

**ATTITUDES TOWARD REAL ANALYSIS AND ITS REFLECTION ON
ACADEMIC PERFORMANCE IN REAL ANALYSIS**
(*Sikap Terhadap Analisis Nyata dan Refleksinya ke atas Prestasi Akademik dalam Analisis Nyata*)

NURUL FAIZAH ZULKIFLI & ADEM KILICMAN*

ABSTRACT

Different students perceive the subject real analysis differently. However, the most common perception of real analysis is through four main aspects which are students' enjoyment, fear, anxiety and distress in learning, usefulness of real analysis in life and perceived achievement in the subject. These perceptions affect how students behave in class during real analysis and subsequently affect their attitudes and academic performance in real analysis. This present work studies the students' attitudes toward real analysis, their academic performance in real analysis and the relationship between these two attributes. The quantitative data for the present study is collected using the questionnaires of Mathematical Attitude Scale Concise Form (MAS Concise Form) and the Academic Success Inventory for College Students (ASICS) to measure students' attitudes toward real analysis and their academic performance in real analysis respectively. The differences in academic performance in real analysis between male and female students was also studied. Overall, it was found that students displayed moderate attitudes toward real analysis and moderate academic performance in real analysis, and there exists a significant relation between attitudes toward real analysis and academic performance in real analysis. However, it was found that there is no relation between students' gender and their academic performance in real analysis.

Keywords: real analysis; attitude; academic performance

ABSTRAK

Setiap pelajar mempunyai persepsi berbeza terhadap subjek analisis nyata subjek. Walau bagaimanapun, persepsi umum terhadap analisis nyata adalah melalui empat aspek utama iaitu keseronokan pelajar, ketakutan, kebimbangan dan kemurungan dalam pembelajaran, kebergunaan analisis nyata dalam kehidupan dan persepsi pencapaian dalam mata pelajaran. Persepsi ini mempengaruhi perlakuan pelajar di dalam kelas semasa analisis nyata dan seterusnya mempengaruhi sikap dan prestasi akademik mereka dalam analisis nyata. Kajian ini mengkaji sikap pelajar terhadap analisis nyata, prestasi akademik mereka dalam analisis nyata dan hubungan antara dua pembolehubah ini. Data kuantitatif untuk kajian ini dikumpul menggunakan soal selidik *Mathematical Attitude Scale Concise Form (MAS Concise Form)* dan *Academic Success Inventory for College Students (ASICS)* untuk mengukur sikap pelajar terhadap analisis nyata dan prestasi akademik mereka dalam analisis nyata. Perbezaan prestasi akademik dalam analisis nyata antara pelajar lelaki dan perempuan turut dikaji. Secara keseluruhannya, didapati pelajar menunjukkan sikap sederhana terhadap analisis nyata dan prestasi akademik sederhana dalam analisis nyata, dan wujud perhubungan signifikan antara sikap terhadap analisis nyata dan prestasi akademik dalam analisis nyata. Walau bagaimanapun, didapati tiada hubungan antara jantina pelajar dengan prestasi akademik mereka dalam analisis nyata.

Kata kunci: analisis nyata; sikap; prestasi akademik

1. Introduction

Real analysis is a subject under the branch of mathematics and is often offered in tertiary education. In real analysis class, the fundamental learning outcomes are to understand and develop proofs. However, due to the abstract nature of real analysis, students often have difficulties in mastering the subject. Due to this struggle, most students then developed a negative perception on the subject leading to a negative attitudes toward real analysis.

Attitudes toward learning alludes to a learning tendency of a student to behave in either an excellent manner or detestable manner. A positive attitude, if developed, is believed to improve students' learning experience. On the other hand, when students approach a subject with negative perceptions, it will indirectly affect their willingness to learn the subject and hence, also affect their academic performance in said subject.

To sum up, it is crucial to comprehend how attitudes toward learning real analysis can impact academic performance of undergraduates in Malaysia. This study assists educators with investigating a more extensive view and more profound figuring out on undergraduates concerning their academic performance in real analysis without bias. Consequently, the purpose of this study is to determine the relationship between students of the Department of Mathematics and Statistics, Universiti Putra Malaysia (UPM)'s attitudes toward real analysis and its reflection on their academic performance in real analysis.

1.1. Definition of terminology

Definition of terminology explains both conceptual and operational definition. For the purpose of this study, the definition of terminology is defined as below:

Attitudes Towards Real Analysis

- Conceptual Definition: Sets of emotions, beliefs and behaviours toward real analysis, a subtopic of mathematics.
- Operational Definition: Respondents' scores on the assessment of the adapted Mathematical Attitude Scale (MAS) in the questionnaire.

Academic Performance in Real Analysis

- Conceptual Definition: The measurement of student achievement across real analysis.
- Operational Definition: Respondents' scores on Academic Success Inventory for College Students (ASICS) (general academic skills subscale and internal motivation/ confidence subscale).

1.2. Problem Statement

Different students perceive the subject real analysis differently. However, the most common perception of real analysis is through four main aspects: students' enjoyment, fear, anxiety and distress in learning, usefulness of real analysis in life and perceived achievement in the subject. As indicated by Yaşar (2014), undergraduates' mentality towards mathematics significantly impacts their scholastic exhibition. On the off chance that their mentality is positive, a positive outcome will be proven on their scholarly execution and moreover.

According to the Sijil Pelajaran Malaysia (SPM) 2019 Results Analysis Report by Kementerian Pendidikan Malaysia (KPM), there was an increment of 0.4% of students who fail mathematics in SPM 2018 (Khalid *et al.* 2020). Also, Doruk and Kaplan (2015), in their study discovered that less than one-tenths students managed to prove theorems correctly with

a large percentage of them ended up leaving the questions blank. Chand (2021) added that the undergraduates students found it challenging to prove because they had trouble using definitions and logic, and comprehending the symbols, notations, and concepts that were employed in the theorem. These research's findings lead to the conclusion that pupils struggle to comprehend and build proofs.

According to Ngussa and Mbuti (2017), there are several factors that contribute to the high failure rates in mathematics and ultimately disorient students' learning. These findings open up a new line of inquiry towards characterising and comprehending the numerous variables that could affect students' learning ability in real analysis. This will make it easier to come up with realistic plans of action for the future, improving real analysis pass rates.

Moreover, limited studies have been conducted regarding attitudes toward real analysis and its reflection on academic performance in real analysis among university students. Most of the previous studies only focused on the independent variable (attitudes toward mathematics and attitudes toward real analysis) in general without the correlation to academic performance.

Therefore, this study is aimed to determine the relationship between attitudes toward real analysis and academic performance in real analysis among UPM students.

1.3. Research questions

- (1) What is the level of attitudes toward real analysis and academic performance in real analysis among students in UPM?
- (2) Is there any relationship between attitudes toward real analysis and academic performance in real analysis among students in UPM?
- (3) What is the difference in academic performance in real analysis between male and female students in UPM?

1.4. Research objectives

Generally, the aim of this study is to investigate the relationship between attitudes toward real analysis and its reflection on academic performance in real analysis among students in UPM. Specifically, this study aims to:

- (1) Describe students' background (age, sex, and educational background), attitudes toward real analysis and academic performance in real analysis among students in UPM.
- (2) Investigate the relationship between attitudes toward real analysis and academic performance in real analysis among students in UPM.
- (3) Compare the differences in academic performance in real analysis between male and female students in UPM.

1.5. Hypotheses

The hypotheses of the study are as follows:

H_{01} : There is no significant relationship between attitudes toward real analysis and academic performance in real analysis among students in UPM.

H_{02} : There is no significant difference in academic performance in real analysis between male and female students in UPM.

1.6. Significance of research

Current study is vital in several aspects, and it benefits several groups which are students and educators. It contributes to the growing understanding of factors affecting academic performance in real analysis among university students where in this study, the factor is students' attitudes toward real analysis. Students should identify their level of attitudes toward real analysis to achieve better performance academically. Besides, this study also raises the awareness for educators to understand students' attitudes toward learning real analysis. Educators can work with each student personally to improve their attitudes toward real analysis and indirectly improve their academic performance in the subject.

2. Methodology

This chapter discusses the methodology that was used to conduct the research, including research design, population and sampling selection, instrumentations, data collection and data analysis (reliability analysis).

2.1. Research design

This research employed a quantitative research approach to study how attitudes toward real analysis reflects on academic performance in real analysis among students in UPM. Survey method with self-administered online questionnaires has been used as a tool for data collection in this research. A large group of university students in the Department of Mathematics and Statistics, Faculty of Science, UPM were observed and surveyed to provide data of students' background, attitudes toward real analysis and academic performance in real analysis. Also, this research was conducted using correlational designs to determine the relationship between attitudes toward real analysis and academic performance in real analysis. The correlational design allows to determine the extent of which one independent variable (attitudes toward real analysis) correlates with the dependent variable (academic performance in real analysis).

2.2. Population and sample selection

The target population for this research was undergraduate students from the Department of Mathematics and Statistics, Faculty of Science, UPM and the samples of this research were obtained from the sample population. Year 3 and Year 4 undergraduate students from the Department of Mathematics and Statistics, Faculty of Science, who have registered for real analysis, were selected as the sample for this research.

In this research, the voluntary response sampling was used to select the sample size. The sample size was 60 respondents from the total number of undergraduate students in the Department of Mathematics and Statistics, Faculty of Science, UPM.

2.3. Instrumentation

In this research, two instruments were used to examine variables of attitudes toward real analysis and academic performance in the subject. Data collection was gathered and conducted through the distribution of online questionnaires to undergraduate students at the Department of Mathematics and Statistics, Faculty of Science, UPM. The questionnaire consisted of three sections as below:

Section A: Demographic information (Student background)

Section B: Attitudes toward real analysis

Section C: Academic performance in real analysis

2.3.1. Demographic information

In section A, respondents were asked to provide their age, sex, course, year of study and whether have they taken real analysis before. All information was collected through a prepared self-administered questionnaire.

2.3.2. Attitude towards real analysis

In this research, the Mathematics Attitude Scale (MAS) Concise Form is used as the instrument to assess respondents' attitudes toward real analysis (section A). The MAS Concise Form was modified by Yaşar (2014) to measure high school students' attitudes toward mathematics, with respects to their gender, high school types and geographic regions where the students live. In this study, the MAS Concise Form was adapted to satisfy the independent variable (attitudes toward real analysis).

This instrument is a self-report instrument with a 5-point Likert scale response format ((1) strongly disagree; (2) disagree; (3) neither agree nor disagree; (4) agree; (5) strongly agree). The original version of this instrument consists of 35 items while the modified, concise form version consists of 19 items. However, in this study, only 11 items were selected to be tested as the remaining eight items are similar in meaning. The selected items are categorised into four subscales: (i) enjoyment (2 direct-scored items), (ii) fear, anxiety and distress (4 reverse-scored items), (iii) usefulness of real analysis in life (2 direct-scored items) and (iv) perceived real analysis achievement (2 direct-scored items and 1 reverse-scored item). All reverse-scored items' mean scores will be reversed prior to data analysis in order to maintain the mean score interpretation (ie. a high mean score indicates a high attitudes toward real analysis).

The MAS Concise Form is scored by calculating the mean score for each factor and items. The mean interpretation of each item in this scale is categorised into three: low (1.00 – 2.33), moderate (2.34 – 3.66) and high (3.67 – 5.00) (Puteh *et al.* 2015). A low mean score indicates that students generally have negative or low attitudes toward real analysis and a high mean score indicates the opposite while a moderate mean score indicates that students' attitudes toward real analysis is moderate.

Example of items from the instrument includes:

- (1) I enjoy learning math problems whenever I see them (Enjoyment)
- (2) I'm so bored in math class (Fear, anxiety and distress)
- (3) I believe that the knowledge I get in mathematics class was useful in life (usefulness of mathematics in life)
- (4) My friends think that I'm successful at mathematics (Perceived mathematics achievement)

In this study, all items in the instrument were adapted to reflect on attitudes toward real analysis. Example of adjusted items from the instrument includes:

- (1) I enjoy learning real analysis problems whenever I see them (Enjoyment)
- (2) I'm so bored in real analysis class (Fear, anxiety and distress)
- (3) I believe that the knowledge I get in real analysis class was useful in life (Usefulness of real analysis in life)

- (4) My friends think that I'm successful at real analysis (Perceived real analysis achievement)

The reliability of the scale, the Cronbach alpha coefficient is 0.956 (Yaşar 2014).

2.3.3. Academic performance in real analysis

The Academic Success Inventory for College Students (ASICS) is an instrument consisting of 50-items (Prevatt *et al.* 2011), used to measure academic success of undergraduate students (section B). This instrument covered 10 subscales: (i) general academic skills (12 direct-scored and 13 reverse-scored items), (ii) internal motivation/ confidence (7 direct-scored items and 1 reverse-scored item), (iii) perceived instructor efficacy (1 direct-scored item and 4 reverse-scored items), (iv) concentration (2 direct-scored items and 2 reverse-scored items), (v) external motivation/ focus (4 direct-scored items), (vi) socialising (4 reverse-scored items), (vii) career decidedness (3 direct-scored items and 1 reverse-scored item), (viii) lack of anxiety (3 reverse-scored items), (ix) personal adjustment (3 reverse-scored items) and (x) external motivation/ current (3 direct-scored items).

For this research purpose, only general academic skills subscale (5 direct-scored items) and internal motivation/ confidence subscale (3 direct-scored items and 1 reverse-scored item) were taken into consideration. Example of items from the instrument includes:

- (1) I studied the correct material when preparing for tests in this class (General academic skills)
- (2) I worked hard to prove I could get a good grade (General academic skills)
- (3) I got satisfaction from learning new material in this class (Internal motivation/ confidence)
- (4) I was pretty sure I could make an A or B in this class (Internal motivation/ confidence)

Also, with respect to the research's subject, real analysis, the assessed instrument was adapted to the respondents' academic performance in real analysis. Example of the adapted items from the instrument includes:

- (1) I studied the correct material when preparing for tests in real analysis class (General academic skills)
- (2) I worked hard to prove I could get a good grade in real analysis (General academic skills)
- (3) I got satisfaction from learning new material in real analysis class (Internal motivation/ confidence)
- (4) I was pretty sure I could make an A or B in real analysis class (Internal motivation/ confidence)

The ASICS applied a 7-point Likert scale with the following stems: (1) strongly disagree, (2) moderately disagree, (3) slightly disagree, (4) neither agree nor disagree, (5) slightly agree, (6) moderately agree, (7) strongly agree. The mean scores for this scale are calculated and categorised into three levels: low (1.00 - 2.99), moderate (3.00 - 4.98) and high (4.99 - 7.00). High scores indicate that students generally have positive functioning related to academic success while low scores indicate the opposite (Prevatt *et al.* 2011). A moderate mean score indicates that students' academic performance in real analysis is moderate. Every negatively worded items' score was reversed to ensure a consistent interpretation of scores' meaning is maintained - high scores indicates positive academic performance in real analysis and vice versa.

2.4. Data collection

The self-administered questionnaire is used in this research to collect data from respondents. The data was collected through the distribution of the questionnaire by email among year 3 and year 4 undergraduate students of the Department of Mathematics and Statistics, Faculty of Science, UPM. The questionnaire was distributed to the respondents to be filled in and the respondents were informed beforehand of the purpose and procedure of the research. Each respondent is required to answer all questions in all sections.

Respondents were required to answer the demographic section which included student background, section B which consists of 11 items to examine attitudes towards real analysis and section C which consists of 9 items to examine their academic performance in real analysis. The questionnaire was conducted in English.

2.5. Data analysis

The raw data obtained from the questionnaire was transcribed and analysed using Statistical Package for the Social Sciences (SPSS) software version 26.0. Data were analysed based on research objectives and hypotheses.

In this research, the independent variable, which is the attitudes toward real analysis and the dependent variable, which is academic performance were analysed to determine the correlation and differences. Data analysis was done using three statistical measures: descriptive analysis (univariate analysis), Pearson correlation test (bivariate analysis) and independent samples *t*-test. Descriptive statistics summarise the characteristics of a data set in the form of frequency distribution, central tendency, and dispersion while inferential statistics (ie. Pearson correlation analysis and independent samples *t*-test) test a hypothesis or assess whether the data is generalisable to the broader population.

Table 1 shows the summary of data analysis for the actual work which is in line with the objectives that were investigated.

Table 1: Data analysis for attitudes toward real analysis and its reflection on academic performance in real analysis

Data analysis	Objectives
Descriptive Statistic	Objective 1
Pearson Correlation	Objective 2
Independent Samples <i>t</i> -Test	Objective 3

3. Result and Discussion

This section's primary purpose was to present and discuss the findings from the self-administered questionnaire that was designed. This chapter covered three subtopics including descriptive analysis (univariate analysis), Pearson's correlation test (bivariate analysis) and independent samples *t*-test.

3.1. Descriptive analysis (univariate analysis)

This current study involved 60 respondents from the Department of Mathematics and Statistics, Faculty of Science, UPM who were selected to answer the questionnaire. This

section described the findings for student background, attitudes toward real analysis, and academic performance in real analysis among UPM students. The data were presented using descriptive analysis in the following ways: frequency, percentage, mean, standard deviation, minimum, and maximum. This analysis was done to achieve objective 1 of the study.

3.1.1. Description of student background

This section described a general profile of students' background. Students' backgrounds that were gathered in the study included age, gender, course of study, and a question of whether the respondents had taken real analysis or not. Table 2 represents the summary of students' background.

Table 2: Description of students' background (n=60)

Items	n (%)	Mean	s.d.	Min.	Max.
Age		22.47	0.89	21	25
21 and below	5 (8.30)				
22-24	53 (88.40)				
25 and above	2 (3.30)				
Gender					
Male	25 (41.70)				
Female	35 (58.30)				
Course of study					
BSc. Mathematics (Hons)	41 (68.30)				
BSc. Mathematics with Education (Hons)	19 (31.70)				
Year of study					
Year 3	24 (40.0)				
Year 4	36 (60.0)				
Have you taken real analysis before?					
Yes	60 (100.00)				
No	0 (0)				

Note: s.d. = standard deviation, Min. = Minimum, Max. = Maximum

As shown in Table 2, a total of 60 respondents were selected for this study. The table illustrates the youngest and oldest ages of the students ranging from 21 years old to 25 years old. According to the results obtained, 5 (8.30%) of respondents were UPM students of age 21 years old and below. Most of the respondents, 53 (88.40%), were of age 22- 24 years old. It was apparent from this table that only a few students of age 25 years old and above answered the questionnaire, which was only 2 (3.30%) respondents out of 60 respondents. The average for students' age was 22.47 years old with the standard deviation of 0.89. As can be seen from the table above, there were 35 (58.30%) female students and 25 (41.70%) male students participating in this study.

On the other hand, respondents for this study are students majoring in Bachelor of Science in Mathematics (Hons) ($n = 41, 68.30\%$) and Bachelor of Mathematics with Education (Hons) ($n = 19, 31.70\%$). As for the year of study, 24 (40.00%) are year 3 students and 36 (60.0%) are year 4 students.

Lastly, all respondents ($n = 60, 100.00\%$) involved in this study has taken up real analysis before.

3.1.2. Description of attitudes toward real analysis

The Mathematics Attitude Scale Concise Form (MAS Concise Form) used in this study was adapted in regard to real analysis instead of mathematics in order to study the attitudes toward real analysis. All 11 items are measured on a 5-point Likert scale.

The mean score of each item factors (enjoyment, fear, anxiety and distress, usefulness of real analysis in life and perceived real analysis achievement) were calculated to get the average mean score for each factor. The mean score for all items were then analysed to determine the level of attitudes toward real analysis.

The mean score for attitudes toward real analysis were divided into three levels: low, moderate, and high. The low level of attitudes toward real analysis indicated that students are behaving poorly towards real analysis and generally does not like the subject while high level indicated that students have positive attitude and behave excellently in real analysis. Below is Table 3 which displays the description of students' attitudes toward real analysis.

Table 3: Description of attitudes toward real analysis

	<i>n</i> (%)	Mean	Mean interpretation
Attitudes toward real analysis		2.42	Moderate
	31 (51.7)	1.00 – 2.33	Low
	24 (40.0)	2.34 – 3.66	Moderate
	5 (8.3)	3.67 – 5.00	High

From Table 3, results for the independent variable (attitudes toward real analysis) showed that in overall, the scale has a mean of 2.42 and was interpreted as moderate. Most students ($n = 31, 51.7\%$) achieved low mean interpretation. 24 (40.0%) students achieve moderate mean scores interpretation while the remaining 5 (8.3%) students achieved high scores interpretation. These data revealed that half of the students in this study displayed a poor attitude in regard to learning real analysis.

3.1.3. Description of academic performance in real analysis

The Academic Success Inventory for College Students (ASICS) was used in this study to measure students' academic performance in real analysis. The items used were adjusted to specifically measure academic performance in regard to real analysis. All 9 items are measured on a 7-point Likert scale.

The mean score of each subscale (general academic skills and internal motivation/confidence) were calculated and the mean score for overall academic performance and each item was also divided into three levels: low, moderate, and high. Low level of academic performance in real analysis revealed that students generally have a below average

performance in real analysis which reflected negatively in their grade for the subject and vice versa. Table 4 below shows the description of overall academic performance in real analysis.

Table 4: Description of academic performance in real analysis

	<i>n</i> (%)	Mean	Mean Interpretation
Academic performance in real analysis		4.18	Moderate
	6 (10.0)	1.00 – 2.99	Low
	40 (67.7)	3.00 – 4.98	Moderate
	14 (13.3)	4.99- 7.00	High

From Table 4, it can be observed that overall, UPM students displayed moderate academic performance in real analysis with a mean score of 4.18. 40 (67.7 %) students displayed moderate academic performance followed by 14 (13.3 %) students with high academic performance and 6 (10.0 %) with low academic performance.

3.2. Pearson’s correlation test (bivariate analysis)

In this section, the correlation between attitudes toward real analysis and academic performance in real analysis among UPM students were determined in bivariate analysis through Pearson’s correlation test. The correlation between these variables is in line with objective 2. The results were also discussed in line with the specific hypothesis, H_{01} . In order to reject the null hypothesis, a significant level of $p < 0.05$ must be achieved. Otherwise, the hypothesis failed to be rejected. The result is illustrated in Table 5.

Table 5: Correlation matrix (lower triangle) for attitudes toward real analysis and academic performance in real analysis

Variables	<i>r</i>
Academic Performance in Real Analysis	0.648**

Note: ** $p < 0.01$

H_{01} : *There is no significant relationship between attitudes toward real analysis and academic performance in real analysis among students in UPM.*

The finding revealed that there was a significant relationship between attitudes toward real analysis and academic performance in real analysis ($r = 0.648$, $p < 0.01$). Hence, H_{01} was rejected. The finding was consistent with previous studies which found that attitudes toward real analysis has a significant directly proportional relation to academic performance in real analysis. Hence, the results implied that a student with a positive attitude toward real analysis can see a positive reflection on their academic performance in said subject and vice versa (Mazana *et al.* 2019). Students who seek to improve their academic performance in real analysis may pursue various courses of action, one of them is they may attempt to improve their attitudes toward real analysis to a better, positive attitude.

3.3. Independent sample *t*-test

Independent sample *t*-test analysis was conducted to test the significant difference in academic performance in real analysis among male and female UPM students (objective 3). The tests were carried out based on the H_{02} . For a hypothesis to be accepted, the *p*-value must be less than 0.05, otherwise the result is insignificant. The results were shown in Table 6.

Table 6: Difference in academic performance in real analysis between male and female students in UPM

Variable	Gender		<i>t</i>	<i>p</i>
	Male	Female		
	Mean	Mean		
Academic performance in real analysis	4.34	4.07	-1.03	0.308

H_{02} : There is no significant differences in academic performance in real analysis between male and female students in UPM

The result from Table 6 shows the mean of academic performance in real analysis among male UPM students was 4.34 while the mean academic performance in real analysis among female UPM students was 4.07. This indicated that both male and female students display moderate academic performance in real analysis with male students exhibiting a slightly higher level of academic performance in real analysis than female students. However, the result indicated that there was no significant difference in academic performance in real analysis between male and female UPM students ($p \geq 0.05$ and $t = -1.03$). Hence, H_{02} failed to be rejected. This finding was in line with the previous study by Widlund *et al.* (2020), where both genders showed the same level of academic performance in class.

3.4. Summary

Table 7 represents the summary of findings of this study. Out of 2 tested hypotheses, there were 1 hypothesis rejected and 1 hypothesis which failed to be rejected.

Table 7: Summary of findings

Null Hypothesis	Type of Test	Results	Status
H_{01} : There is no significant relationship between attitudes toward real analysis and academic performance in real analysis among students in UPM.	Pearson's correlation	$r = 0.648$ $p < 0.01$	Rejected
H_{02} : There is no significant difference in academic performance in real analysis between male and female students in UPM.	<i>t</i> -test	$t = -1.03$ $p = 0.308 > 0.05$	Failed to be rejected

4. Conclusion

In general, this paper focused on the investigation of the relationship between attitudes toward real analysis and academic performance in real analysis. From descriptive analysis, the results indicated that UPM students displayed moderate (mean score = 2.42) attitudes toward real analysis and moderate (mean score = 4.18) academic performance in real analysis.

From the Pearson correlation test, the result revealed that there was a significant relationship between attitudes toward real analysis and academic performance in real analysis ($r = 0.648$, $p < 0.01$). In other words, the high value in attitudes toward real analysis resulted in high value in the academic performance in real analysis and likewise.

The result from the independent sample t -test analysis showed that there was no significant difference in academic performance in real analysis between male and female students in UPM ($t = -1.03$, $p > 0.05$). Therefore, it was found that genders play no role in determining students' academic performance in real analysis.

References

- Chand H.B. 2021. Difficulties experienced by undergraduate students in proving theorems of real analysis. *Scholars' Journal* **4**(1): 149-163.
- Doruk M. & Kaplan A. 2015. Prospective mathematics teachers' difficulties in doing proofs and causes of their struggle with proofs. *Bayburt University Journal of Education Faculty* **10**(2): 315-328.
- Khalid F.A.M., Rozaimi N.N.A.A. & Taha H. 2020. Perlakuan metakognitif pelajar tingkatan empat di sekolah Hulu Selangor dalam menyelesaikan masalah matematik. *Journal of Science and Mathematics Letters* **8**(2): 74-85.
- Mazana M.Y., Montero C.S. & Casmir R.O. 2019. Investigating students' attitudes toward learning mathematics. *International Electric Journal of Mathematics Education* **14**(1): 207-231.
- Ngussa B.M. & Mbuti E.E. 2017. The influence of humour on learners' attitude and mathematics achievement: A case of secondary schools in Arusha City, Tanzania. *Journal of Educational Research* **2**(3): 170-181.
- Prevatt F., Li H., Welles T., Festa-Dreher D., Yelland S. & Lee J. 2011. The academic success inventory for college students: Scale development and practical implications for use with students. *Journal of College Admission* **211**: 26-31.
- Puteh M., Che Ahmad C.N., Mohamed Noh N., Adnan M. & Ibrahim M.H. 2015. The classroom physical environment and its relation to teaching and learning comfort level. *International Journal of Social Science and Humanity* **5**(3): 237- 240.
- Widlund A., Tuominen H., Tapola A. & Korhonen J. 2020. Gendered pathways from academic performance, motivational beliefs, and school burnout to adolescents' educational and occupational aspirations. *Learning and Instruction* **66**: 101299.
- Yaşar M. 2014. Short form of "mathematics attitude scale": Its psychometric properties. *Pakistan Journal of Statistics* **30**(6): 1267-1277.

Department of Mathematics and Statistics,
Faculty of Science, Universiti Putra Malaysia
43400 UPM Serdang
Selangor DE, MALAYSIA
E-mail: nurulfaizahzul@gmail.com, akilic@upm.edu.my*

Received: 5 May 2023

Accepted: 15 August 2023

*Corresponding author