Attitude towards statistics among pre-service teachers of institute of teacher education

A A Mustam\textsuperscript{1*}, M Adnan\textsuperscript{1}, J Johnny\textsuperscript{2}, M A B Setambah\textsuperscript{3}

\textsuperscript{1}Faculty of Science and Mathematics (FSM), Sultan Idris Education University, Malaysia.
\textsuperscript{2}Institute of Teacher Education Temenggong Ibrahim Campus
\textsuperscript{3}Institute of Teacher Education Bahasa Melayu Campus

\textsuperscript{*} Corresponding author’s email: afianakhbaripgkti@gmail.com

Abstract. Statistics is increasingly being recognized as a necessary component in many colleges, universities and teacher training programs. The importance of this component of mathematics is essential to bettering one’s economic prospects, gaining employment, keeping employment, and obtaining better employment. The main objective of this study was to determine the attitude of pre-service teachers towards statistics. This study also aimed to investigate the relationship between attitude towards statistics with gender, major and campus respectively. The participants comprised of 80 undergraduates from the Institute of Teacher Education (IPG) who were enrolled in the preparatory programme for the bachelor’s degree in education; whereby, they need to undertake the Basic Statistics Course. They consisted of 3 main majors, namely, Malay Language; Physical Education and Health; and Design and Technology from two campuses which are Bahasa Melayu Campus and Temenggong Ibrahim Campus. The Survey of Attitudes toward Statistics (SATS 36) which was translated into Malay language and contains 36 items that assess six constructs \((r = .827)\) was used to answer the main objective of this study. The study found that the attitude of pre-service teachers towards statistics were ranked medium \((3.437)\).

1. Introduction
It is of utmost importance to expose students who pursue degree, diploma or certificate programmes to introductory statistics or fundamental statistics courses regardless of their field of study \([1-4]\). Despite many researchers emphasizing the importance of this course and being a vital component required for future employment, students appeared to view statistics in a negative light. Many students find statistics to be a stumbling block in academia instead of looking at it as a beneficial tool. This view is in line with findings obtained by many researchers that there exists anxiety towards statistics among students who undertook this course \([5-8]\).

The effect of this anxiety appeared to create negative impacts and lack of motivation, thus causing less interest towards fundamental statistics courses \([5, 9-11]\). Anxiety towards statistics, negative belief, lack of interest, and lack of motivation displayed by students will eventually show a weak attitude towards the use of statistics and data analyses. This in turn will influence the students' academic performance and conceptual understanding \([5, 12]\).
In order to ensure the success of students towards mastering fundamental statistical subjects, academic performance and conceptual understanding play a crucial role. A study by [13] showed that there is a significant relationship between anxiety in statistics with statistical attitudes. [4] also stated that if students portray negative attitudes toward statistics then it may affect their academic performance; while the positive attitude towards statistics could positively affect academic performance [5]. Negative attitudes towards statistics would not only affect the present; but also and future of students [14].

Statistics is a branch of science in mathematics. The use of this field in everyday life is widespread. Studying statistics is a necessity [1,9,10,15] to the extent that this course is made mandatory for all students who pursue the preparatory programme for the bachelor’s degree in education (PPISMP) at the Institute of Teacher Education Malaysia (IPGM). In fact, statistics has been incorporated at all levels of education from pre-school to tertiary education. The inclusion of statistics course was also evident in all undergraduate programs both locally and abroad [16].

Basic Statistics (GSA 1072) is one of the mandatory courses that must be taken by PPISMP students at IPGM. [17] This course is offered during the second semester of their program. The purpose of this course is to train skilled trainers in administering, analyzing and translating data accurately. They also learn about normal distribution and calculate the central tendency, dispersion and probability. Besides, the pre-service teachers should also be able to determine the correlation between two variables. Information and communication technology skills were also integrated in teaching and learning sessions. The outcome of this course is expected to be applied in everyday life and also assist these pre-service teachers when they are posted in school.

The attitude towards statistics may influence the level of student confidence, which in turn may have an impact towards their achievement in statistical subjects. In this study, the researchers aimed to study the attitude towards statistics among IPG pre-service teachers who took the subject of Basic Statistics and its relationship with gender, major and campus. The attitude towards statistics will be measured by using the Survey of Attitude Towards Statistics (SATS-36) questionnaire, that was developed by [18]. Originally the questionnaire consisted of 4 main domains i.e. effects, cognitive efficiency, value and difficulty (SATS-28). However, two new domains namely, business and importance were added into the instrument thus naming it SATS-36.

### 2. Method

A survey research design was used to investigate pre-service teachers’ attitude towards statistics. The sample involved 80 first year foundation programme students’ from two IPG campuses, namely, Bahasa Melayu Campus and Temenggong Ibrahim Campus who undertook the Basic Statistics course during their second semester in the 2018/2019 session. They consisted of three main majors: Malay Language; Physical Education and Health; and Design and Technology. Table 1 presents the description of the sample.

| Table 1: Demography of Sample |
|-----------------------------|
| **Gender** | **Frequency** | **Percentage** |
| Male | 29 | 36.25 |
| Female | 51 | 63.75 |
| **Major** | | |
| Malay Language | 26 | 32.50 |
| Physical Education and Health | 29 | 36.25 |
| Design and Technology | 25 | 31.25 |
| **Campus** | | |
| Bahasa Melayu Campus | 26 | 32.50 |
| Temenggong Ibrahim Campus | 54 | 67.50 |
The SATS-36 survey (Cronbach’s $\alpha = 0.827$) was administered online upon the samples after the fifth week of their course that assessed both cognitive and non-cognitive factors of the sample. This questionnaire has been translated into Malay to facilitate data collection process. The back-to-back translation process has been performed by a selected language specialist. There are 36 items in the survey form with six attitude components measured using a 5-point Likert Scale as [22]. The six attitude components consist of the following as described in [18]: (1) Effect – students’ feelings related to statistics; (2) Cognitive Competence – students’ attitudes related to their statistical intellectual knowledge and skills; (3) Value – students’ attitudes about the usefulness, relevance, and value of statistics in their personal and professional life; (4) Difficulty – students’ attitudes related to the difficulty of statistics as a subject; (5) Interest – students’ level of individual interest towards statistics; (6) Effort – the amount of work required from the students to learn statistics.

For the purpose of conducting the analysis, items with negative wordings were transformed into positive wordings. Data was analysed using the Statistical Package for Social Science (SPSS). In order to describe the level of the samples’ attitude toward statistics, descriptive statistics were used. Meanwhile, the Spearman correlation test was used to determine the relationship between attitude with gender, major and campus location respectively.

3. Result and Discussion

1.1. The Level of Attitude Toward Statistics Among Pre-service Teachers

Table 2 describes the mean, standard deviation and the minimum and maximum value of the level of attitude towards statistics.

| Descriptive Statistics | Value |
|------------------------|-------|
| Mean                   | 120.85|
| Standard Deviation     | 12.302|
| Minimum                | 87    |
| Maximum                | 151   |

The average value of 120.85 indicated that the pre-service teachers have a medium level of attitude towards statistics as interpreted in Table 3. This result means that the pre-service teacher have neither negative nor positive attitude towards statistics. In this study, the researchers used the Three levels of attitude in which a high-level score indicates a positive attitude towards statistics while a low-level score indicates vice versa.

| Level  | Range Score |
|--------|-------------|
| Low    | 36 – 84     |
| Medium | 85 – 132    |
| High   | 133 – 180   |

Table 4 outlines the mean score of the samples’ level of attitude towards statistics according to the six attitude components. The analyses show that the pre-service teachers have high positive attitude towards statistics in the the effort component with a mean of 4.28. Meanwhile, the interest and cognitive capability components show the positive attitude with means 3.60 and 3.72 respectively. A moderate attitude was observed in the affective and value component with means 3.24 and 3.21 respectively. However, the pre-service teachers indicated a negative attitude toward statistics with mean 2.66 in the difficulty component.
Table 4: Mean Score for Each Attitude Component

| Attitude Component | Mean  |
|--------------------|-------|
| Affective          | 3.24  |
| Value              | 3.21  |
| Interest           | 3.60  |
| Cognitive Capability | 3.72  |
| Difficulty         | 2.66  |
| Effort             | 4.28  |

This result obtained indicated an overall medium level of attitude towards statistics. This finding is consistent with [8] despite the difference in level of education of the sample in this study. The finding in this study also coincide with [14] where the effort component appeared to mark a high positive attitude towards statistics. Based on the findings, students are aware that statistical subjects are challenging and they are struggling to understand the concept as they know the importance of statistics [2, 16, 20, 25].

1.2. The Relationship Between Pre-Service Teacher’s Attitude Towards Statistics and Gender, Major and Campus Location.

The Spearman correlation test was used to investigate the relationship between attitude towards statistics according to gender, major and campus location. Based on Table 5, the analyses indicated a negative and very weak correlation between attitude toward statistics and gender (r=.048; p=.672). Referring to Guilford's correlation-correlation guideline, the level of interaction of these two aspects is very weak. Therefore, there can be no relationship between gender and attitude towards statistics. This study is consistent with the findings in [14].

Table 5: The Result of Spearman Correlation Test Between Pre-Service Teacher’s Attitude Towards Statistics and Gender

| Spearman's rho | Gender | Correlation Coefficient | Sig. (2-tailed) | N | Attitude |
|----------------|--------|--------------------------|-----------------|---|----------|
|                | Gender | Correlation Coefficient  | -0.048          | .672 |          |
|                | N      | 80                       | .              | 80 |          |
|               | Attitude | Correlation Coefficient  | .048            | 1.000 |        |
|                | Sig. (2-tailed) | .672                  | .              | 80 |          |
|                | N      | 80                       | .              | 80 |          |

Table 6 shows the relationship between attitude and the major of the pre-service teachers. The analyses indicated a positive but weak correlation between attitude towards statistics and their respective major (r=.153; p=.174). Hence, there is no significant differences in attitude according to the samples’ respective major.

Table 6: The Result of Spearman Correlation Test Between Pre-Service Teacher’s Attitude Towards Statistics and Major Taken.

| Spearman's rho | Major | Correlation Coefficient | Sig. (2-tailed) | N | Attitude |
|----------------|-------|--------------------------|-----------------|---|----------|
|                | Major | Correlation Coefficient  | .153            | .174 |        |
|                | Sig. (2-tailed) | .174                  | .              | 80 |          |
|                | N      | 80                       | .              | 80 |          |
|               | Attitude | Correlation Coefficient  | .153            | 1.000 |        |
|                | Sig. (2-tailed) | .174                  | .              | 80 |          |
|                | N      | 80                       | .              | 80 |          |

Table 7 shows the relationship between attitude towards statistics and its campus location. The analyses indicated a very weak correlation between attitude toward statistics and campus location (r=.074; p=.514). Hence, there exists no difference between the two-campus location despite one being in the capital city of Malaysia while the other is located in the southern region of Malaysia.
Table 7: The Result of Spearman Correlation Test Between Pre-Service Teacher’s Attitude Towards Statistics and Campus Location.

| Spearman's rho | Campus                  | Correlation Coefficient | Attitude Correlation Coefficient |
|---------------|-------------------------|--------------------------|----------------------------------|
|               |                        | 1.000                    | 0.074                            |
| Sig. (2-tailed)|                        | .                       | .514                             |
| N             | 80                      | 80                       | 80                               |

4. Conclusion
On the whole, it was evident that the level of the pre-service teachers in this study towards statistics is at a moderate level. Hence, the possible reason of students working harder or putting in more effort in order to overcome their difficulties when undertaking statistical courses in their programme of study. The correlation investigation in this study indicated that there is a weak relationship in attitude with gender, major taken and campus location. Therefore, it appears that these three factors do not portray any differences in their relation with attitude towards statistics. The findings in this study shows that there is a need to address the issue of mediocre attitude towards statistics among pre-service teachers in these campuses. This issue is somewhat important as statistics is a preparatory course to pave the way for pre-service teachers to instil within themselves the knowledge of basic statistics. Mastery in this course would somewhat assist pre-service teachers to conduct research in their final year project. Besides that, research is part and parcel of an educators’ life. Understanding basic statistics is of crucial value in enabling educators to conduct simple assessment and interpreting their results in order to further develop their students’ capabilities and performance at school.

5. References
[1] Ben-zvi D and Garfield J 2010 Introducing the Emerging Discipline of Statistics Education p. 355–361.
[2] Siswono T Y E, Hartono S and Kohar A W 2018 Effectiveness of project based learning in statistics for lower secondary schools Eurasian J. Educ. Res. 2018, 75 pp.197–212
[3] Wilks S S 2006 Undergraduate statistical education The American Statistician 60 1 pp.39-45
[4] Budé L, Wiel M, Van De Imbos T, Candel M Broers N and Berger M 2007 Students’ achievements in a statistics course in relation to motivational aspects and study behaviour Stat. Educ. Res. J. 6, 1 pp.5–21
[5] Schau C and Emmio lu E 2012 Do introductory statistics courses in the United States improve students’ attitudes? Stat. Educ. Res. J. 11, 2 pp.86–94
[6] Williams A S 2013 Worry, intolerance of uncertainty, and statistics anxiety Statistics Education Research Journal 12 1
[7] Hill D and Bilgin A A 2018 Pre-Service Primary Teachers’ Attitudes towards Mathematics in an Australian University Creative Education 9 4 pp.597-614
[8] Rosli M K, Maat S M and Rosli N, 2017 Students’ Attitude and Anxiety Towards Statistics : A Descriptive Analysis Res. Educ. Psychol. 1 11 pp.47–56
[9] Capshew T F 2005 Motivating social work students in statistics courses Soc. Work Educ. 24 8 pp.857–868
[10] Nolan M M Beran T and Hecker K G 2012 Surveys assessing students’ attitudes toward statistics: A systematic review of validity and reliability Stat. Educ. Res. J. 11 2 pp.103–123
[11] Schneider W R 2011 The Relationship Between Statistics Self-Efficacy, Statistics Anxiety , and Performance in an Introductory Graduate Statistics Course Univ. South Florida Sch. Commons p. 65
[12] Bayer T J 2016 Effects of Guided Project-Based Learning Activities on Students’ Attitudes Toward Statistics in an Introductory Statistics Course STEMPS Theses Diss.
[13] Finney S J and Schraw G, 2003 Self-efficacy beliefs in college statistics courses Contemp. Educ. Psychol. 28, 2 pp. 161–186
[14] Ashaari N S Judi H M Mohamed H and Tengku Wook T M, 2011 Student’s Attitude Towards Statistics course Procedia - Soc. Behav. Sci. 18 p. 287–294
[15] Shafie I 2008 Pengantar Statistik Sintok (Kedah: Penerbit Universiti Utara Malaysia)
[16] Chew P K and Dillon D B 2014 Statistics anxiety update: Refining the construct and recommendations for a new research agenda Perspectives on Psychological Science 9 2 pp.196-208
[17] Institut Pendidikan Guru 2018 Buku Panduan Akademik Program Persediaan Ijazah Sarjana Muda Perguruan (Cyberjaya: Kementerian Pendidikan Malaysia)
[18] Schau C 2003 Students’ Attitudes: the “Other” Important Outcome in Statistics Education In Proceedings of the joint statistical meetings pp. 3673-3681
[19] Creswell J W 2012 Educational research: Planning, conducting, and evaluating quantitative and qualitative research 4
[20] Rosli M K and Maat S M 2017 Attitude towards statistics and performance among post-graduate students AIP Conf. Proc. 1847
[21] Nik Azis N P 2014 Pengembangan nilai dalam matematik dan sains (Kuala Lumpur: Penerbit Universiti Malaya)
[22] Estrada A, Batanero C, Lancaster S 2011 Teachers’ attitudes towards statistics Teaching statistics in school mathematics-Challenges for teaching and teacher education Springer, Dordrecht pp. 163-174
[23] Chua Y P 2012 Kaedah Penyelidikan (Kuala Lumpur: McGraw-Hill Companies)
[24] Chua Y P 2016 Mastering Research Methods 2nd Edition (Kuala Lumpur: McGraw-Hill Companies)
[25] Hommik C and Luik P 2017 Adapting the survey of attitudes towards statistics (Sats-36) for estonian secondary school students Stat. Educ. Res. J. 16 1 p. 228–239.

Acknowledgments
We would like to acknowledge and express our appreciation to all the participants of this study in providing their invaluable responses for the purpose of this study.