. The age range of participants was between 21 and 71. The participants were both master's (n = 92) and doctoral (n = 74) students. They had various

statistical backgrounds, but surprisingly 45 students had not completed a single graduate level statistics course. The STAR (Statistics Anxiety Rating) instrument was applied to collect data related to statistics anxiety. ATS instrument was used to measure attitude toward statistics. MSPSS (Perceived Social Support) instrument was applied to measure the social support and finally SELS (Self-Efficiency to Learn Statistics) instrument was used to measure the self-efficacy. The simultaneous multiple regression was used to identify the relationship between self-efficacy to learn statistics (dependent variable) and attitude toward statistics, statistics anxiety and social support (independent variables). Perepiczka et al. (2011) found that students' anxiety and their attitudes toward statistics were important predictors of students' statistics self-efficacy. The repeated multiple regression without the social support was also used to explore the moderating effects of social support and it was interestingly found that the social support was not a contributing variable. Based on the results, self-efficacy to learn statistics and statistical anxiety negatively correlated. However, self-efficacy to learn statistics and attitudes toward statistics positively correlated.

Further, using the Survey of Attitudes toward Statistics as well as information on demographics and prior learning experiences, Hannigan et al. (2014) focused on 121 medical students (58% female and mostly Irish) who were registered first-year students in graduate medical school in Ireland to find the attitudes toward statistics of graduate-entry medical programs with different background and understand the role of previous learning experience. The SATS-36 instrument was applied to collect data related to six attitudes components. This instrument is an extension of SATS-28 which includes four attitude components. The Cronbach's alpha exhibited good reliability for SATS-36 scale and items on the six components. According to the results. Most participants (85%) had taken a quantitative course in their primary degree. The multivariate linear regression was used to predict components of attitude using demographic variables such as age, sex, nationality and variables which presented the past educational experiences. According to the multivariate linear regression, perception of mathematics performance in the past was the strongest predictor for all attitude components except for affect (Tezer & Ozcan, 2015; Casem, 2016). Older age was a predictor for difficulty component and Irish nationality was the predictors for all components except affect and interest. According to the Spearman's correlation coefficient, the number of prior quantitative course was positively correlated with difficulty and cognitive competence. Also, there was a positive correlation between performance in mathematics in the past and affect, cognitive competence, value, difficulty, interest and effort. Hannigan et al. (2014) found that students view statistics as a difficult subject. In fact, their feeling toward statistics was not positive and they felt fear, stress and insecurity. The study demonstrated that although students appreciated the usefulness of statistics in their professional life, their feelings toward statistics were less positive. Besides, students' attitudes regarding their interest in statistics as well as their statistics knowledge and skills were neutral to positive (Hannigan et al., 2014).

Roberts and Saxe (1982) illustrated the effects of cognitive and non-cognitive factors on attitudes toward statistics using pretest and posttest of SAS instrument. The participants in this study were 132 (74% female, 36 undergraduate and 96 postgraduate) students, who hadregistered for introductory statistics course at Pennsylvania State university. The basic mathematics test, basic statistics test, statistics attitude scale and calculator attitude scale were used to collect data. According to the results, the pre and post test SAS were significantly different and changed positively from the beginning to the end of the course . SAS scores were correlated with basic mathematics skills, statistics pre-knowledge and course grade. Also, SAS was significantly correlated to the sex so that males had higher SAS scores than females. The data also presented that more positive attitudes are related with higher level of performance. Previous literature also points out factors that may influence students' attitudes toward statistics such as students' mathematical background, statistics experience, confidence and gender (Elmore & Vasu, 1980; Waters et al., 1988; 2004; Chiese & Primi, 2010). Elmore and Vasu (1980) focused on 188 students from statistics classes in a university to measure the effect of their attitudes toward statistics. They conducted multiple regression analyses assessing predictors of success in statistics classes and found that gender differences affect students' performance in statistics. This study revealed that female students had more positive math attitude than male students. Using the Survey of Attitudes Toward Statistics (SATS), Mills (2004) concentrated on 203 undergraduates (55.7%

male, 82.2% European American) in an introductory statistics class in the College of Business in (2000) to assess their attitudes toward statistics. The SATS-28 instrument with four subscale was used to collect data. Descriptive statistics, categorical data method and correlation were used to evaluate students' attitudes. Spearman correlation was used to reveal the relationship between confidence, mathematics skill and statistics experience. According to the results for descriptive statistics, 66.8% students had never taken a statistics course before,and almost half the students (48%) reported that their average grade ranged between 3 and 3.5. Cronbach alpha indicated acceptance reliability for four subscales. Categorical data analysis methods were applied to compare student attitudes in males versus females. Based on the results, student attitudes were neutral in terms of affect, meaning that they both agreed and disagreed with the statements of this component. Student expressed negative attitudes for cognitive competence and value components. Finally, student agreed with the difficulty component. Mills (2004) found that students had more positive attitudes toward statistics associated with factors such as statistics experiences and confidence. In this study, males felt more confident than females about learning statistics however, there was not any difference between males and females on like statistics.

Similarly, Chiese and Primi (2010) examined 487 undergraduate psychology students (aged 21.4, 82.6% female) attending an introductory statistics course, covering both descriptive and inferential statistics, to assess the students' attitudes on statistics. Data were collected at the University of Florance in Italy. During the 60–hour course, the examples and exercises were done by pencil and paper method. No computer packages were used. In this survey, SATS-28 instrument with four subscales was used to assess attitude toward statistics, PMP (Prerequisite di Mathematica per la Psicometria) scale helped measure the mathematics background and STARS instrument illustrated the academic anxiety or mathematics anxiety. The midcourse tasks score, final examination grade and failures were used to measure statistics achievement. The pre and post-SATS were completed at the beginning and at the end of the course, respectively. The PMP and STARS were administrated at the second day and at the middle of the course, respectively. SEM analysis was done by AMOS software. According to the results, the attitudes toward statistics altered during the course. Chiese and Primi (2010) suggested that students' attitudes are related to their mathematical background.

Moreover, Griffith et al. (2012) investigated 684 undergraduate students (416 female) across various disciplines. The participants in this survey were from business (207 students), criminal justice (196 students) and psychology (281 students) majors. The age range was 18-48. In this study, mixed methods design was used. In the first step, the participants were asked whether they had positive or negative attitudes toward statistics. Majority of the participants (63%) had positive attitudes towards statistics. In the second step, they categorized the positive and negative groups according to the three majors. A Chi-square test was used to indicate the relationship between major and general attitude toward statistics. There was a significant relationship between major and general attitude toward statistics. The participants with business major had more positive attitudes compared with those of other majors. According to the qualitative data analysis, the students with positive and negative attitudes were divided into five groups . Chi-square tests were used to identify the relationship between major and response category. According to the results, there was a significant relationship between use in future career and majors. Also, two-thirds of students with positive attitudes identified that they would use statistics in their future career and graduate school. Business majors believed statistics is important in future career while psychology majors believed statistics is important for graduate school. The five groups for negative attitudes were difficulty, nonuse in future career, dislike math, not related to major and professor. Chi-square tests were used to determine the relationship between category and major. Based on the results, there was a significant relationship between nonuse in future career with majors. Griffith et al. (2012) compared the qualitative analysis domain with SATS domain and found use in future career (positive attitude), need for graduate school (positive attitude), nonuse in future career (negative attitude) and not related to major (negative attitude) were similar to value in SATS domain. Challenging course (positive attitude) and difficulty (negative attitude) were similar to difficulty in SATS domain. Like math (positive attitude) and dislike math (negative attitude) were similar to cognitive competence in SATS domain.

Furthermore, Zhang et al. (2012) found that medical postgraduates have more positive attitudes on statistics which may be influenced by statistical and mathematical background, age, research experience and so on. The goals of this study were to identify the attitudes toward statistics for medical postgraduate, identify the relationship between attitudes toward statistics and students' achievement, and assess the effective factors of these attitudes. They used SATS-28 instrument with four subscale which are affect, cognitive competence, value and difficulty. They (Zhang et al., 2012) added one open-ended question to find more information about the origin of the general attitude. Furthermore, students' demographic questions, educational and academic background questions were asked. They collected data for pre-SATS from 539 medical postgraduates that registered for a statistics course and 83 postgraduates were randomly selected from them for post-SATS. The students had an average age of 26.5 years, 42.9% of whom were females. They used descriptive statistics to exhibit the characteristics of the sample. They used one way ANOVA and t-test to compare the differences of SATS score between educational, demographic and academic factors. Multivariate linear regression was used to identify the effective factors to attitude toward statistics. The paired t-test was used to determine the variation of attitudes among pre- and post-course. Pearson correlation was also used to illustrate the relationships between the scores of SATS and its four subscales and achievement on the exam. According to the results, students with younger age, higher level of statistical education, research experience and better mathematics basis tended to have more positive attitudes. According to the descriptive statistics results, 42.1% students had taken statistical course. 78% students focused on clinical career. Most of them had good or neutral background about mathematics and statistics. According to the results of data analysis, most of the students had high scores in affect, cognitive competence and value, and very low scores for difficulty. According to the results, there were significant relationships between age, year of medical training, statistical education, mathematical basis, computer basis, research experience and attitudes towards statistics. Younger students had more positive attitudes than the older ones. Students with higher level of mathematics basis had more positive attitudes. Furthermore, students with clinical academic had negative attitudes. At the end, there was a significant relationship between achievement and SATS score. Based on the open-ended question, the source of students' attitude came from the previous statistical or mathematical course. They (Zhang et al., 2012) highlighted significance of attitudes on statistics as they can affect learning of statistics.

Jatnika (2015) examined influence of SPSS course on students' attitudes and achievements on statistics. Using the Survey of Attitudes Toward Statistics (Schau, 2003) and conducting Wilcoxon test and t-test, Jatnika (2015) focused on university students at Faculty of Psychology. This study had a one-group pretest-posttest design, and its data were collected using SATS-36 questionnaire. Total sampling technique was used to collect93 student participants but the collected data were from 67 students because some of them were not present at the time of data collection. Jatnika (2015) measured six aspects of attitude including affect, cognitive competence, value, difficulty, interest and effort. Jatnika found that after taking the SPSS course, students' attitudes regarding their statistics knowledge and skills (cognitive competence) changed significantly while their feelings and level of interest in statistics as well as their attitudes regarding difficulty and amount of effort did not change significantly. Furthermore, it was found that students' attitudes regarding the usefulness of statistics decreased which showed that the SPSS course could not improve students' attitudes regarding the relevance of statistics in their professional life. This study also evaluated the effect of SPSS course on achievement about statistics. According to the results, the achievemnet about statistics significantly decreased (p=.000) at the end of SPSS course. It might be because of the students anxiety when they implemented computers.

Negative attitudes influence students' achievements in statistics and their use of statistical knowledge in their future careers (Benson, 1989; Gal et al., 1997). Previous research examined attitudes toward statistics mostly among secondary and undergraduate students, but limited studies have been focused on postgraduates' attitudes (Keshtkar 2018, Zhang et al., 2012), especially in the field of applied linguistics. Finally, as this review of literature shows, most of the previous studies have looked at medical science or business students and students in social sciences have almost been neglected.

Method

Quantitative method was followed to do this research. The data were collected using the survey method and the SATS-28 questionnaire developed by Schau et al. (1995). The data were analyzed using IBM SPSS (Version 20). Qualitative method was also used to elicit more in-depth insight from the participants by observing them and taking field-notes during the workshop. The study had a one-group pretest-posttest design.

-Participants. This study was carried on 20 postgraduate students (75% females) from Applied Linguistics postgraduate stidents in a public university in Malaysia in 2013.

-Treatment. A two-day basic workshop was organized as a treatment to develop the students' understanding of the concepts (rather than formulas) of statistics. The workshop was run by the first author, who began by emphasizing the importance of statistics and that it is a very useful research tool. The workshops concentrated on the following topics: basic statistical concepts, introduction to SPSS and the *t* statistic for single-sample, independent samples and related samples. Total sampling method was used to choose all the students who participated in the workshops. Quasi-experimental single group pre/post-test design was chosen to determine the students' attitudes toward statistics before and after the treatment.

- ***Instrument***. Attitudes cannot be measured directly and thus an instrument is needed to assess attitudes toward statistics. For this purpose, commonly one of the three following instruments is used; (1) Statistics Attitude Survey, SAS, (Roberts & Bilderback, 1980; Roberts & Saxe, 1982); (2) Attitude Towards Statistics, ATS, (Wise, 1985); and, (3) Survey of Attitudes Toward Statistics, SATS, (Keshtkar and Talebizadeh 2017). In this study, SATS-28, consisting of 28 items, was employed which used a Likert-type scale to measure four components of attitudes (by Schau et al., 1995) as follows:

(1) Affect; for example, *I like statistics.*
(2) Cognitive competence; for example, *I can learn statistics.*
(3) Value; for example, *Statistical skills make me more employable.*
(4) Difficulty; for example, *Statistics formulas are difficult to understand.*

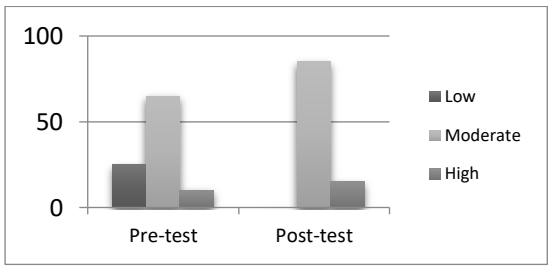
A Cronbach's alpha reliability value of 0.87 indicated that the instrument was internally consistent.

-Statistical analysis of data. To analyze the data, the study employed IBM SPSS, Version 20. Related Samples Wilcoxon Signed Rank Test was used to comapre two sets of scores from the same participants. The data from the observations were analyzed qualitatively.

Results and Discussion

In the following section, the findings of data analysis based on the components of attitudes toward statistics are presented in four subsections.

-Treatment Effect: Affect. The affect component among the postgraduate students was measured to find their feelings and attitudes toward statistics before and after the treatment. Figure 1 below presents the results on the analysis of affect:



Pre-test	Post-test
M =22.7	*M* = 26.15
Median = 21	Median = 26
	p = .017

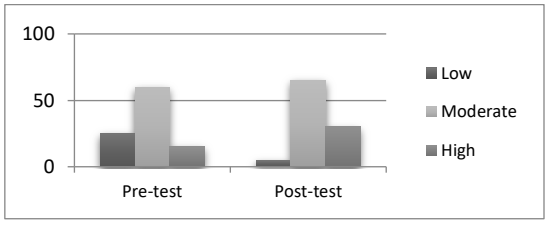
Fig. 1. First Component of Attitude: Affect (n = 20)

As it is shown in Figure 1, students' attitudes toward statistics has significantly changed. The comparison of the mean scores of the students before and after the treatment shows that they were less positive toward statistics before the workshop; however, they had more positive feelings after the treatment. A Wilcoxon Single-Ranks test indicated that the post-test scores (M = 26.15, SD = 4.85) were statistically significantly higher than pretest scores (M = 22.7, SD = 5.14), $Z = 2.38$, $p < .05$.

Zhang et al. (2012) studied the significant changes to students' attitude toward statistics before and after a statistics course. In contrast with the results of the present study, their results presented significant negative changes for Affect components. It means their students had more stressful and uncomfortable feeling after the course. Also, Hannigan et al (2014) presented

that the scores of Affect component after statistical course were slightly less positive. The results of Jakinta (2015) presented that students' attitude toward Affect did not significantly change after and before statistics course. This difference could be attributed to the method of instruction. In the current study, there was a friendly relationship between the facilitator and the students during the workshop. Students were called upon to go to the board and 'assist' the lecturer with the analysis of exercise data. Another assumption that can be made for the prositive change in the students' feelings toward statistics in the current study could be that the lecturer came from a similar area (i.e., Applied Linguistics), which created some sort of empathy between the lexturer and the students. Finally, related literature shows female students suffer from higher general and statistical test anxiety (Keshtkar and Dadkhoda Zadeh 2018). Generally, female lecturers and students outnumber male lectuers and students in Applied Linguistics departments which makes it even more vital to focus on their needs to statistical skills.

-Treatment Effect: Competence. The second component of attitudes toward statistics was measured to show the students' intellectual knowledge and their statistical skills. Figure 2 summarizes the results of analysis that shows how the students felt about their ability to learn statistics before and after the workshop.



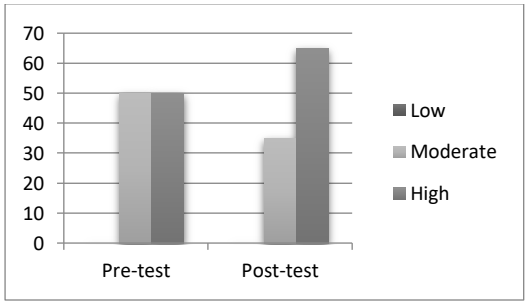
Pre-test	Post-test
M =23.95	*M* = 27.5
Median = 24.5	Median = 28
	p = .021

Fig. 2. Second Component of Attitudes: Competence (n = 20)

As the figure indicates, there is a difference between the mean scores of students before and after the treatment. It can be seen that after the treatment students have more positive views about their statistical knowledge and skills and are more confident that they can learn statistics. A Wilcoxon Single-Ranks test indicated that the post-test scores (*M* = 27.7, *SD* = 4.88) were significantly higher than pretest scores (*M* = 23.95, *SD* = 5.38), *Z* = 2.31, *p* < .05.

Jatnika (2015) also used the Wilcoxon test to find changes in cognitive competence component after an SPSS course. Likewise, she found that cognitive component significantly increased after SPSS course, meaning students' attitudes regarding the knowledge and skills after implementation of SPSS course significantly increased (Jatnika, 2015). By contrast, Zhang et al. (2012) found that the score of cognitive competence after completing the medical statistics course negatively increased. Yet in another study, Hannigan et al. (2014) reported that their students had neutral to positive attitudes about the intellectual knowledge and skills after statistical course. The reason behind these inconsistent results can be related to several factors from the instruction method used in the treatment, the teaching style of the instructor as well as the attitude of the instructor him/herself. When the instruction method takes the learners' backgrounds and needs into account, when learners' self-investment and involvement are emphasized, when the instructor and the learners come from similar disciplinary backgrounds, and when instructors themselves have positive attitudes toward learning-teaching statistics, it is more likely that the learners finally develop positive attitudes toward their ability to learn statistics.

-Treatment Effect: Value. The usefulness of statistics in students professional life was measured by third component of attitude, i.e. value, as presented in the following (Fig. 3):



Pre-test	Post-test
M =44.2	*M* = 45.95
Median = 44.5	Median = 47
	p = .325

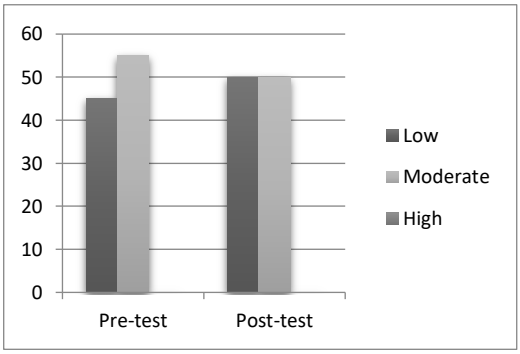
Fig. 3. Third Component of Attitudes: Value

As the above Figure shows, the difference between the students mean scores is not so significant. After the treatment, students'

attitude regarding the relevance of statistics in their professional life was slightly changed. A Wilcoxon Single-Ranks test indicated that albeit with their slight difference, there was no sufficient evidence to conclude that the post-test scores (M = 45.95, SD = 7.02) were significantly higher than pretest scores (M = 44.2, SD = 6.13), Z = 0.985, p > .05.

Zhang et al. (2012), who experimented the changes in mean scores after their statistics course, also found that score on the 'value' subscale was non-significant. Therefore, students felt statistics was very useful in their personal and professional life. Furthermore, Jatnika (2015) used Wilcoxon test to compare the scores before and after SPSS course for the 'value' component. She found that there were no significant changes in scores of Value subscale after the implementation of the SPSS course. One possible explanation for the insignificant changes between the students' attitudes toward the value of statistics before and after the treatment in the current study is that their pre-test scores were already very high for this subscale. In contrast to the results of the previous two subscales, in which some students had indictaed negative attitudes affect- and competence-wise, none of the students disagreed with the significant role of statistics in their future academic development (Brunner and Ganga-Contreras, 2017). Their views remained positive with slightly more students with positive attitudes on the post-test.

-Treatment Effect: Difficulty. The difficulty level was measured to find out how difficult statistics is perceived by the students. The result is given below:



Pre-test
M =22.95
Median = 23

Post-test
M = 22.35
Median = 21.5
p = . 294

Fig. 4. Fourth Component of Attitudes: Difficulty

As Figure 4 shows, before the workshop most student (55%) perceived statistics as moderately difficult while the remaining 45% believed that it was of low difficulty. In comparison with the pre-test, after the workshop, fewer students (50%) perceived statistics as moderately difficult. However, the results of Wilcoxon Single-Ranks test indicated that there was no sufficient evidence to conclude that the post-test scores (M = 22.35, SD = 5.98) were significantly lower than pretest scores (M = 22.95, SD = 5.3), Z = 1.05, p > .05.

Likewise, Jatnika (2015) used Wilcoxon test for the same objective andfound that the difference between students' attitudes toward the difficulty of statistics before and after SPSS course was not significant. In contrast, Hannigan et al. (2014) reported their students tended to perceive statistics as difficult. Zhang et als (2012)also reported that students found statistics significantly more difficult after the treatment. the statsitical formulas, students are of course more likely to consider statistics increasingly difficult. In the current study, the students were encouraged to use SPSS the way they use MS Word; when one is using MS Word, one rarely has to be aware of the underlying algorithms and formulas behind each menu. The students were, of course, taught about the basic statistical concepts and the important assumptions behind each statsitical method; however, they were not pushed to learn or use the formulas or to do manual calculations for performing any of the statistical tests. This may be the reason why they did not perceive statistics as highly difficult.

-Qualitative findings.As the quantitative results indicated, the participants generally had positive attitudes toward statistics both before and after the workshop. Based on the lecturer's observation, they were extremely attentive and took the workshop very seriously. There were a few insteresting cases that were observed and noted. One particular case was a PhD student who had submitted her thesis and was waiting for her viva voce. As she declared, she had used parametric methods to analyze her data. However, after the workshop, she realized that she had to follow non-parametric data analysis methods. Later she reported that her results, which had been statistically non-significant, all turned out to be significant. It was amazing to see how a two-day workshop had been able to help a PhD student improve the accuracy and quality of her work. From another point of view, it was also regretful to see that the supervisory

committee members did not have the sufficient statistical skills to help the student. The case is indeed warning as it could also be the case in other similar departments in other universities.

The second case, was another PhD student who stated that the workshop helped her see her results in many different ways. Eagerly she also participated in the subsequent intermediate and advanced workshops, which helped her see that she could use factorial ANOVA and calculate the joint effect of the two independent variables instead of simply runnig two one-way ANOVA tests. According to her, the workshop made her more confident about her since previously she had requested a colleague with only intermediate statistical skills to help her analyze her data. Now she knew what her data and findings really meant.

The final casewas a student who found out that rather than merely reporting descriptive statistics results, he could also use Chi-square goodness of fit test. He said that now his findings looked more scientific and were more generalizable because he could move one level deeper to inferential statistics and test hypotheses. As he pointed out, now he was more confident of the significance of the contribution of his study and was sure that he could publish it in a higher impact journal.

According to the students, whenever they needed statistical support, unfortunately they had to refer to other faculties, or they had to participate in workshops outside their faculty. Some of them had participated in some SPSS workshops advertised by independent researchers or held by other faculties. However, since the examples provided were not related to their research areas, those workshops had not been as helpful; not to mention that they usually had to pay some considerable amount of participation fee. Therefore, when asked whether they would register in an elective statistics course offered by the department, the students unanimously agreed that they definitely would.

Conclusion and Recommendations

The study examined the Applied Linguistics postgraduates students' attitudes toward statistics drawing on four components of attitudes by Schau et al. (1995), including affect, competence, value and difficulty. It was found that after a two-day workshop, the students tended to have more positive attitudes toward statistics. The study suggests that short-courses and workshops can significantly improve postgraduates students' attitudes toward this subject. As the literature review also indicated, most undergraduate and postgraduate students do not take statistics courses. Therefore, it is highly recommended that policy makers and curriculum developers think twice about the significance of statistical skills in some faculties which have traditionnaly been known to value qualitative methods more than quantitative methods. Educational practitioners and statistics instructors should also be encouraged to develop pedagogical approaches and instructional techniques which facilitate students learning of statistics and enable them to develop more positive attitudes toward statistics; however, further longitudinal research is necessary with larger sample sizes and at more advanced statistics workshops.

Statistics is oftem looked upon as a cold, intiguing, and thus anxiety-provoking subject by most lecturers and students in the area of Applied Linguistics, which may be due to the fact that commonly most research projects in this area follow qualitative data collection and analysis methods (Aleksandrovna Maximova and Aleksandrovich Belyaev, 2017). The situation becomes even more tense when an outsider from a different area and faculty comes to the language faculty to teach statistics. Statistics is one of those subjects that is hard to comprehend without relevant examples. It is crucial that different statistical methods be taught by giving examples which are related to the students' research areas. The instruction will turn out to be more effective when the learners can relate the examples to their own research projects.

This study provides further proof on the validity and reliability of the pre and post versions of SATS to assess the students' attitude and beliefs before and after a statistics course. Indeed, as Gal et al. (1997) also argued , similar to mathematics in statistics, attitude, achievement and persistence might affect each other. Therefore, it is suggested that statistical teachers evaluate students' attitudes to find out their presuppositions. Evaluation of students' attitudes toward statistics is important for statistics instructors and educational practitioners who can improve their teaching practice which in turn will improve their students' positive views toward statistics.

Reference

Ajzen, I. (1989). *Attitude structure and behavior*. Hillsdale, NJ: Lawrence Erlbaum.

Aleksandrovna Maximova, O & V. Aleksandrovich Belyaev (2017). Generational Indigenation in a Multi-Ethnic and -Religious Society (Tatarstan, Russia). Opción, Año 33, No. 84 (2017): 38-64.

Benson, J. (1989). Structural components of statistical test anxiety in adults: An exploratory model. *Journal of Experimental Education*, 57(3), 247-261.

Berk, R. A., & Nanda, J. P. (1998). Effects of jocular instructional methods on attitudes, anxiety, and achievement in statistics courses. *International Journal of Humor Research*, 11, 383-409.

Brunner, J.J & Ganga-Contreras, F. (2017). Vulnerabilidad educacional en América Latina: Una aproximación desde la sociología de la educación con foco en la educación temprana Opción, Año 33, No. 84 (2017): 12-37

Casem, R. Q. (2016). Effects of flipped instruction on the performance and attitude of high school students in mathematics. *European Journal of STEM Education, 1*(2), 37-44. https://doi.org/10.20897/lectito.201620

Chiese, F., & Primi, C. (2010). Cognitive and non-cognitive factors related to students' statistics achievement. *Statistics Education Research Journal*, 9(1), 6-26.

Cruise, R. J., Cash, R. W., & Bolton, D. L. (1985, August). The development and validation of an instrument to measure statistical anxiety. Paper presented at the meeting of the American Educational Research Association, Chicago.

Elmore, P. B., & Vasu, E. S. (1980). Relationship between selected variables and statistics achievement: Building a theoretical model. *Journal of Educational Psychology*, 46, 215-222

Escalera-Chávez, M. E., García-Santillán, A., Venegas-Martínez, F. (2014). Modeling Attitude toward Statistics by a Structural Equation. Eurasia Journal of Mathematics, Science and Technology Education, 10(1), 23-31. https://doi.org/10.12973/eurasia.2014.1019a

Estrada, A., Batanero, C., & Lankaster, S. (2011). Teachers' attitude towards statistics. In C. Batanero, G. Burrill, & C. Reading (Eds.), *Teaching statistics in school mathematics-Challenges for teaching and teacher education: A joint ICMI/IASE study* (pp. 163-174). Springer Science+Business Media B.V.

Gal, I., & Ginsburg, L. (1994). The role of beliefs and attitudes in learning statistics: Towards an assessment framework. *Journal of Statistics Education*, 2(2).

Gal, I., Ginsburg, L., & Schau, C. (1997). Monitoring attitudes and beliefs in statistics education. In I. Gal, & J. B. Garfield (Eds.), *The assesment challenge in statistics education* (pp. 37-51). Voorburg, The Netherlands: IOS Press.

Griffith, D. J., Adams, T. L., Gu, L. L., Hart, L. C., & Nichols-whitehead, P. (2012). Students' attitudes toward statistics across the disciplines: a mixed-methods approach. *Statistics Education Research Journal, 11(2), 45-56.*

Hannigan, A., Hegarty, A. C., & McGrath, D. (2014). Attitudes towards statistics of graduate entry medical students: The role of prior learning experiences. *BMC Medical Education 14*(70), 1-7.

Hogg, R. V. (1991). Statistical education: Improvements are badly needed. *The American Statistician, 45*, 342-343.

Hu, R., Xiaohui, S., Shieh, C.-J. (2017). A Study on the Application of Creative Problem Solving Teaching to Statistics Teaching. *Eurasia Journal of Mathematics, Science and Technology Education, 13*(7), 3139-3149.

Jatnika, R. (2015). The effect of SPSS course to students attitudes toward statistics and achievement in statistics. *International Journal of Information and Education Technology*, 5(11), 818-821.

Keshtkar M. M., (2017). Energy, exergy analysis and optimization by a genetic algorithm of a system based on a solar absorption chiller with a cylindrical PCM and nano-fluid, *Int. Journal of Heat and Technology, 35* (2), 416-420.

Keshtkar M. M., Talebizadeh, P., (2018). Investigation of transient conduction–radiation heat transfer in a square cavity using combination of LBM and FVM, *Sadhana, 43* (4), 145-155.

Keshtkar M. M.; Dadkhoda Zadeh M. (2018). Thermal Simulation of the Symmetric and Asymmetric Arrangement of Barriers on Heat Transfer Enhancement in a Porous Gas Heat Exchanger, Journal of Thermal Science and Engineering Applications, 10 (1), 120-135.

Keshtkar M.M. (2018). Numerical analysis of transcritical carbon dioxide compression cycle: a case study, 7 (1), 1-6.

Mills, J. D. (2004). Students' attitudes toward statistics: Implications for the future. *College Student Journal, 38*(3), 349–361.

Roberts, D. M., & Saxe, J. E. (1982). Validity of a statistics attitude survey: A follow up study. *Educational and Psychological Measurement, 42*(3), 907–912.

Schau, C. (2003). Students' attitudes: The "other" important outcome in statistics education. Paper presented at the Joint Statistical Meetings, San Francisco, CA. (Online: http://evaluationandstatistics.com/JSM2003.pdf)

Schau, C., Stevens, J., Dauphinee, T., & Del Vecchio, A. (1995). The development and validation of the survey of attitudes toward statistics. *Educational & Psychological Measurement, 55* (5), 868-876.

Tezer, M., Ozcan, D. (2015). A Study of the Validity and Reliability of a Mathematics Lesson Attitude Scale and Student Attitudes. *Eurasia Journal of Mathematics, Science and Technology Education, 11*(2), 371-379.

Waters, L. K., Martelli, T. A., Zakrajsek, T., & Popovich, P. M. (1988). Attitudes toward statistics: An evaluation of multiple measures. *Educational and Psychological Measurement, 48*(3), 513-516.

Wise, S. L. (1985). The development and validation of a scale measuring attitudes toward statistics. *Educational and Psychological Measurement, 45*(2), 401–405.

Zhang, Y., Shang, L., Wang, R., Zhao, Q., Li, C., Xu, Y., & Su, H. (2012). Attitudes toward statistics in medical postgraduates: Measuring, evaluating and monitoring. *BMC Medical Education,* 12(117), 1-8.