Individual differences in attitudes toward mathematics

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Abstract. The purpose of the research was to analyze the students’ attitude toward mathematics in terms of the different aspect of mathematics game preferences, grade levels, and genders. The subjects of the research were 107 students. They were taken from 2 elementary schools and were taken through proportional random sampling The instrument of the research used The Attitude Toward Mathematics Inventory (ATMI) Likert scale from Tapia. The findings of the research reveal that there are different students attitude toward mathematics based on their mathematics game preferences and their grade levels. As far as their genders are concerned, there are no differences between male and female students attitude toward mathematics. The results of the research support the previous research that was investigated by other experts.

1. Introduction
Having competency in mathematics plays important role in humans being life. For examples, in the health sector and machinery industry sector. However, Indonesian people competences on Mathematics internationally are still far from expectation. Based on the data from National of Educational Progress in USA, [3] point out that there are less than 40% American students who are doing well at mathematics. To students in Indonesia, Programme for International Students Assessment has ever investigated the average scores for middle school in 2015. The findings of the investigation show that the level of the students' math competences is 386. In other words, they are on the average level of math competence. The result was released in 2016. By looking at the International math averages, off 70 countries in the world, Indonesia is in the 63 level. Internationally, Indonesian students math competence is below the international standard score’s [4]. Based on these conditions are needed strategies to strengthen the students' comprehension in mathematics particularly in the elementary school students [5], because early skills for mathematics influence to later academic performance in secondary school. For example, arithmetical word problem-solving in elementary school as basic for algebra [6].

We are living in a digital technology age, video games are the most familiar game for children and adolescents to promote healthy behaviour and social interaction [7]. Technology has a broad impact on several areas of human lives, not only in schools setting [8] but also at home [9]. It is
important that parental monitoring for their school age’s children who are playing a game [10]. Parents are as role models for their children through their parenting in the digital era. They can learn together and teach them playing the educational game to create a positive attitude toward subject matter, for example, math game [11]. Therefore, parental involvement [12], in children’s math activities at home can impact their academic performance in math positively [13, 14]. In a digital age, parental involvement can support their children to like mathematics through playing a math game.

Using digital learning materials in teaching can improve attitudes towards learning mathematics for students elementary school [15]. Therefore, based on gender and students grade that students’ mathematics self-concept is the difference [16]. Male students have a more positive attitude toward math compared to female students [17]. The difference found is that there is no different gender-related to attitudes toward mathematics [18]. The previous researches also support the findings is that there is a different attitude toward Math based on gender and the students major. The question is then why it is important to look into and explore the students’ attitude toward Math in this research? The answer is because the students’ attitude toward Math contributes to their math achievement [22, 23]. The aims of the study are to analyze: (1) the different students' attitudes toward mathematical are based mathematical games preferences; (2) the difference in attitude toward mathematics based on students' grade; (3) the difference in attitude towards mathematics based on gender.

2. Method
The study is a comparative study, in which it compares the students’ attitude toward Math based on the following characteristics: first, game preferences; the students who like playing a game and who do not. Second, the students grade levels: fourth graders, fifth graders, and sixth graders. Third, genders: males (M) students and females (F) students. The subjects of the research are two elementary schools in Kendari city. Before taking the subjects, the students are identified to find out who likes playing a math game and who do not in each class. The result of identification provides some students characteristics. They can be seen in Table 1.

| School | Class IV | Class V | Class VI | Total |
|--------|----------|---------|----------|-------|
|        | Like M F | Like M F | Like M F |       |
|        |          |         |          |       |
| A      | 10 8 14  | 8 4 16  | 6 6 16  | 110   |
| B      | 12 6 14  | 12 6 10 | 8 6 14  | 104   |
| Total  | 22 12 28 | 20 10 26| 14 12 30| 214   |

Based on the total of students in Table 1, some 50% are taken as samples through proportional random sampling in each characteristic, so the total subjects of the research are 107 students. The samples can be seen in Table 2. First, game preference: there are 45 students like playing a game and 62 students who do not. Second, grade level: there are 37 fourth graders, and 35 students of fifth graders and sixth graders each of them. Third, genders: there are 48 male students and 59 female students.”
Table 2. Some students based on class, do/don’t like playing a game, and gender

| Game preferences | Like | Dislike | Like + Dislike | Male | Female | Male + Female |
|------------------|------|---------|----------------|------|--------|---------------|
| Class IV         | 17   | 20      | 37             | 17   | 20     | 37            |
| Class V          | 15   | 20      | 35             | 17   | 18     | 35            |
| Class VI         | 13   | 22      | 35             | 14   | 21     | 35            |
| Total            | 45   | 62      | 107            | 48   | 59     | 107           |

To permit their children to play a game in order to study mathematics is considered difficult. In this case, there are some Math video games which are played by students — for example, Minecraft, cooking fever, a clash of clan, and math blaster. On the other side, there are students dislike playing a game, including mathematical game. Their parents are not allowing them to play a game because it gives a negative impact on them.

Attitude towards mathematics as a dependent variable, and gender, grade and game preferences as independent variables. The instrument of the study uses The Attitude Toward Mathematics Inventory (ATMI) that is proposed by [20]. The attitude scale is 5 points Likert type scale and consist of 39 items for strongly agree (5 points), agree (4 points), neutral (3 points), disagree (2 points), and strongly disagree (1 point). Students complete descriptions about their parents who allow them to play or do not allow playing a game, and parents who guide them playing a math video game.

Based on validity test, one item is excluded, and all items are valid through coefficient correlation with r-count > r-table .316, df = 37 on signficance level α = .05. Cronbach's Alpha .926 > r-table .316, df = 37. Therefore, it can be considered that the test is reliable.

Before analyzing the differences in scores between the groups, the first thing to do is to test the assumption of data normality and homogeneity of variance as a requirement for analysis. If the assumption of normality and homogeneity of variants was fulfilled, then the hypothesis is tested for the difference between two averages or independent samples t-test at the significance level α = .05. This way to analyze attitudes based preferences in the game, and based on class level (grades IV, V, and VI). Therefore, analyzing the difference in attitude toward mathematical based on gender is using one-way ANOVA at a significant level α = .05. Analysis of data using the SPSS for Windows 22 application.

3. Result and discussion

The results of the normality test on mathematics using the Kolmogorov-Smirnov test to the students who do not like playing games with p-value = .064 > 0.05, and students who like playing games with the Shapiro-Wilk test p-value = .098 > .05. Based on class level using the Shapiro-Wilk test for class IV students p-value = .86 > .05, for class V students p-value = .684 > .05, and class VI students p-value = .055 > .05. Furthermore, Kolmogorov-Smirnov test (N > 50) for girls, p-value = .200 > .05, while men with the Shapiro-Wilk test (N < 50) p-value .381 > .05. Thus the data is normally distributed.

3.1. Students attitude toward math based on their game preferences

Table 3. Students attitude average scores toward mathematics based on like/dislike playing a math game

| Game preferences | N   | Mean  | Std. Deviation | Std. error mean |
|------------------|-----|-------|----------------|-----------------|
| Score            |     |       |                |                 |
| Like             | 45  | 164.78| 13.87          | 2.07            |
| Dislike          | 62  | 155.24| 16.06          | 2.04            |
Table 3 provides the average scores of students who like playing a game and who do not. The average score of students who like playing a game is 164.78 while the average score of students who do not like playing a game is 155.24.

Table 4. Independent samples t-test attitude toward mathematics based on like/dislike playing a math game

| Levene's test for equality of variances | t-test for equality of means |
|----------------------------------------|-------------------------------|
| F | Sig. | t | df | Sig. (2-tailed) | Mean difference | Std. error difference | 95% Confidence interval of the difference |
|---|------|---|----|-----------------|----------------|-----------------------|----------------------------------------|
| Equal variances assumed | 3.57 | .06 | -3.03 | 105 | .002 | -9.54 | 2.97 | -15.43 | -3.64 |
| Equal variances not assumed | -3.28 | 101.78 | .001 | 9.54 | 2.90 | -15.30 | -3.77 |

Table 4 gives the data about the students’ attitude toward math based on their preferences on mathematics games with its p-value = .062 > .05. The value indicates that it fulfills the assumption of variant homogeneity that they have the same variants. The analysis is, therefore, using the equal variant assumption. Furthermore, the students’ attitudes toward math who like playing the games and who do not have significant differences with its p-value = .002 < .05. The different scores between both of them are -9.54. The score indicates that the students attitude on math particularly the students who do not like playing games are lower by 9.54, ranging from -15.43 to -3.64 and at the level of thrust 95%.

The first hypothesis of the research is that there is difference students attitude toward mathematics based on math game preferences. The result has shown that the participants who like playing math game have a significant correlation with attitude toward mathematics. In this study, participants are students in elementary school who have different parenting style, particular in using gadget. They teach children to learn mathematics by using math game. Previous studies have shown that parental involvement in academic performance students in elementary school [24, 25]. Other side, parents and children, both of them are living in a digital era. Parents use electronic tools (internet) to communicate for others, to look for information about job, knowledge and many more. Therefore, parents need to minimize punishment to children but apply parents disciplinary while their children are having poor academic performance [26]. For example, mathematics, parents show a positive attitude for a game which is played by their children. Otherwise, if parents have a negative attitude toward video game, then they should more be involved in their children when they are playing the games [27].

3.2. Attitude toward mathematics based on the level of the students’ grade

Table 5. Students average scores in mathematics based on their grade levels

| Class | N  | Mean  | Std. Deviation | Std. Error | 95% Confidence interval for mean |
|-------|----|-------|----------------|------------|----------------------------------|
|       |    |       |                |            | Lower bound | Upper bound |
| IV    | 37 | 37154.00 | 16.37         | 2.69        | 148.54       | 159.46     |
| V     | 35 | 35159.91 | 13.38         | 2.26        | 155.32       | 164.51     |
| VI    | 35 | 35164.14 | 16.24         | 2.75        | 158.56       | 169.72     |
| Total | 107| 107159.25 | 15.83         | 1.53        | 156.22       | 162.29     |
The level (grade) of the class determines the students' attitude on math, that is the higher their class level, the greater their math scores are. It can be seen in Table 5 that the average scores of fourth grade (VI) are 154.00, the fifth grade (V) score is 159.91, and the fourth grade (IV) score is 164.14. The scores indicate that they are higher than on another.

Table 6. Test of homogeneity of variances on the students attitude on mathematics based on the level of the class

| Levene Statistic | df1 | df2 | Sig. |
|------------------|-----|-----|------|
| 2.205            | 2   | 104 | .115 |

Table 6 provides the data on the students' attitude on math based on the level of the class of p-value = .062 > .05. The value fulfills the assumption of variant homogeneity that the three groups have the same variants. The post-hoc test uses the Bonferroni test to determine the significant difference of the class group.

Table 7. One-way ANOVA for attitude toward mathematics based on grade levels

| Sum of squares | df | Mean square | F    | Sig. |
|----------------|----|-------------|------|------|
| Between Groups | 1873.16 | 2 | 936.58 | 3.94 | .022 |
| Within Groups  | 24699.03 | 104 | 237.49 |      |      |
| Total          | 26572.19 | 106 |        |      |      |

The results of one way ANOVA test within the groups show that the F statistic was = 3.94 with its p-value = .022 < .05. It, therefore, can be concluded that there are significant differences on students attitude toward math within the groups of the class level.

Table 8. Post Hoc attitude tests toward mathematics based on the level of the students' grade

| Dependent variable: Attitude | Mean difference (I-J) | Std. Error | Sig. | 95% Confidence interval |
|------------------------------|-----------------------|------------|------|------------------------|
|                              |                       |            |      | Lower bound            | Upper bound |
| Bonferroni                   |                       |            |      |                        |             |
| IV                            | -5.91                 | 3.63       | .32  | -14.76                 | 2.93            |
| VI                            | -10.14*               | 3.63       | .02  | -18.98                 | -1.30          |
| V                             | 5.91                  | 3.63       | .32  | -2.93                  | 14.76          |
| VI                            | -4.23                 | 3.68       | .76  | -13.19                 | 4.73           |
| VI                            | 10.14*                | 3.63       | .02  | 1.30                   | 18.98          |
| V                             | 4.23                  | 3.68       | .76  | -4.73                  | 13.19          |

Based on the table, The 5th and 6th grade show significant differences in the students' attitude toward math. However, the 4th-grade students show differently. The Second hypothesis of the research is that there is a different attitude toward mathematics based on the students' grades. This study supports previous researches which is done by expert [28, 29]. This finding of the research suggests that children become more aware of their mathematical performance in relation to become older, either because of generally greater self-awareness or because of the greater experience of tests and teacher assessments. Additionally, the children’s self-assessment has increased influence on their motivation, and their performance as they get older [30]. This research has limitations; for example, there is not scale inventory especially for parents. It is necessary due to parental self-report scale describes how the relationship between parents and their children in learning math. In a recent study only using students’ perspective related their parents allow them playing a math game.
3.3. Attitude toward mathematics based on gender

Table 9. Mean on attitude toward mathematics based on gender

| Gender | N  | Mean  | Std. deviation | Std. error mean |
|--------|----|-------|----------------|-----------------|
| Score  |    |       |                |                 |
| Male   | 48 | 160.19| 14.48          | 2.09            |
| Female | 59 | 158.49| 16.94          | 2.20            |

Table 9 shows that the average scores of the male students' attitude on math is higher than the female students. The average score of male scores is 160.19, and the average scores of female students are 158.49. Furthermore, to find out whether there are differences between male students and female students' attitude on math, the t-test can be seen in Table 10.

Table 10. Independent samples t-test attitude toward mathematics based on gender

| Levene's test for equality of variances | t-test for equality of means | 95% Confidence interval of the difference |
|----------------------------------------|-----------------------------|----------------------------------------|
|                                       | F              | Sig. | t       | df | Sig. (2-tailed) | Mean difference | Std. error difference | Lower | Upper |
| Equal variances assumed                | 3.12           | .08  | -.55    | 107| .58            | -1.70           | 3.09               | -7.82 | 4.43  |
| Equal variances not assumed            | .58            | 1.70 | 3.04    | 4.32| -7.72          | 4.32 |

Table 10 gives the data about the students' attitude on math based on sex (gender) with its p-value = .58 > .05. The value fulfills the assumption of variant homogeneity that they both have the same variants. The data were analyzed by using equal variant assumption. The results of the analysis show that there are no significant differences in students' attitudes toward math between male students and female students because its p-value is p-value = .08 > .05. However, the male students' scores are higher than the female students. The different score is very small that is -1.70. The score indicates that the female students score lower by 1.70 ranging from -7.82 to 4.43 with the level of trust is 95%.

The third hypothesis is that there is no difference between male and female students' attitude toward mathematics. Previously, many kinds of research show significant correlation on it, but many studies do not. This study supports previous research that there is no difference between females and males in attitude toward mathematics [31].

4. Conclusion
The results of the research reveal that there are no distinctions between male students and female students' attitude toward math. Furthermore, The students who frequently play video games on education (math) have a positive and significant contribution to their attitudes toward mathematics than the students who do not. There is a different attitude toward math based on grade levels. The higher class has a more positive attitude toward math than the lower class. Therefore, further research will be focusing on math game education based on parenting involvement. Particularly in children primary school. The idea is that to build their positive attitude toward mathematics. Parenting involvement is not only as a model to build a positive attitude toward mathematics, but also play an important role for successful academic in many areas, including mathematics performance [32].
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