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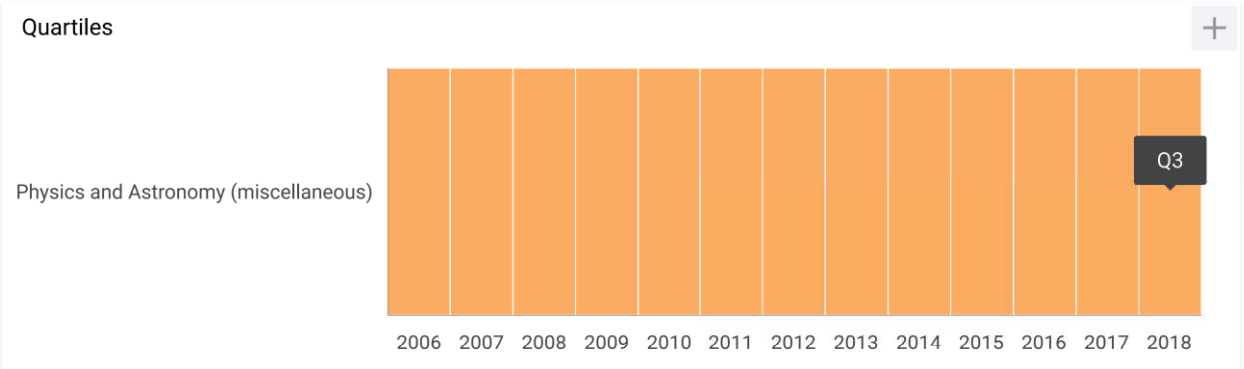

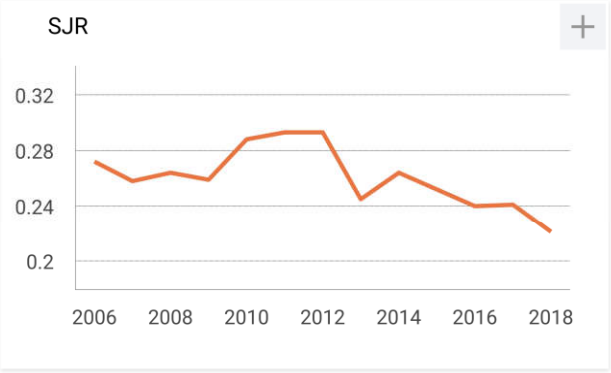
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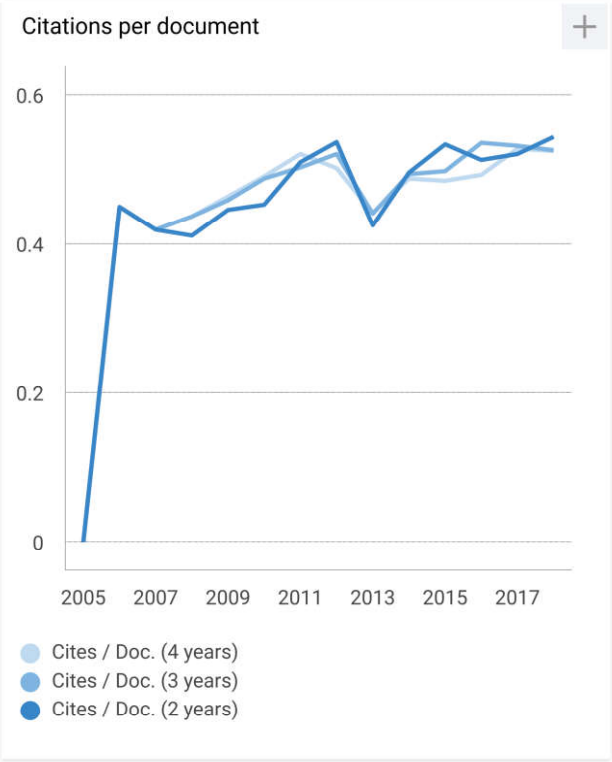
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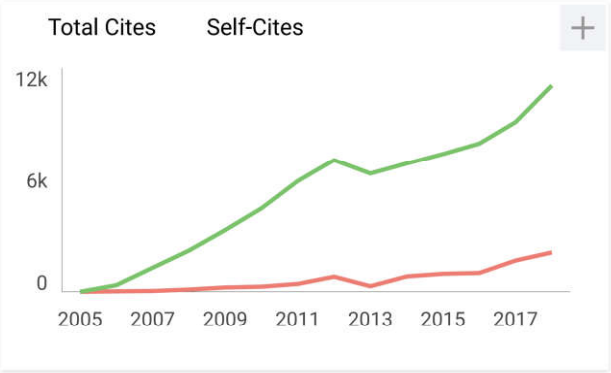
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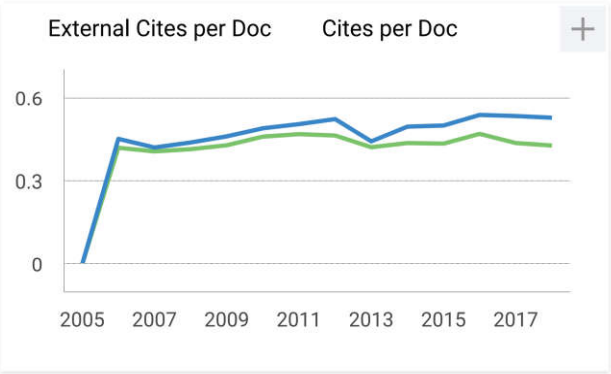
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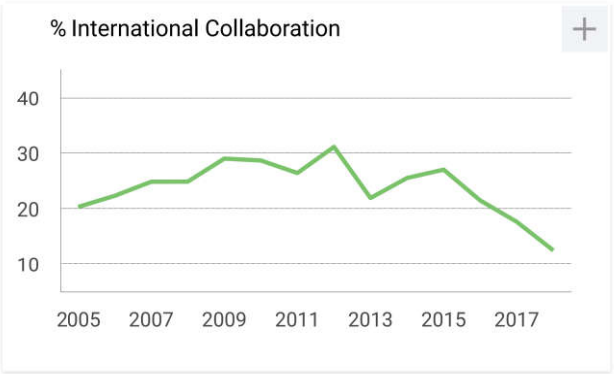
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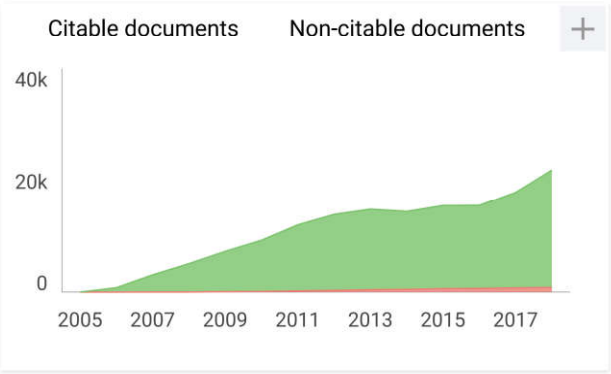
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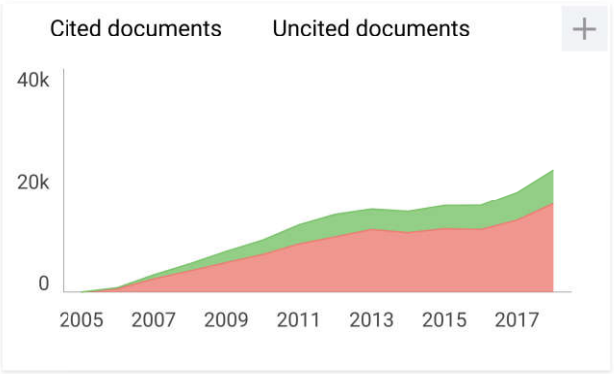
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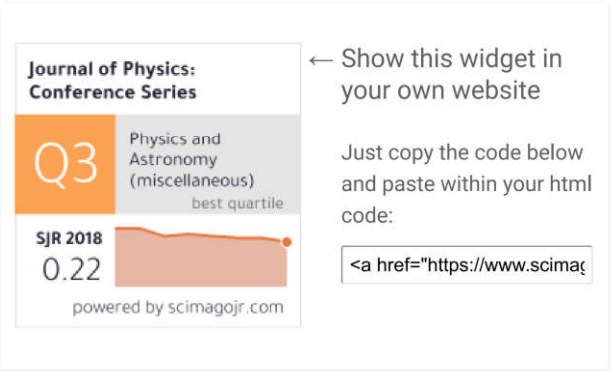
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20-24 November 2018

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Preface: Proceedings of the 2nd International Seminar on Innovation in Mathematics and Mathematics Education 2018

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We are honored to present a collection of articles from the 2nd International Seminar on Innovation in Mathematics and Mathematics Education (ISIMMED 2018) which was conducted in Universitas Negeri Yogyakarta, Indonesia from 20 to 24 November 2018.

The theme of the conference was '*innovative technology in mathematics: new ways for learning, teaching, and researching mathematics'*. In the era of Industrial Revolution 4.0, the use and integration of technology into various aspects of everyday life is rapidly increasing. The availability and development of advanced technology have a great impact on the practices of educational research and classroom activities in the fields of mathematics and mathematics education. This situation becomes a great challenge and motivation for researchers and educators. Various technological innovations have been invented and developed to improve the quality of research and education in the field of mathematics. The advanced technological tools such as computer algebra systems (CAS), interactive and dynamic geometry software, and hand-held devices, have been enabling the effectiveness of mathematics teaching and learning.

During the ISIMMED 2018, scholars, educators, and researchers in the field of mathematics and mathematics education from many countries gathered to share their expertise and works. After a series of review process, 108 articles are selected to be published in this Scopus-indexed proceeding. The remaining articles are published in the regular proceeding.

The editors and the committees of ISIMMED 2018 would to thank the participants who have contributed and shared their scientific works in this proceeding. We also would to to express our gratitude to every committee member for organizing the conference and to Universitas Negeri Yogyakarta for the financial support.

15 March 2019

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Is there any interaction effects of students' gender and mathematical disposition towards learning achievement?

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Is there any interaction effects of students' gender and mathematical disposition towards learning achievement?

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Abstract. Mathematics learning achievement is affected by external and internal factors. External factors include the environment and teachers, while one of the internal factors is the student's gender. However, the research findings of gender difference effects on learning achievement showed varied results. It indicates that there might be other factors which have important effects on gender differences towards learning achievement, such as mathematical disposition. The aim of this quantitative study is to describe the interaction effects between students' gender and mathematical disposition towards learning achievement. Participants consisted of 200 high school students. Data were obtained using a questionnaire on a Likert scale and the score of the daily test result. Furthermore, the data were analysed using Two-way ANOVA. Findings revealed that there is no interaction effect between the two variables towards learning achievement. As an individually separated factor, mathematical disposition does have an effect on students' learning achievement, but, is not the case with students' gender. Results and recommendations are further discussed in this paper.

1. Introduction

Mathematics is one of the subjects which must be taught in school, from elementary through high school. There are five strands of desirable mathematical actions for students, that are the students is have the ability of (1) Conceptual understanding, it includes the understanding of mathematical concepts, operations, and relations; (2) Procedural fluency, it involves the students' skills in carrying out ideas flexibly, precisely, efficiently, and properly; (3) Strategic competence, the ability to formulate, represent, and solve mathematical problems; (4) Adaptive reasoning, the students' capability for logical thought, reflection, explanation, and confirmation, and (5) Productive disposition, the habitual tendency to see mathematics as reasonable, helpful and worthwhile, combined with a belief in diligence and one's own ability [1]. By learning mathematics, students are not only able to develop their cognitive abilities, but also the affective aspect [2].

Given the importance of learning mathematics, many researchers tried to find out how to improve the mathematics achievement, which presents an important role in student's further education, career selection, and professional achievement [3]. The conclusion of their studies is by implementing certain learning strategies can improve the student's mathematical achievement [4]. However, there are many other factors which affect the learning achievement, the external and internal factors [5]. External factors include the environment and teachers, while one of the internal factors is the student's gender.

There are many public stereotypes which state that girls are better in terms of learning achievement [9]. Nevertheless, the results of research related to gender differences in learning achievement, especially mathematics achievement, show varied results. Some of the studies state that male and female not significantly differ in mathematics achievement ([6]; [7]; [8]; [9]; [10]). The results of other studies show that gender difference in mathematics achievement favouring the male students ([3]; [11]; [12]), on the contrary, other studies conclude that female outperformed the male students' mathematical achievement ([13]; [14]). The inconsistent on research findings show that there might be other factors which have important effects on gender differences towards learning achievement. Therefore, it's necessary to investigate the possible interaction effects between gender and other factors, such as mathematical disposition.

Notwithstanding its utility and importance, mathematics is perceived as a difficult, boring, and complicated subject [15]. Instead of giving more attention and interest to mathematics, students tend to avoid the subject because it's "too complex", and as a result, it affects how frequently they study math and how much they enjoy doing it. The tendency of that thinking commonly referred to a negative disposition towards mathematics. Mathematical Disposition affects greatly towards the success of learning math [2], and it can affect the student's eagerness to engage in a math context [16]. Mathematical disposition is not merely about students' attitude towards math, but rather the tendency to think and act in a positive way [17]. It related to student's belief about the complexity level of math, their inclination towards math, and their dedication to learning mathematics [16]. Without a good mathematical disposition, students can't achieve their mathematical skills optimally [18]. Thus, mathematical disposition became one of the important factors which affect considerably to the success in learning math, in other words, it has a relationship with learning achievement.

There are six aspects of mathematical disposition namely : (1) confidence, it includes the confidence in solving mathematics problems, communicating ideas, answering and asking a question, or doing a presentation; (2) flexibility on solving math problems with indicators considering a various possible way of solving the problem; (3) tenacity, it's about students' persistence in solving math problems, showing perseverance and determination during learning; (4) interest and curiosity towards the subject-matter, including material that has been taught, being taught, and what will be taught; (5) monitoring and reflecting, one of the indicators is the students' habit to re-check their works; and (6) assessing and appreciating the application of mathematics in other fields, in daily life, in other subjects, as well as in the advancement of other fields [17].

With this study, we're going to find out if there are any interaction effects between students' gender and mathematical disposition towards learning achievement. Will male students with high math disposition have better learning achievement rather than female students, or vice versa, with the same level of math disposition? Which has better learning achievement between male and female with different level of math disposition?

2. Experimental method

This design of this study is factorial design because the experiment consists of two factors. The aim of this study is to describe the interaction effects between students' gender and mathematical disposition towards learning achievement. In this study, there are two factors which are the students' mathematical disposition and students' gender. For the mathematical disposition factor, there are three levels namely (1) high, (2) medium, and (3) low. Meanwhile, for the gender factor, there are two levels namely (1) male, and (2) female. Therefore this study has a 3 x 2 factorial design. There were two independent variables, mathematics disposition and gender. Learning achievement was the dependent variable.

The study was conducted at a senior high school which the characteristics of the school are co-ed school, located in the district, and the students' achievements are diverse. The subjects in this study are 200 students with age between 16-18 years old. The instrument used in this study was a questionnaire of mathematical disposition (r=0,859) on a Likert Scale which has been validated by the expert. The questionnaire consists of 51 statement items which measured six aspects of mathematical disposition namely confident, flexibility, tenacity, interest and curiosity, monitoring and reflecting, assessing and

appreciating mathematic's role. Data for the learning achievement were obtained from the average score of the daily tests result.

3. Result and discussion

Two-way ANOVA was used to analyze the learning achievement data. The result shows that there were no statistically significant interaction effects between students' gender and mathematical disposition towards learning achievement. The graphic representation is shown in figure 1.

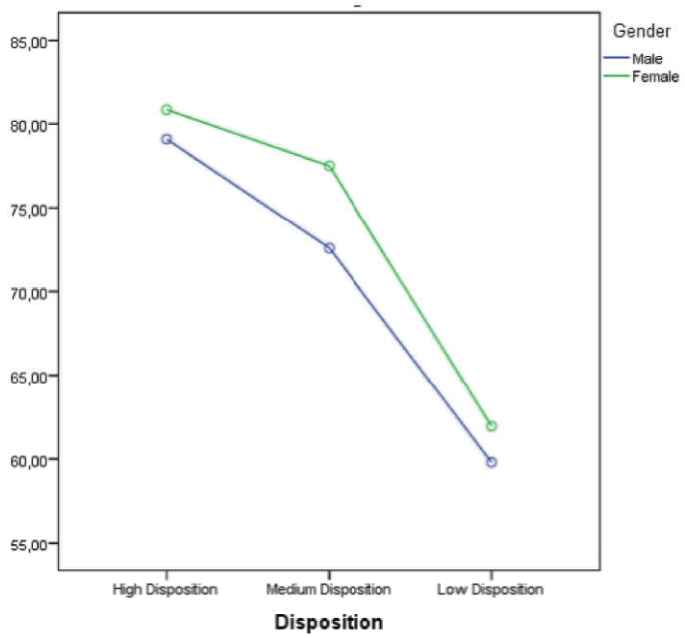

Figure 1. The graphic of gender differences in learning achievement based on the mathematical disposition

At each level of mathematical disposition, the score of female students outperforms the male one. Although overall, there are differences in learning achievement's scores between female and male students, the difference is not significant. This result indicates that students' mathematical disposition tends to have the same effect for both male and female students. There is no significant difference between the mathematical dispositions of both genders. The students' average score on each aspect of the mathematical disposition is shown in Table 1.

Table 1. The average score on each aspect of students' mathematical disposition.

Aspect	Average Score	
	Male	Female
Confident	76	72,8
Flexibility	80	81,2
Tenacity	64	64,9
Interest	66	62,5
Monitoring	70,8	71,5
Appreciating	80	80,8

This study found that between the six aspects of mathematical disposition, the biggest gender differences were in the confidence and interest aspects. The rest aspects stayed at an equal level between male and female students. The findings support the two arguments which state that male students have higher confidence in mathematics than the female one ([19], [20]) and that female students are simply less interested than male in mathematics [21]. It's in contrast to the statement which claims that the students' gender doesn't have an effect on their interest in mathematics [22].

For main effects in this study, there were statistically significant differences in learning achievement between students' mathematical disposition. However, there were no significant differences between students' gender. Tables 2 and table 3 show the average of students learning achievement score on each individually separated factor.

Table 2. The average of students' learning achievement on the mathematical disposition factor.

Mathematical disposition	Learning Achievement
High	79,96
Medium	75,04
Low	60,87

The result is in agreement with other studies which state mathematical disposition does make a difference to learning ([1], [4], [23]), it does have an impact on students' mathematics achievement [24]. Mathematical disposition is closely related with students' attitude towards math. It's affecting students' fun and enjoyment while engaged in mathematical activities. The more they enjoy engaging in math activities, the more they willing to spend time working on math problems or reading and exploring the subject-matter. That's why mathematical disposition can affecting students' learning achievement.

Table 3. The average of students' learning achievement on the gender factor.

Gender	Learning Achievement
Male	70,49
Female	73,43

The study found that female students outperformed the male even though the difference is not statistically significant ($\alpha = 5\%$). The absence of gender difference effects towards learning achievement is supported by other studies ([25], [26]). These findings fail to support the pattern of gender difference in other studies which states that female students began to fall behind male in mathematics learning during the intermediate school years, and further behind in the high school years ([27]–[29]).

The results of this study add to the evidence that there are various results of studies which related to the effect of gender differences on learning achievement. This inconsistency in gender differences caused by some factors, one of them is the variances of educational systems [30]. In this study, gender doesn't have an effect on learning achievement can be due to several factors, one of them is the school quality. The school in this study is categorized as a good school, wherein a good co-ed school gender difference is not an issue towards learning achievement [31].

4. Conclusion and recommendations

Based on the analysis, it shows that there was no detectable interaction effect between students' gender and mathematical disposition towards learning achievement. It's indicated that the differences in learning achievement couldn't be attributed to the interaction between the two variables. As an individually separated factor, mathematical disposition does have an effect on students' learning achievement, but, is not the case with students' gender.

The absence of the interaction effects between the two factors shows that, rather than mathematical disposition, there are other factors which have more influence on gender differences when it's observed from student learning achievement. In other words, the influence of gender difference on learning achievement may be exerted in the interaction with other factors.

Therefore, it is recommended to conduct further research to investigate the interaction between gender and other factors, such as the learning system; learning style; etc., towards learning achievement. It is also recommended to conduct further research which aims to find out whether there are interactions between mathematical disposition and gender towards other mathematical abilities, for examples the reasoning and critical thinking skills.

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