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# Pengaruh Kemandirian Belajar, Gender, dan Keyakinan Matematika terhadap Pembuktian Matematika

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**Abstrak**

Penelitian ini memiliki tujuan yaitu untuk mengetahui pengaruh kemandirian belajar, gender dan keyakinan matematika terhadap pembuktian matematika. Metode yang digunakan dalam penelitian ini adalah metode survei dengan menggunakan analisis korelasional. Populasi dalam penelitian ini adalah siswa di salah satu SMA N 1 Ngawen dan pengambilan sampel menggunakan teknik *purposive sampling*. Subjek penelitian ini adalah siswa dari kelas yang berbeda yaitu siswa kelas X.6, X8, dan XI.9. Instrumen yang digunakan ialah tes pembuktian matematika dan instrumen non-tes berupa angket kemandirian dan angket keyakinan matematika dengan menggunakan skala likert. Analisis data dilakukan dengan alat bantuan program SPSS 23.0 yang terdiri dari analisis deskriptif, uji prasyarat analisis data dan pengujian hipotesis. Penelitian ini menyimpulkan bahwa secara bersama-sama kemandirian belajar, gender dan keyakinan matematika berpengaruh terhadap pembuktian matematika, kemandirian belajar berpengaruh positif terhadap pembuktian matematika, gender tidak berpengaruh terhadap pembuktian matematika, dan keyakinan tidak berpengaruh terhadap pembuktian matematika, siswa kelas X.6, X8, dan XI.9 SMA N 1 Ngawen.

**Kata Kunci**: gender, kemandirian belajar, keyakinan matematika, pembuktian matematika

# *The Influence of Learning Independence, Gender, and Mathematical Beliefs on Mathematical Proof*

***Abstract***

*This research aims to determine the influence of learning independence, gender, and mathematical beliefs on mathematical proof. This research uses a survey method with correlational analysis. The population in this study were students from one of the Ngawen 1 High Schools and sampling using the Purposive Sampling technique for this research was students in classes X.6, X.8, and XI.9. The instruments used are mathematics proof tests and non-test instruments in the form of independence learning questionnaires and mathematics beliefs questionnaires using the Linkert Scale. Data analysis was carried out using the SPSS 23.0 program, consisting of descriptive analysis, data analysis prerequisite tests, and hypothesis testing. This research concludes that together learning independence, gender, and mathematical beliefs have an effect on mathematical proofs, learning independence has a positive effect on mathematical proofs, gender has no effect on mathematical proofs, mathematical beliefs have no effect on mathematical proofs, students in class X.6, X.8 and XI.9 SMA N 1 Ngawen.*

***Keywords****: gender; learning independent; mathematical beliefs; mathematical proof*

## INTRODUCTION

One of the subjects that fall into the important category is mathematics. Mathematics is taught in elementary school, middle school, high school, and university. Mathematics is considered very important in universities because it has links with other fields such as natural sciences, engineering, medicine, and social sciences (Jones 2000). Mathematics lessons are not only about studying the calculation of a value using an existing formula but there is also proof in mathematics (Erawati & Purwati, 2020). In conventional learning, it can be stated that most students tend to memorize procedures and have difficulty developing understanding (Rifandi, 2017). Payadnya (2019) states that reasoning abilities show the process of solving mathematical problems with high-level thinking.), Reasoning is an important skill needed to understand mathematical concepts and use practical ideas and procedures in mathematics to build new knowledge. Standard learning processes according to Mundy (2000) include problem-solving, reasoning and proof, connection, communication, and representation. According to Dewi & Dasari (2023), reasoning and proof skills are important to realize as a result of learning mathematics, because mathematical proof is one of the essential abilities that need to be developed. According to Herizal (2020) what is included in mathematical reasoning ability is the ability to prove mathematics. Mujib, 2019), states that proof is one of the most advanced mathematical abilities to achieve and is the most difficult ability. Agree with Samsudin, Setia Budi, and Dzulkifli (2021) how important it is to master mathematical proof because it is studied at every level of education. According to the Educational Development Center (2003), mathematical proof includes (a) assembling facts; (b) gaining understanding; (c) conveying ideas to others; (d) challenging; (e) easy to understand; and (f) constructing mathematical theories.

Many studies related to mathematical proofs show the difficulties experienced by students in constructing proofs. Waluyo and Vidákovich (2021a) states that students' lack of understanding of mathematical proofs, students' understanding is obtained from their teachers, and written learning sources such as textbooks and other sources are one of the factors that influence mathematical proofs. Therefore, the most important thing in students' mathematical proof is understanding concepts and proof strategies. Thompson, Senk, and Johnson (2012) stated that students cannot understand the meaning and purpose of proof, students also cannot differentiate between concepts, definitions, notations, and proof strategies, how to start proof, and metacognitive strategies for carrying out proof by observing progress. Hasan et al. (2023) states that there are six main elements in the profile of Pancasila students, namely (a) faith, piety, and noble character, (b) global diversity, (c) independence, (d) cooperation, (e) critical reasoning, and (f) creativity. Students' difficulties in solving mathematical problems and students' difficulties in planning and prioritizing mathematics learning are problems that can hinder students' learning independence. Ariani et al. (2022) argue that one of the factors that influence mathematical reasoning is independent learning. Learning independence can be said to be when students no longer depend on other people, they do not only accept the material that the teacher conveys, but students take the initiative to seek information by conducting research in books or other sources. Learning independence is an internal factor for students, with their intentions and motivation, taking full responsibility for mastering knowledge and learning materials. Independence of learning is a process in which students control their learning process and the purpose of the learning (Lubis, Abdillah, & Lubis, 2020). According to Tujuh (2019) it is stated that thanks to independent learning, achievement, and success will be easily achieved because independence is very important in learning. The learning and teaching process will be optimal if the learning process is effective and efficient and does not depend on the teacher. Research Marniati, Jahring, and Yuliani (2021a) shows that students' mathematical reasoning abilities can be influenced by independent learning.

Another factor that can be said to be important is the student's gender. The influence of gender differences will give rise to students' physiological and psychological differences in learning. Therefore, male and female students certainly have differences when learning mathematics. However, Kartika (2020)believes that gender differences not only lead to differences in mathematical abilities but also differences in how to gain mathematical knowledge (Nugraha, 2020a). The perception that female students are less superior in mathematics can also affect mathematical proof abilities. Differences in

mathematical thinking between male and female students can affect the way they solve mathematical proof problems. Female students tend to be more diligent and determined than male students, while male students tend to be more confident than female students. Erawati and Purwati (2020) state that women often observe things that are concrete, practical, emotional, and personal, while men focus on things that are intelligent, abstract, and objective. In terms of ability between men and women, there is no significant difference, what is different is attitude.

According to Imran, Kadir, and Mustamin (2017), current learning does not only focus on cognitive aspects but also emphasizes emotional aspects. One of the influential emotional aspects is mathematical beliefs. Students' beliefs about mathematics being "strong" in solving mathematical problems can be seen through six scales proposed by Kloosterman & Stage (Hakim, Yuwono, Subanji, & Raharjo, 2016), namely: (1) I can solve mathematical problems by taking time; (2) There are word problems that cannot be solved with simple, step-by-step procedures; (3) Understand important concepts in mathematics; (4) Word problems are important in mathematics; (5) Effort can improve mathematical abilities; and (6) Mathematics is useful and relevant to real life. Students' lack of confidence in their mathematical abilities and low student motivation can influence a person's attitude and views toward mathematics. Students assume that lessons are difficult, abstract, and formulaic and only smart people can deal with mathematics lessons, this makes students make errors in beliefs or responses due to a lack of confidence (Tanzila & Nasution, 2022). When students cannot solve mathematical problems, understanding and emotions will form and conceptualize individually in mathematical behavior that motivates and finding their thought patterns is a positive influence of belief.

Learning independence, gender, and mathematical beliefs interact with each other and influence a person's ability in mathematical proof. Learning independence and mathematical beliefs have a significant influence on students' motivation and approach to proof. Gender can influence the way they approach and perceive mathematics, although this influence is often influenced by social and cultural factors. Realizing and understanding these influences, researchers have research objectives, namely to identify the joint influence of learning independence, gender, and mathematical beliefs on mathematical proof, to identify the influence of learning independence on mathematical proof; the influence of gender on mathematical proof; and the influence of mathematical beliefs on mathematical proof; students of SMA N 1 Ngawen, Blora. This research is expected to provide benefits, especially to students, in developing mathematical proofs that are needed, including learning independence, gender, and mathematical beliefs.

## METHOD

The type of research used is quantitative research, to identify the influence of the independent variable on the dependent variable. The independent variables used in this research are learning independence, gender, and mathematics beliefs. Meanwhile, the dependent variable in this research is mathematical proof. This research was students from SMA N 1 Ngawen, Blora. The samples used were students X.6, X.8, XI.9 The sampling technique used was the Purpose Sampling technique.

This research instrument consists of tests and non-tests, mathematics proof tests, learning independence questionnaires and mathematics belief questionnaires. Learning independence and mathematics belief questionnaires each use the Likert Scale. In this research, mathematical proof indicators are used according to Utari and Hartono (2019) of six items, but the researcher focuses on four indicators, namely: (1) students are expected to create a pattern to produce conjectures, (2) students are expected to determine whether an allegation is true or false and include the reasons, (3) students are expected to write evidence for a statement, (4) students are expected to determine whether an argument is true or false. on the mathematical proof indicator using semantic validity, namely by looking at the suitability of the data and interpreting according to the concept by experts, by conducting checks/examinations by experts (expert judgment)(Utari & Hartono, 2019). Expert judgment instruments in this study were carried out by two experts. The mathematical proof test contains 4 short questions consisting of mathematical proofs about the relationship of angles on two parallel lines, proof of congruent triangles, proof of odd-even numbers, and proof of quadratic equations.

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The learning independence instrument consists of 5 indicators, namely (1) Confidence in yourself; (2) behaving disciplined in the learning process; (3) Not relying on other people; (4) having a sense of responsibility; (5) having activeness and initiative in learning Mulyaningsih (2014)which will then be tested for validity using SPSS 23. Each indicator consists of six positive statements, so the total of statements on the independent learning instrument is 30 positive statements. Examples of statements used in the independent learning instrument are "I have no doubts about the answers to the problems I am working on, I study alone without the help of others, I submit assignments given by the teacher on time, I can spend time doing math assignments rather than playing, and I still study mathematics even though there is no homework or exams".

The mathematics belief instrument consists of 3 indicators of mathematics confidence, namely beliefs about the properties of mathematics, beliefs about mathematics learning, and beliefs about mathematics achievement (Sommerhoff, Brunner, & Ufer, 2021). The instruments then be tested for validity using SPSS 23. From each indicator, there are six positive statements, so the total statement on the mathematics confidence questionnaire is 18 positive statements. This statement is adapted from research conducted with a translation of the TEDS-M beliefs scale. An example of a statement used in the mathematics belief instrument is "Mathematics problems can be solved in many ways, students learn mathematics best by paying attention to the teacher's explanations, and only students who never give up can solve difficult mathematics problems".

The data analysis technique was carried out by testing the validity and reliability of the research instruments. Furthermore, the research prerequisite tests are the normality test, multicollinearity test, and heteroscedasticity test. The technique for determining the relationship between the independent variable and the dependent variable is multiple linear regression analysis consisting of simultaneous tests, partial tests, and coefficient of determination tests. The hypothesis testing criteria used are at the significance level $\alpha \leq 0.05$, the F-count value $\geq$ F-table, and the t-count value $\geq$ t-table, then the coefficient of determination value is determined to determine the partial percentage and simultaneous influence of the independent variables on the dependent variable in this research.

## RESULTS

The purpose of descriptive analysis is to describe the data so that it is easy to understand and informative. In this section, an overview of the data is presented which includes the average value (mean), middle value (median), frequently occurring values (mode), size of data distribution (standard deviation), maximum value, and minimum value. It will be presented in the following table:

Table 1. Descriptive Statistical Test Results

| | **Mathematics beliefs** | **Independent learning** | **Mathematics proof** |
|---|---|---|---|
| N | 100 | 100 | 100 |
| Mean | 68,44 | 106,30 | 11,47 |
| Median | 68,00 | 105,00 | 12,00 |
| Mode | 69 | 114 | 14 |
| Std. Deviation | 6,107 | 9,930 | 3,743 |
| Minimum | 53 | 75 | 3 |
| Maximum | 85 | 128 | 18 |

### Validity and Reliability Test

Data tabulation uses Microsoft Excel software and is processed using SPSS 23.0 tools. Next, the data were tested for validity for all items in the questionnaire statement on learning independence and mathematical belief based on decision-making using the Pearson Validity Test, with r-table N=100 at a significance of 5% in the distribution of statistical r-table values, so an r-table value of 0.195 was obtained. The data from the validity test shows that all the statement items in both the learning independence and mathematics belief questionnaires are said to be valid. Then for the reliability test, instrument decision making, if the instrument has a Cronbach Alpha value $\leq 0.60$ then it can be said that

the instrument is reliable. The resulting data processing shows that the Cronbach Alpha values for learning independence and mathematics confidence are 0.852 and 0.760, respectively.

**Analysis Prerequisite Test**

The purpose of the normality test is to see whether the residual value is normally distributed or not. The method used in this normality test is the one-sample Kolmogorov-Smirnov test with a limit value of α of 0.005. If the normality value is less than α then it can be said that the data is not normally distributed, conversely, if the test value is more than α then it can be said to be normally distributed. In this study, the sig value was 0.284>0.05, so the data was normally distributed. The multicollinearity test aims to check whether there is a relationship between the independent variables. A regression model is said to be multi-co-free if it has a VIF around one and a tolerance value close to one. Based on the SPSS 23.0 calculation, the VIF value for the variables of learning independence, gender, and mathematics confidence respectively is 1.297; 1,057; and 1.252, then the tolerance value for each independent variable is 0.771; 0.946; and 0.799. It can be concluded that the independent variable has a VIF value around 1 and a tolerance value close to 1. It can be assumed that there is no multicollinearity problem in the regression model. The heteroscedasticity test is used to determine whether, in the regression model, there is an inequality in the residual variance from one observation to another. The results of this research, namely the Scatterplot, show that there is no particular pattern at the points that form waves, circles, etc. The points spread above and below the number 0 on the Y-axis. The regression model in this research does not have heteroscedasticity problems.

**Results of Multiple Linear Regression Analysis**

One of the analyses used in this research is multiple linear analysis. This analysis is used to determine whether learning independence, gender, and mathematics beliefs work together. It will be presented in the following table:

Table 2. Results of Multiple Regression Analysis

| Model | | Unstandardized Coefficients | | T | Sig. |
|---|---|---|---|---|---|
| | | B | Std. Error | | |
| 1 | (Constant) | -1,305 | 4,833 | -,270 | ,788 |
| | Independent Learning | ,089 | ,042 | 2,133 | ,035 |
| | Gender | 1,033 | ,813 | 1,271 | ,207 |
| | Mathematical Beliefs | ,023 | ,067 | ,340 | ,735 |

Based on the table above, the following regression equation can be formed: Y= -1.305+0.089 X1 +1.033 X2 +0.23 X3. The results of the calculations that have been carried out produce an equation that shows that the X value is a regression which is assumed to be as follows:

1) The constant value is -1.305, meaning that if learning independence X1, gender X2, and mathematical confidence
2) The regression coefficient for the learning independence variable (X1) is 0.089. The coefficient shows a positive direction of influence, meaning that the more the learning independence variable (X1) increases, the higher the mathematics proof variable (Y).
3) The regression coefficient for the gender variable (X2) is 1.033. The coefficient shows a positive direction of influence, meaning that as the gender variable (X2) increases, the mathematical proof variable (Y) also increases.
4) The regression coefficient for the mathematics belief variable (X3) is 0.23, meaning that the coefficient shows a positive direction of influence, meaning that as the mathematics belief variable (X3) increases, the mathematics evidence variable (Y) also increases.

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The F test (simultaneous test) is used to determine whether the variables learning independence (X1), gender (X2), and mathematical confidence (X3) simultaneously have a significant effect on mathematical proof (Y). If the significance value is <0.05 then there is a significant influence on mathematical proof. It will be presented in the following table:

Table 3. Test F

| Model | F | Sig |
|---|---|---|
| Regression | 3,239 | 0,025[b] |

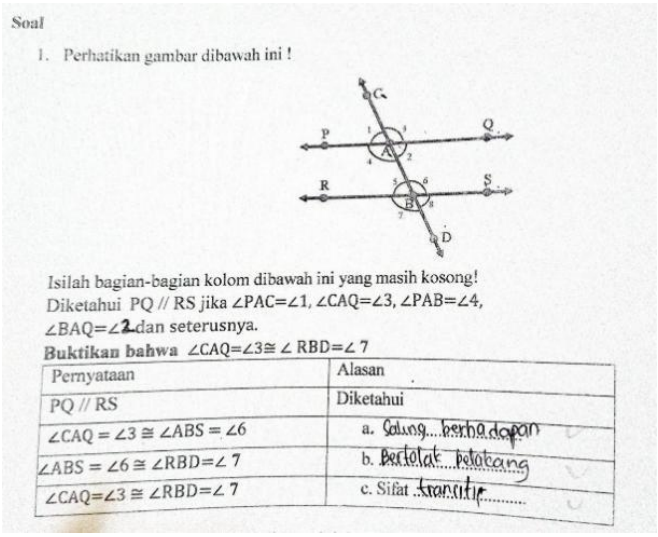
The results of the statistical test processing showed that the calculated F significance value was 3.239 with a significance level of 0.025 or below the standard of 0.05, which means that the factors of learning independence, gender, and mathematical confidence had a positive effect on mathematical proof for students in classes X.6, X.8 and XI.9 of high school. N 1 Ngawen, Blora.

The t-test (partial test) is used to determine whether the factors of learning independence, gender, and mathematical confidence partially have a significant influence on students' mathematical proof. The results of statistical test processing based on Table 2 show that the significant value of the learning independence variable is (Sig) 0.035 < (α) 0.05, so it can be concluded that H1 is accepted, meaning that the learning independence variable (X1) has a partial effect on mathematical proof. The significant value of the gender variable is (Sig) 0.207 > (α) 0.05, so it can be concluded that H2 is rejected, meaning that the gender variable (X2) has no partial effect on mathematical proof. The significant value of the mathematical belief variable is (Sig) 0.735 > (α) 0.05, so it can be concluded that H3 is rejected, meaning that the mathematical belief variable (X3) has no partial effect on mathematical proof.

The coefficient of determination test R Square is used to determine the magnitude of the contribution of one or more variables (independent variables) to the variation (increase/decrease) of other variables (dependent variables). Based on the R Square test results in the table above, it shows that the R Square value is 0.092 or equal to 9.2%. This states that the variables of learning independence, gender, and mathematical confidence in mathematical proof for students in classes X.6, X.8, and XI.9 SMA N 1 Ngawen, Blora.

**Item Number 1 Performs Mathematical Proof**

Question number one is a question about the relationship between angles on two parallel lines. Therefore, the work results of one of the students that are seen are how students make estimates of the answers shown by giving reasons and providing solutions to solving the problem. In this case, students answer questions that have been provided in the table and provide appropriate reasons. The results of the student's work can be shown in Figure 1.


Soal

1. Perhatikan gambar dibawah ini !

Isilah bagian-bagian kolom dibawah ini yang masih kosong!
Diketahui PQ // RS jika ∠PAC=∠1, ∠CAQ=∠3, ∠PAB=∠4, ∠BAQ=∠2 dan seterusnya.
**Buktikan bahwa** ∠CAQ=∠3≅ ∠ RBD=∠ 7

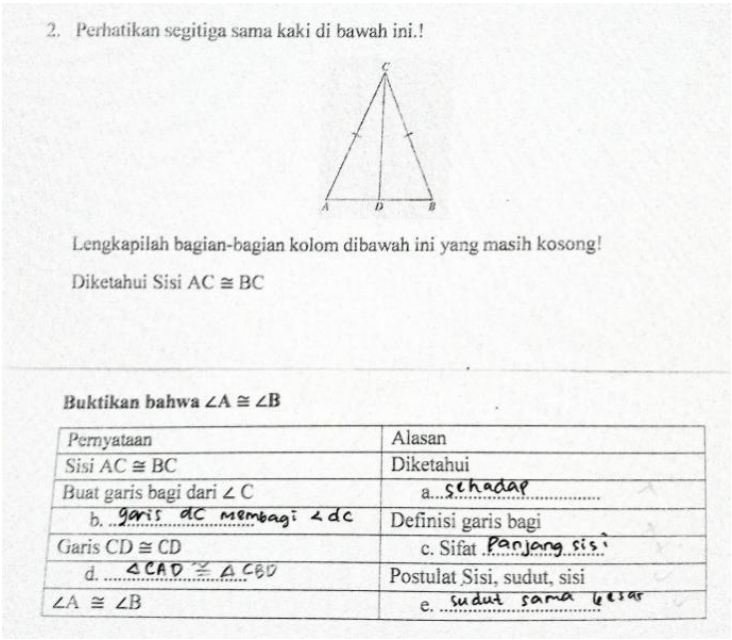
| Pernyataan | Alasan |
|---|---|
| PQ // RS | Diketahui |
| ∠CAQ = ∠3 ≅ ∠ABS = ∠6 | a. Sdung...berhadapan |
| ∠ABS = ∠6 ≅ ∠RBD=∠ 7 | b. Berpelat pelotang |
| ∠CAQ=∠3 ≅ ∠RBD=∠ 7 | c. Sifat transitif |

Figure 1. Result of student work for number 1

Based on the results of the students' work, it shows that they can work on the questions well. However, there are still some students who are still confused about solving the proof questions above.

**Item Number 2 Performs Proof**

Question number two is a question about proving congruent triangles. Therefore, the work results of one of the students that are seen are how students make estimates of the answers shown by giving reasons and providing solutions to solving the problem. In this case, students answer questions that have been provided in the table and provide appropriate reasons. The results of the student's work can be shown in Figure 2.



2. Perhatikan segitiga sama kaki di bawah ini.!

Lengkapilah bagian-bagian kolom dibawah ini yang masih kosong!

Diketahui Sisi AC ≅ BC

**Buktikan bahwa ∠A ≅ ∠B**

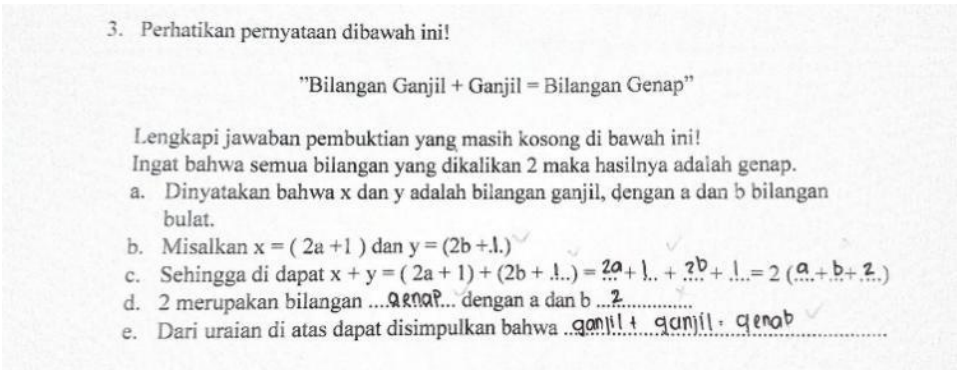
| Pernyataan | Alasan |
|---|---|
| Sisi AC ≅ BC | Diketahui |
| Buat garis bagi dari ∠ C | a. sehadap |
| b. garis dc membagi ∠dc | Definisi garis bagi |
| Garis CD ≅ CD | c. Sifat panjang sisi |
| d. ∠CAD ≅ ∠CBD | Postulat Sisi, sudut, sisi |
| ∠A ≅ ∠B | e. sudut sama besar |

Figure 2. Figure 1. Result of student work for number 2

Based on the results of the student's work, shows that there are still many students who have not been able to do the correct proof. In proof number two, some students are still working on the mathematical proof incorrectly.

**Item Number 3 Conducting Proof**

Question item number three is a question about proving odd and even numbers. For the results of one of the students' work, what is seen is how the student provides a solution to the question by completing the proof answer that is still empty. The results of the student's work can be shown in Figure 3.



3. Perhatikan pernyataan dibawah ini!

"Bilangan Ganjil + Ganjil = Bilangan Genap"

Lengkapi jawaban pembuktian yang masih kosong di bawah ini!
Ingat bahwa semua bilangan yang dikalikan 2 maka hasilnya adalah genap.

a. Dinyatakan bahwa x dan y adalah bilangan ganjil, dengan a dan b bilangan bulat.
b. Misalkan x = ( 2a +1 ) dan y = (2b +1.)
c. Sehingga di dapat x + y = ( 2a + 1) + (2b + 1..) = 2a + 1.. + 2b + 1..= 2 (a + b + 1..)
d. 2 merupakan bilangan ...genap... dengan a dan b ...z.....
e. Dari uraian di atas dapat disimpulkan bahwa ..ganjil + ganjil = genap

Figure 3. Figure 1. Result of student work for number 3

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Based on the results of the student's work, it shows that they can work on the questions well, but some students are not careful in writing the answers so parts 3d and 3e are not quite right.

**Item Number 4 Conducting Proof**

Question item number four is a question about proving quadratic equations. For the results of one of the students' work, what is seen is how the student provides a solution to the question by continuing the proof answer that is still empty. The results of the student's work can be shown in Figure 4.

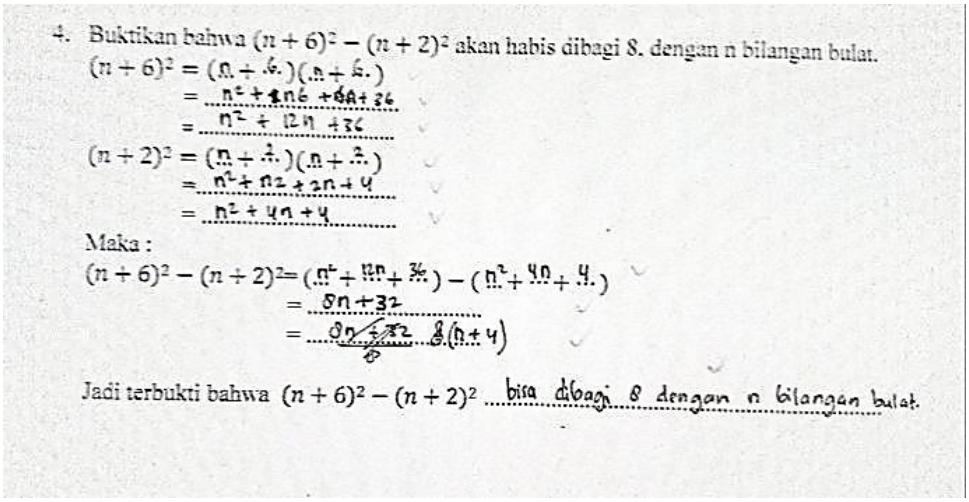


Figure 4. Result of student work for number 4

Based on the results of the students' work, it shows that they can work on the questions well. However, there are still students who have not been able to solve the questions with the correct proof.

**DISCUSSION**

Based on the results of data processing using the SPSS 23.0 software tool, the results of this research show that there is a positive influence of learning independence, gender, and mathematics beliefs together on mathematical proof, this can be seen from the results of the multiple regression analysis. Next, partial hypothesis results will be presented as follows:

**The Influence of Independent Learning on Mathematical Proof**

The results of this research show that there is a positive influence of independent learning on mathematical proof of the results of the t-test carried out by researchers. The results of this research are strengthened in the theoretical study put forward by Marniati, Jahring, & Yuliani, (2021b) that independence has a significant effect on students' mathematical reasoning. Herizal (2020) which states that the ability to prove mathematics is an ability that is included in mathematical reasoning. Bungsu et al. (2019) states that learning independence is defined as a student's ability to carry out learning activities with their motivation without any coercion or pressure from other people.

The results of this research are also strengthened by research conducted by Fajriyah et al. (2019) with the title "The influence of independent learning in junior high school students on mathematical reasoning abilities" with the results that there is a positive and significant influence of independent learning on mathematical reasoning which is by the discussion above on mathematical proof is part of reasoning ability. Learning independence is an internal factor that affects students' mathematical reasoning ability because this factor comes from within the student. Students who have learning independence tend to have better mathematical reasoning abilities than students who do not have learning independence (Dzulkifli, Samsudin, & Budi, 2022). Learning independence is the ability of students to control, organize, and develop their potential independently, responsibly, and without the help of others so that they can learn independently (Cahya, Effendi, & Roesdiana, 2021; Fajriyah, Nugraha, Akbar, & Bernard, 2019b). When students have an independent attitude in themselves, they carry out learning activities that do not depend on their friends so that when the math exam is held,

students consciously learn to take full responsibility for their learning outcomes (Firdausy, Setyaningsih, Ishabu, & Waluyo, 2019). One of the keys to the success of students' mathematical abilities is independent learning because with independent learning students have the responsibility to learn independently to develop their abilities in mathematical proof.

**The Influence of Gender on Mathematical Proof**

The results of the regression calculations show that gender does not affect mathematical proof. The results of this research are strengthened by research conducted (Nugraha, 2020b) with the research title "The Influence of Gender and Study Group on the Mathematical Reasoning Ability of Boarding School Students" with the results of one of the research results showing that there is no significant influence of gender on mathematical reasoning, where Mathematical proof goes into mathematical reasoning. However, this statement contradicts research conducted Utomo, Hendrayana, Yuhana, & Saputro (2021) which states that gender influences mathematical reasoning. The differences between males and females certainly cause differences in mindset and differences in how to deal with various problems in learning. It is said that men are superior in reasoning while women are superior in accuracy, precision, and precision of thinking. On the other hand, male students excel in processing visual knowledge while women excel in processing emotions and verbal knowledge.

However, researchers also agree with research conducted by (Waluyo & Vidákovich, 2021b) which states that there are no gender differences in understanding mathematical proof. Thus, the differences between males and females in solving proof problems do not provide evidence that one of them will solve proof problems well. This is by research conducted by the American Psychological Association (Yazidah, 2017). Seen from the difference in mathematical proof tests, female students are better than male students in mathematical proofs. This can be seen from the difference in the average score of mathematical proof, the average score of male students' mathematical proof is 10.5, and for female students is 11.8857, this is to research conducted by (Rachma, Ardianti, & Zuliana, 2022) mathematical reasoning ability possessed by female students is better when compared to male students.

**The Influence of Mathematical Beliefs on Mathematical Proof**

The research results show that there is no influence of mathematical beliefs on mathematical proof. This agrees with research conducted by Isharyadi & Deswita (2017) with the research title "The influence of mathematical beliefs on the mathematics learning achievement of high school students" with the results of the research showing that there is no significant influence of mathematical beliefs on mathematics learning achievement. However, this is different from research conducted by Tanzila & Nasution (2022) which states that there is a significant influence between mathematical beliefs on mathematics learning outcomes.

Liviananda & Ekawati (2019) states mathematical beliefs are students' perspectives that are considered correct in the world of mathematics that can influence students' responses in learning mathematics and responding to mathematical problems that determine how they choose an approach to solving the problem. According to Xiao, Yu, & Yan (2009), it was shown that the strongest predictor was belief in the perceived ability to solve math problems, the more students believe in their abilities, the better their math grades. However, in this study, mathematical beliefs did not influence mathematical proof.

**The Influence of Learning Independence, Gender, and Mathematical Beliefs on Mathematical Proof**

The results of this study indicate that there is a positive influence of learning independence, gender, and mathematical beliefs together on the mathematical proof of students in Class X.6, X8, XI.9 of SMA N 1 Ngawen in the 2022/2023 Academic Year, this can be seen from the results of multiple regression analysis. In addition, hypothesis testing was carried out through the F test, the results of which can be concluded that learning independence, gender, and mathematical beliefs together have a positive effect on the mathematical proof of students in classes X.6, X8, XI.9 of SMA N 1 Ngawen in the 2022/2023 Academic Year.

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## CONCLUSION

After carrying out a series of observations and research as carried out in the previous chapter, the final results or conclusions of the research carried out on students in classes X.6, X.8, and XI.9 SMAN 1 Ngawen, Blora for the 2022/2023 academic year as follows: (1) Learning independence, gender and mathematical beliefs together have a significant effect on mathematical proof, (2) Learning independence has a significant effect on mathematical proof, (3) Gender has no effect on mathematical proof, (4) Mathematical beliefs have no effect on mathematical proof.

## REFERENCES

Ariani, S., Prayitno, S., Tyaningsih, R. Y., & Arjudin, A. (2022). Pengaruh Kemandirian Belajar Terhadap Kemampuan Penalaran Matematis Materi Barisan dan Deret di Masa Pandemi COVID-19. *Griya Journal of Mathematics Education and Application*, *2*(4). https://doi.org/10.29303/griya.v2i4.250

Bungsu, T. K., Vilard, M., Akbar, P., & Bernard, M. (2019). Pengaruh Kemandirian Belajar Terhadap Hasil Belajar Matematika Di Smkn 1 Cihampelas. *Journal on Education*, *1*(2), 382–389.

Cahya, I. M., Effendi, K. N. S., & Roesdiana, L. (2021). Pengaruh Kemandirian Belajar Terhadap Kemampuan Penalaran Matematis Siswa SMP. *Anargya: Jurnal Ilmiah Pendidikan Matematika*, *4*(1). https://doi.org/10.24176/anargya.v4i1.6080

Dewi, N. S., & Dasari, D. (2023). Systematic Literature Review: Kemampuan Pembuktian Matematis. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *7*(1), 240–254. https://doi.org/10.31004/cendekia.v7i1.1987

Dzulkifli, M., Samsudin, A., & Budi, A. S. (2022). Analisis Tingkat Kompetensi Mahasiswa Terhadap Capaian Pembelajaran Mata Kuliah Pada Dacum Chart Program Studi Teknologi Industri Pangan. *Jendela Pendidikan*, *2*(03). https://doi.org/10.57008/jjp.v2i03.253

Erawati, N. K., & Purwati, N. K. R. (2020). Kemampuan Pembuktian Matematika Berdasarkan Gender Dan Gaya Belajar. *Prima: Jurnal Pendidikan Matematika*, *4*(2), 109. https://doi.org/10.31000/prima.v4i2.2617

Fajriyah, L., Nugraha, Y., Akbar, P., & Bernard, M. (2019a). Pengaruh Kemandirian Belajar Siswa Smp Terhadap Kemampuan Penalaran Matematis. *Journal On Education*, *01*(02), 288–296.

Fajriyah, L., Nugraha, Y., Akbar, P., & Bernard, M. (2019b). Pengaruh Kemandirian Belajar Siswa SMP Terhadap Kemampuan Penalaran Matematis. *Journal On Education*, *01*(02).

Firdausy, A. R., Setyaningsih, N., Ishabu, L. S., & Waluyo, M. (2019). The Contribution of Student Activity and Learning Facilities to Learning Independency and its Impact on Mathematics Learning Outcomes in Junior High School. *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, *1*(2), 29–37. https://doi.org/10.23917/ijolae.v1i2.8104

Hakim, A. R., Yuwono, I., Subanji, & Raharjo, S. (2016). Studi Kuantitatif: Perubahan Keyakinan Mahasiswa tentang Matematika Sebelum dan Saat Kuliah di Politeknik. *Jppm*, *9*(1), 50–62.

Hasan, M., Harahap, T. K., Mainuddin, Trisnawati, S. N. I., Nuraisyiah, Hamzah, H., Atirah. (2023). Pengantar Pendidikan Indonesia: Arah Baru dalam Membentuk Profil Pancasila. *Penerbit Tahta Media*.

Herizal, H. (2020). Faktor yang Memengaruhi Kemampuan Pembuktian Matematis Siswa [Factors that Influence Students' Mathematical Proof Ability]. *Jurnal Pendidikan Matematika Dan Matematika*

*Program Studi Pendidikan Matematika Fakultas Keguruan Dan Ilmu Pendidikan Universitas Islam Lamongan*, *2*(1), 33–42.

Imran, A. P., Kadir, & Mustamin, A. (2017). Analisis Literasi Matematik dan Keyakinan Matematik Siswa SMA Negeri di Kota Kendari. *Jurnal Pendidikan Matematika*, *8*(2), 159–168.

Isharyadi, R., & Deswita, H. (2017). Pengaruh Mathematical Beliefs Terhadap Prestasi Belajar Matematika Siswa Sma. *Pythagoras*, *6*(1), 1–10. https://doi.org/10.33373/PYTHAGORAS.V6I1.596

Kartika, D. L. (2020). Aktivitas Metakognisi Mahasiswa dalam Pemecahan Masalah Program Linear (Studi Kasus Berdasarkan Perbedaan Gender). *Square : Journal of Mathematics and Mathematics Education*, *2*(2). https://doi.org/10.21580/square.2020.2.2.6481

Liviananda, F., & Ekawati, R. (2019). Hubungan Keyakinan Siswa tentang Matematika dan Pembelajarannya dengan Kemampuan Matematika. *Jurnal Ilmiah Pendidikan Matematika*, *8*(2).

Lubis, L., Abdillah, A., & Lubis, H. K. (2020). IJLRES - International Journal on Language, Research and Education Studies ISSN : 2580-6777 ( p ); 2580-6785 ( e ). *International Journal on Language, Research and Education Studies*, *4*(2), 209–222. https://doi.org/10.30575/2017/IJLRES-2019091201

Marniati, Jahring, & Yuliani, W. (2021a). Pengaruh Kemandirian Belajar Terhadap Kemampuan Penalaran Matematis Siswa Kelas VIII SMP Negeri 1 Loea. *Arus Jurnal Pendidikan*, *1*(2). https://doi.org/10.57250/ajup.v1i2.5

Marniati, Jahring, & Yuliani, W. (2021b). Pengaruh Kemandirian Belajar Terhadap Kemampuan Penalaran Matematis Siswa Kelas VIII SMP Negeri 1 Loea. *Arus Jurnal Pendidikan*, *1*(2), 35–40. https://doi.org/10.57250/ajup.v1i2.5

Mujib, A. (2019). Kesulitan Mahasiswa Dalam Pembuktian Matematis: Problem Matematika Diskrit. *Jurnal MathEducation Nusantara*, *2*(1), 51–57.

Mulyaningsih, I. E. (2014). Pengaruh Interaksi Sosial Keluarga, Motivasi Belajar, dan Kemandirian Belajar terhadap Prestasi Belajar. *Jurnal Pendidikan Dan Kebudayaan*, *20*(4), 441–451. https://doi.org/10.24832/jpnk.v20i4.156

Mundy, J. F. (2000). how. In *Notices of the American Mathematical Society* (Vol. 47, pp. 868–876).

Nugraha, D. A. (2020a). Pengaruh Gender dan Rombongan Belajar terhadap Kemampuan Penalaran Matematis Siswa Boarding School. *Jurnal Educatio*, *6*(2). https://doi.org/10.31949/educatio.v6i2.599

Nugraha, D. A. (2020b). Pengaruh Gender Dan Rombongan Belajar Terhadap Kemampuan Penalaran Matematis Siswa Boarding School. *Jurnal Educatio FKIP UNMA*, *6*(2), 232–241. https://doi.org/10.31949/educatio.v6i2.599

Payadnya, I. P. A. A. (2019). Investigation of students' mathematical reasoning ability in solving open-ended problems. *Journal of Physics: Conference Series*, *1200*(1). https://doi.org/10.1088/1742-6596/1200/1/012016

Rachma, D. M., Ardianti, S. D., & Zuliana, E. (2022). Tingkat Kemampuan Penalaran Matematis Siswa Kelas IV Ditinjau Dari Gender Di SD N Galiran. *WASIS : Jurnal Ilmiah Pendidikan*, *3*(2), 108–112. https://doi.org/10.24176/wasis.v3i2.8651

 *Print ISSN: 2088-2157, Online ISSN:* 2580-0779

Rifandi, R. (2017). Supporting Students' Reasoning About Multiplication of Fractions by Constructing an Array Model. *JRAMathEdu (Journal of Research and Advances in Mathematics Education)*, *1*(2), 99–110. https://doi.org/10.23917/jramathedu.v1i2.3385

Samsudin, A., Setia Budi, A., & Dzulkifli, M. (2021). Jurnal jendela pendidikan. *Jendelaedukasi.Id*, *01*(02), 48–60.

Sommerhoff, D., Brunner, E., & Ufer, S. (2021). How Beliefs Shape the Selection of Proofs for Classroom Instruction. *Proceedings of the International Group for the Psychology of Mathematics Education*, *4*(March), 73–80.

Tanzila, S., & Nasution, H. A. (2022). Pengaruh Kecemasan Matematis dan Belief Matematika Terhadap Hasil Belajar Matematika Siswa. *Jurnal MathEducation Nusantara*, *5*(2), 21. https://doi.org/10.54314/jmn.v5i2.233

Tujuh, S. D. (2019). Pentingnya Ganjaran dan Hukuman terhadap Perilaku Kemandirian Siswa dalam Pendidikan Agama Islam. *Tarbawy : Jurnal Pendidikan Islam*, *6*(1). https://doi.org/10.32923/tarbawy.v6i1.864

Utari, T., & Hartono, H. (2019). Muatan penalaran dan pembuktian matematis pada buku teks matematika SMA kelas X Kurikulum 2013. *Jurnal Riset Pendidikan Matematika*, *6*(1), 1–13. https://doi.org/10.21831/jrpm.v6i1.17002

Utomo, H. P., Hendrayana, A., Yuhana, Y., & Saputro, T. V.D. (2021). Pengaruh Gender Terhadap Kemampuan Pemecahan Masalah dan Penalaran Matematis Ditinjau dari Minat Belajar. *TIRTAMATH: Jurnal Penelitian Dan Pengajaran Matematika*, *3*(2), 106. https://doi.org/10.48181/tirtamath.v3i2.12643

Waluyo, M., & Vidákovich, T. (2021a). Assessment of Students' Mathematical Proof Comprehension: Gender and Year Level Background. *Journal of Physics: Conference Series*, *1776*(1). https://doi.org/10.1088/1742-6596/1776/1/012017

Waluyo, M., & Vidákovich, T. (2021b). Assessment of Students' Mathematical Proof Comprehension: Gender and Year Level Background. *Journal of Physics: Conference Series*, *1776*(1). https://doi.org/10.1088/1742-6596/1776/1/012017

Xiao, C., Yu, P., & Yan, L. (2009). Influences on Affect and Achievement: High School Students' Epistemological Beliefs about Mathematics. In *Journal of Mathematics Education © Education for All* (Vol. 2).

Yazidah, N. I. (2017). Analisis Kesalahan Menyelesaikan Soal Pembuktian Geometri Euclid Ditinjau Dari Gender Pada Mahasiswa Ikip Budi Utomo Malang. *Kalamatika: Jurnal Pendidikan Matematika*, *2*(1), 71–80. https://doi.org/10.22236/kalamatika.vol2no1.2017pp71-80