Students’ Perception in Learning Mathematics across Gender and Ethnicity

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Abstract. This study attempts to integrate students’ perceptions in mathematics knowledge in answering and explaining problems of mathematics learning that is presence in the classroom. The survey instrument used in this study called “Students’ Perception on Mathematics Survey”(SPMS). All the marks and data gathered were tabulated, summarized, and analyzed using the Statistical Package for Social Sciences (SPSS) version 18. ANOVA analysis was used to analyze the data gathered. The data analysis reveals that there is no relationship between perception in mathematics across gender and ethnicity. It is recommended that future research employs bigger sampling for generalization purposes. In this way, results from this study may help to improve teachers’ teaching methods in mathematics as well as to enhance students’ academic performance in mathematics.

1. Background of the Study

Students’ perceptions about mathematics are related to their perception in learning mathematics. Mathematics perception is defined as how students personally view mathematics as a subject, and how they feel and think about learning the subject. The perceptions of the students regarding mathematics and mathematics teaching have been considered as a very significant factor underlying their school experiences and achievements[1][2]. However, there is evidence that shows the lack of research exploring mathematics perception, mathematics skills, and mathematics achievement among Malaysian secondary school students, thus a more specific study is warranted [3]. Therefore, more investigations on students’ perceptions about mathematics and its impact towards students’ overall academic achievement in school and later on in their future careers need to be conducted [3].

Mathematics achievement is a subject of much interest and of utmost importance in the secondary school [4][5]. Mathematics achievement is defined as a method to measure the ability of students to understand, analyse, and answer specially designed test items based on the standard syllabus. In the present ever-demanding success-oriented society, mathematics achievement is often seen as a key factor in ensuring the success of a student in the school system [6].

2. Statement of the Problem

The major notion or perception that mathematics is a very difficult subject to learn, together with mathematics being labelled negatively among students in schools, makes this study even more vital.
Thus, both arguments discussed earlier in this section pave the way for the term “math anxiety” to surface and slowly conquer students’ mind. Various studies have been conducted to address the problems of mathematics anxiety, yet the results are mixed.

Furthermore, it is interesting to note that not many studies have been done to explore all the above issues. This is more so when addressing issues across genders and ethnicities in Malaysian context [7]. What are the perceptions of Malaysian male and/or female students across the major ethnic groups about their own mastery of mathematics and why they find learning mathematics is such a tough subject? All these are real issues currently present in secondary schools in Malaysia but yet are not empirically investigated.

Therefore, this study attempts to integrate a well-known mathematical theory called the APOS Theory into students’ perceptions and mathematics knowledge in answering and explaining the problems that occur during the process of learning mathematics in the classroom. It is hoped that through this study, students and teachers can apply and utilise the principles in APOS Theory to better understand the subject and they will be able to propose solutions to the existing problems of learning mathematics in the classroom.

3. Objective of the Study
The aim of this study is to relate students’ perceptions towards learning mathematics and their achievements across two background variables, which are gender and ethnicity. In this study, the ethnics involved are only the three major races in Malaysian society, which are the Malay, Chinese, and Indian.

4. Research Questions
1. Are there any significant differences in terms of perceptions towards learning mathematics across genders among the selected students?
2. Are there any significant differences in terms of perceptions towards learning mathematics across ethnicities among the selected students?

5. The Significance of the Study
The results of this study will shed more light on the possible differences in perceptions across genders and ethnicities. The results will not only explain the potential differences in performances between male and female students, but also across the three major races.

6. Limitation of the Study
This study is limited in several aspects. This study only focuses on the selected samples, i.e., among form-one students due to time and resource constraints, besides issue of availability of the students in the schools. The samples for this study were from selected urban schools in Kuantan, Pahang only. No students from rural schools were involved. Thus, the results cannot be generalised to a wider population.

7. Mathematics in Malaysia
Among all the subjects taught in Malaysian secondary school, Mathematics is among the difficult subjects. The reason mathematics is known to be difficult is because it is almost entirely deals with abstract concepts [8]. Examples of those abstract concepts are limit, infinity, differentiation and so forth. Students usually learn better when they can see the concept concretely. Another problem in mathematics is due to the fact that secondary school students generally fear mathematics subject more than other subjects [9][10]. This fear may be the result of students perceiving that mathematics is a very difficult subject together with the notion that mathematics is a boring and dry or uninteresting subject. All these reasons may result in students having low scores in their school mathematics examination. Subsequently, due to all the reasons above, mathematics is seen to be unpopular subject
among secondary school students. Therefore this makes learning mathematics a real challenge for students in school. The problem is seen to affect Malaysian students much more than the rest [11].

8. APOS as A Tool in Mathematics
APOS theory helps us to analyse data and by using the theory to explain the data or results can lead to changes in the theory. Usually, the genetic decomposition in the original theoretical analysis is revised and refined as a result of the data. In rare cases, it may be necessary to enhance the overall theory. An important example of such a revision is the incorporation of the triad concept of Piaget and Garcia, which leads to a better understanding of the construction of schemas. The enhancement of the theory was introduced by Clark, et al. who reported on students’ understanding of the chain rule, and it is being further elaborated upon in three other studies namely sequences of numbers (Mathews, et al., the chain rule and its relation to composition of functions, and the relations between the graph of a function and properties of its first and second derivatives [12][13][14][15].

9. Methodology
This quantitative study aimed to assess students’ perception towards mathematics together with the application of APOS Theory. This study was an explanatory type of study, which made use of a survey, and also included correlation as a part of the research design. According to Creswell, correlational study provides an opportunity to see relationships between the relevant variables [16]. This type of study works when the researcher wants to relate two or more variables and thus useful in predicting the outcomes. Hence, the study used a survey which was designed to obtain the precise information from the current state of phenomenon and to get valid conclusion. A set of questionnaires was used as an instrument for the collection of data needed from the participants selected in the study.

10. Population
The population selected for this study was all form-one students from secondary schools in the district of Kuantan, Pahang. Since this study was a purposive study, only 5 schools were selected to participate. These five schools were selected based on their overall performance as assessed by the Kuantan Educational Department. The schools were 2 cluster schools, namely SMK Abdul Rahman Talib (SMART) and SMK Sultan Abu Bakar (SMKSAB), and the remaining 3 schools were ordinary government schools, namely SMK Sg. Isap, SMK Cenderawasihnd, and SMK Tengku Panglima Perang (SMKTPP).

11. Research findings
This section summarises the analysis of the data collected from the respondents. The analysis shows the characteristics of the respondents and provides answers to questions regarding students’ general perception towards Mathematics. The analysis also assesses the relationship between students’ perception towards Mathematics and their Mathematics achievement. In addition, independent variables namely gender, ethnicity, and school are included in the analysis in order to describe students’ perception towards Mathematics. Descriptive data, t-test for mean comparison, analysis of variance (ANOVA), and correlation are used to answer the research question.

| Table 1. Distribution of Samples According to Race |
|-----------------------------------------------|
| School | Race | Total |
|        | Malay | Chinese | Indian |        |
| SMART  | 23    | 8       | 9      | 40     |
| SMKSAB | 17    | 13      | 10     | 40     |
| SMK Sg.Isap | 19    | 14      | 7      | 40     |
| SMK Cenderawasih | 16    | 15      | 9      | 40     |
| SMKTPP | 16    | 14      | 10     | 40     |
| Total  | 91    | 64      | 45     | 200    |
Table 1 shows the distribution of samples based on ethnicity and school of the respondents. In terms of number of students among the three ethnicities from the five schools, Malay students were the highest. Out of the total 200 respondents, 91 were Malays, 64 were Chinese, and 45 were Indians.

For Malay students, 23 students were from SMART, 19 students were from SMK Sg. Isap, 17 students were from SMKSAB, and the remaining 32 students were equally distributed between SMK Cenderawasih and SMKTPP.

For Chinese students, the highest number was from SMK Cenderawasih (n=15), 28 students were equally distributed between SMK Sg. Isap and SMKTPP, 13 students were from SMKSAB, and 8 students were from SMART.

For Indian students, 20 students were equally distributed between SMKSAB and SMKTPP, and another 18 students were equally distributed between SMK Cenderawasih and SMART. The remaining 7 students were from SMK Sg. Isap.

11.1 Students’ perception towards Mathematics based on gender

### Table 2. Independent t-test: SPMS Scores and Gender

|                          | Mean  | SD    | df  | t    | p    |
|--------------------------|-------|-------|-----|------|------|
| Total Score (Action)     | 0.0507| 0.08193| 198 | 0.619| 0.537|
| Total Score (Process)    | -0.00805| 0.07693| 198 | -0.105| 0.917|
| Total Score (Object)     | 0.03117| 0.08440| 198 | 0.369| 0.712|
| Total Score (Schema)     | -0.01423| 0.07219| 198 | -0.197| 0.844|

Note: equal variances assumed. *p<0.05

An independent t-test was computed to compare gender difference in students’ perception towards Mathematics. Based on Table 2, the results were interpreted by using the t-test at p < 0.05, level of significance. Output for Levene’s test for equality of variances in Action total score indicated a statistically non-significant p-value of 0.061, which was larger than 0.05. Based on the outcome, estimates from the equal variances were consulted. The results indicated that the difference between the means for males and females was not statically significant (df=198; t=0.619, p=0.537). There was no significant difference in both means score for male and female for Process total score (df=198; t=-0.105, p=0.917). It was the same with Object total score; there was no significant difference in gender (df=198; t=0.374, p=0.712). Finally, there was no significant difference between the means for male and female for Schema total score (df=198; t=-0.197, p=0.844).

In conclusion, when t-test was done to compare males and females across all four variables (Action total score, Process total score, Object total score, and Schema total score), there were no significant differences of perception across genders. This showed that there was no gender difference in Mathematics perceptions at all in all the four components in APOS (Action, Process, Object, Schema).
11.2 Students’ perceptions towards Mathematics based on ethnicity

Table 3. Analysis of variance ANOVA

|                        | Sum of Squares | df  | f    | p    |
|------------------------|----------------|-----|------|------|
| Total score (Action)   |                |     |      |      |
| Between Groups         | .487           | 2   | .729 | .483 |
| Within Groups          | 65.774         | 197 |      |      |
| Total                  | 66.261         | 199 |      |      |
| Total score (Process)  |                |     |      |      |
| Between Groups         | .004           | 2   | .007 | .993 |
| Within Groups          | 58.298         | 197 |      |      |
| Total                  | 58.302         | 199 |      |      |
| Total score (Object)   |                |     |      |      |
| Between Groups         | .106           | 2   | .149 | .862 |
| Within Groups          | 70.120         | 197 |      |      |
| Total                  | 70.226         | 199 |      |      |
| Total score (Schema)   |                |     |      |      |
| Between Groups         | 1.459          | 2   | 2.880| .059 |
| Within Groups          | 49.891         | 197 |      |      |
| Total                  | 51.350         | 199 |      |      |

Note: *p<0.05

A one-way ANOVA was conducted to compare the significant difference between students’ perception (Action, Process, Object and Schema) towards Mathematics across ethnicities. According to Table 3, there was no significant difference in terms of perception towards Mathematics (Action) across ethnicities among the students as the result was $p=0.05$ for all three ethnicities ($F(2,197)=0.729$, $p=0.483$). There was also no significant difference in terms of perception towards Mathematics (Process) across ethnicities among the students as the result was $p=0.05$ for all three ethnicities ($F(2,197)=0.007$, $p=0.993$). There was also no significant difference in terms of perception towards Mathematics (Object) across ethnicities among the students as the result was $p=0.05$ for all three ethnicities ($F(2,197)=0.149$, $p=0.862$). There was also no significant difference in terms of perception towards Mathematics (Schema) across ethnicities among the students as the result was $p=0.05$ for all three ethnicities ($F(2,197)=2.880$, $p=0.059$).

The above results showed that there was no significant difference in terms of students’ perception towards Mathematics across ethnicities in all the components of APOS theory. Hence, this implies that students’ ethnicity did not have any impact on students’ perception towards Mathematics. In other words, all ethnic groups were same in terms of their perception learning towards Mathematics.

12. Conclusion
The study generally aimed to measure students’ perception towards Mathematics and achievements across two background variables, which were gender and ethnicity.

12.1 Students’ perception and gender
The first research question of the study, which is: “Are there any significant differences in terms of perceptions towards learning mathematics across genders among the selected students?” The present study compared the perception towards Mathematics between male and female students.

Overall findings showed that there was no significant difference between gender and students’ perception towards Mathematics. This result did not concur with the result of the study conducted by Benbow and Stanley that reported male student often had positive perception towards Mathematics compared to female students [17]. One of the reasons for this present result could be due to the nature of the samples, which were sampled using purposive sampling. Another possible reason could be due to the Malaysian context, which may be different from the western context. Thus, it is not surprising
that the results of this present study did not adhere to the results from previous researches. Therefore, gender of Malaysian students in the selected Kuantan schools did not influence their perception towards Mathematics.

12.2 Students’ perception and ethnicity
An analysis of variance (ANOVA) was also carried out between the three major races in Malaysia namely Malay, Chinese, and Indian, and students’ perception towards Mathematics. From the analysis, the study found that there was no statistical significant difference based on ethnicity among the respondents in their perception towards Mathematics. However, the present result was not similar to the result of Hedges and Nowell that reported significant difference between ethnicity and students’ perception towards Mathematics [18]. In the study by Hedges and Nowell, the differences were found to be higher, especially for black-white students, thus affecting their performance in learning Mathematics [18].

Hence, the researcher concluded that students with different ethnicity did not give any impact in their perception towards Mathematics. Again, this may be in congruence with the results on gender as discussed earlier. It can be argued that, despite the different outcomes between this study and the study from western researches, the unique contexts (situation, culture, geographical location, etc.) of Malaysian students across genders and ethnicities may influence the results as there were no significant differences in the variables.

Finally, quite a number of studies still need to be conducted upon the accomplishment of this study in order to further the research on other possible factors contributing to students’ perception towards mathematics.

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