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An Analysis of Students' Mathematical Curiosity in Online Learning Viewed from Academic Level and Gender

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ABSTRACT
Online learning affects students' curiosity, so it is important to develop students' curiosity during the pandemic. The purpose of this study is to describe and analyze students' curiosity about online learning. This study was conducted in the Department of Mathematics Education during the odd semester 2021/2022 with 106 students in three different courses. The research instrument was a mathematical curiosity questionnaire administered to students using the Google Documents application. The data analysis technique used was descriptive analysis. The results showed that the general curiosity of the students is classified as "strong" with a percentage of 75.17%. Academically, students with low, medium and high curiosity are considered strong with percentages of 74.07 percent, 76.5 percent and 75.12 percent. Measured by gender differences, the proportion of male and female students is 76.43 and 77.5 percent. Data analysis showed that in the era of the Covid-19 pandemic, curiosity about learning mathematics does not depend on the academic level of online learning or on gender differences. The effect of the result that the students during the Covid-19 pandemic, mathematical curiosity is still used in online learning and should be improved. This research contributes to the growing body of knowledge on mathematical learning in the digital age and offers practical recommendations for fostering mathematical curiosity in online.

KEYWORDS
Academic level; gender; mathematical curiosity; online learning

INTRODUCTION

In education, face-to-face meetings are no longer carried out due to strict health protocols that everyone must comply with. Consequently, there's a switch from offline learning system to online learning (Moyo et al., 2022; Nadeak, 2020).

Nevertheless, it will affect the motivation, interest and desire to learn for students, especially in higher education, and their curiosity about learning. A person can achieve success in life with strong curiosity. One is not satisfied with the information provided. Teachers should arouse students' curiosity, so they are motivated to analyze what is in learning (Kadek et al., 2020).

In addition, curiosity is defined as the behavior to know and find out about a problem (Fauzi et al., 2017). Curiosity leads students to explore new things in learning, thus it is essential to instill curiosity in students (Sthephani & Yolanda, 2021). Curiosity can also be interpreted as a positive trait that the purpose is to get something more interesting (Suhardin, 2021). Particularly, curiosity needs to be developed in learning mathematics. Dede et al. (2017) stated that mathematics is one of the core educational subjects and an essential skill in the 21st Century (Chimmalee & Anupan, 2022).

Curiosity is a tendency to ask, investigate and seek after gaining knowledge. The tendency to question things, investigate, and seek is a framework of thinking in deep curiosity about something. A person's high enthusiasm to seek answers to a question is a catalyst to develop one's scientific abilities (Binson, 2009) and curiosity is about seeking and finding activities so that they become enthusiastic (Suhadak, 2014).

Curiosity encourages intrinsic motivation to study and comprehend something, allowing it to be developed during the learning process. (Irna Hanifah Ameliah et.al, 2016 ; Mardiana & Suyata, 2017; Nurkamilah, 2017; Dwidayati, 2017). Aligned with these findings, the researcher conducted several studies related to students' mathematical curiosity (Zetriuslita et al., 2016a; Zetriuslita et al., 2020b ; Zetriuslita & Ariawan, 2021).

Instilling curiosity is important, therefore many studies discussed it (Bayuningrum et al., 2021; Fitriyani et al., 2020; Zetriuslita & Ariawan, 2021). Curiosity can be impactful for students to solve existing problems. Curiosity encourages students to create a discussion, ask questions, or do anything related to the attitude of curiosity (Irna Hanifah Ameliah et al., 2016).

If students already have a high level of curiosity, comprehension and learning outcomes will be achieved well. Each student has a different level of curiosity, hence problem-solving ability differs too. Thus, students will have a better ability to solve problems with curiosity. If their curiosity is good, there will be an increase in students' learning progress and comprehension.

Internal factor is one of the achievements in learning process (Novesar, 2020). One of the factors is curiosity. Curiosity concerning other topics is also better for the students rather than curiosity in science only. Therefore, teachers need to instill students' curiosity. Their problem-solving skill will be better too. It is aligned with Permendikbud no. 22 / 2016 about

Process Standards that one of the principles is "going from students are told to students will find out".

Teachers have carried out many ways in online learning, such as presentations using Microsoft PowerPoint and providing lecture notes in PDF files or videos. In this case, the researcher used online learning platforms such as WhatsApp and Google Classroom, uploading learning videos and sharing the handbook in PDF format. The use of online sources is a valid way for accumulating information as current research shows that online sources are, in many locales, the primary sources of information that open the way for new applications and realities (Zorba, 2023).

There is another factor that determines students' learning success, known as academic level. The academic level of each students has a significant effect on the problem-solving ability (Gayatri et al., 2013). Apart from that, gender difference is also influential, because there is a difference in psychology and learning outcomes of students. Therefore, each gender has its own way of acquiring mathematical knowledge (Zetriuslita et al., 2016a).

By finding out students' learning curiosity, using various approaches, it is expected that there is an improvement in curiosity that will affect their learning progress.

METHODS

The goal of this study is to use a quantitative approach to describe students' mathematical curiosity based on their academic level and a qualitative approach to analyze the quantitative results, so the research method used is descriptive quantitative and qualitative. This study's respondents include all 106 third-semester students (Number Theory and Integral Calculus courses) and fifth-semester students (Research of Mathematics Education) from the academic year 2021/2022.

Table 1.

Blueprint for a Mathematical Curiosity Questionnaire

No	Indicators	Sub-indicators	Number of Statements
1	Asking about information or problem/ questions the provided.	Asking and responding to given problem	10
2	Willingness to explore the details	Trying to investigate the problem	9
3	Enthusiasm in learning	Enthusiasm in having a discussion	10
4	Searching for the information from various sources	Reading related literature about the given problem	6
5	Trying to find the alternatives of problem solving	Trying to find a solution to the problem	5
	Total Statements		40

Instrument of the research is a questionnaire that the researcher has developed from curiosity indicators. The questionnaire consists of 40 questions that represent five indicators with a Likert scale, options for each answer namely Always, Often, Rarely, and Never. This questionnaire has been tested for feasibility and has a reliability score of 0,910 with Very High category. Next, a validity test was conducted to each statement in the questionnaire. Of all the forty items, it can be said that each question is valid because it gained a value of more than 0,2 in Corrected Item-Total Correlation.

The data collection was conducted by distributing the questionnaires to the respondents through Google Classroom. An analysis of quantitative data in this study is Microsoft Excel software. The analysis and interpretation of data obtained from the questionnaire used the following formula and criteria (Lestari & Yudhanegara, 2015) such as:

$$P = \frac{F}{N}$$

Description:
P: Percentage of answer
F: Frequency
N: Total of respondents

Table 2.
Interpretation of Score Interval

Score Interval	Criteria
P ≥ 81%	Very Strong
61% ≤ P < 81%	Strong
41% ≤ P < 61%	Fair
21% ≤ P < 41%	Weak
P < 21%	Very Weak

To classify students based on their academic level, it can be seen from students' final semester scores in Mathematics Lesson Planning, Integral Calculus, and Number Theory with score intervals and categories can be seen in Table 3:

Table 3.
Interpretation of Academic Level

Score Interval	Category
$x \geq \bar{x} + stdev$	High
$\bar{x} - stdev \leq x < \bar{x} + stdev$	Medium
$x < \bar{x} - stdev$	Low

Source: (Zetriuslita & Ariawan, 2021)
Description
x = Students' score

$\bar{x}$ = Average

$stdev$ = Standard deviation

The interview result was analyzed in a qualitative narrative manner by describing the information.

RESULT AND DISCUSSION

Result

Mathematical Curiosity of Mathematics students

The data was obtained using the questionnaire that the students received on the fifteenth meeting before taking the final term exam in three courses, namely Mathematics Lesson Planning, Integral Calculus, and Number Theory. The questionnaire distribution was organized online through Google Classroom. After the data were collected, the researcher analyzed the questionnaire given to the students are shown in Table 4:

Table 4.

Descriptive analysis of Mathematical Curiosity in terms of Courses

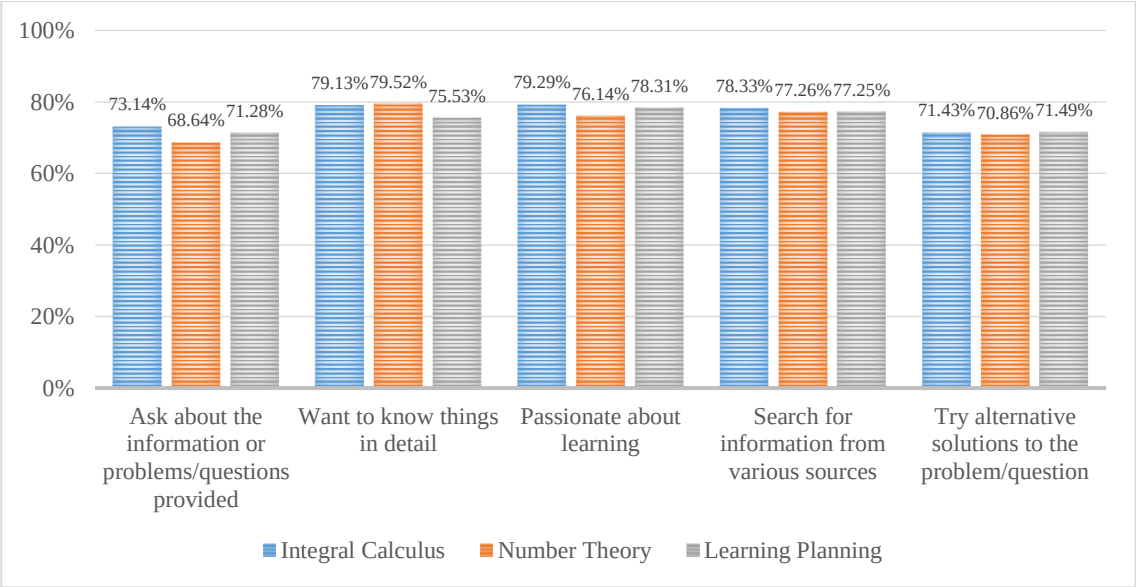
No	Criteria of Mathematical Curiosity	Total of Students (Person)			Percentage
		Lesson Planning	Number Theory	Integral Calculus	
1	Very Strong	16	8	11	33%
2	Strong	19	27	25	67%
3	Fair	0	0	0	0%
4	Weak	0	0	0	0%
5	Very weak	0	0	0	0%
Total		106 persons			100%

Source: *Processed data from the Researcher*

In table 4, it can be seen that the highest percentage is in the Strong criteria with a percentage of 67%, followed by "Very Strong" with a percentage of 33%. Then, an analysis of mathematical curiosity based on the indicators of each course can be seen in Figure 1.

Figure 1.

Diagram of percentage Mathematical Curiosity based on indicators in each course



Moreover, the researcher analyzed the data in regards to the result above. The result of Mathematical curiosity analysis based on the indicators can be seen in Table 5.

Table 5.

Results of Mathematical Curiosity Analysis Based on Indicators

No	Indicators	Percentage	Criteria
1	Asking about a piece of information or problem/ questions provided.	71,02%	Strong
2	Willingness to know things in detail	78,06%	Strong
3	Enthusiasm in learning	77,91%	Strong
4	Searching for the information from various sources	77,61%	Strong
5	Trying to find the alternatives of problem solving	71,26%	Strong
Total percentage		**75,17%**	**Strong**

Based on the table, it can be seen that all indicators reached the Strong criteria. Of the five indicators, “the willingness to know things in detail” gained the highest percentage (78, 06%). Meanwhile, the lowest percentage is in “asking about the information or problem” by 71,02%. It shows that the students have the strong curiosity about detailed information. Thus, the total percentage in this indicator is 75,17% and in the Strong category.

In classroom instruction, there is a difference in an ability called academic level. In this research, this level was divided into three groups; high, low, and medium. The category of students was conducted using the rule of interpretation of academic level presented in Table 3 above. As the score obtained by 106 students in the courses namely Integral Calculus, Number Theory, and Mathematics Lesson Planning, it was gained an average of 83,5 and standard

deviation of 10,3. Then, the final result of students' categories based on academic level can be seen in Table 6.

Table 6.

Score Intervals for Grouping Students' Academic Level

Score Interval	Category	Number of Students
$x \geq 93{,}8$	High	11
$73{,}2 \leq x < 93{,}8$	Medium	77
$x < 73{,}2$	Low	18
Total		106

Source: *Processed Data from Researchers*

Based on the processed data, it can be seen that majority of students are in medium level. However, the number of students with high level is still lower than the other categories. While the number of low-level students tends to be higher than students with high level, but less than students with low level. Furthermore, students' Mathematical Curiosity can be reviewed based on their academic level, with the results shown in the table.

Table 7.

Descriptive Analysis of Mathematical Curiosity Based on Academic Level

No	*Mathematical Curiosity* Based on Academic Level	Percentage	Criteria
1	Low	74.07%	Strong
2	Medium	76.5%	Strong
3	High	75.12%	Strong
Average		75.23%	Strong

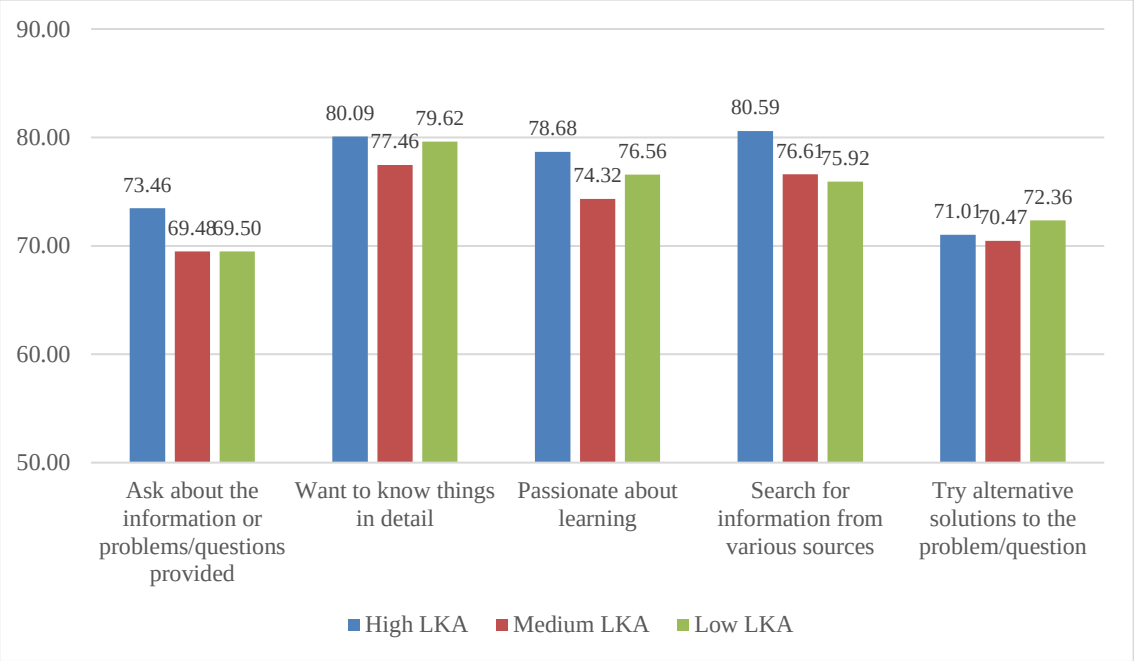
Source: *Processed Data from Researcher*

From the table above, it can be seen that the medium academic level has the highest percentage compared to the low and high levels. The low level has the lowest point compared to the medium and high levels. Besides, it also can be seen from the five indicators of Mathematical curiosity given to the students as the sample, are shown in the figure 2.

The figure 2 depicts that the indicator of high academic level is better than the medium and low academic levels. For students with medium academic level, it has a lower percentage and doesn't surpass the high and low academic levels. The percentage of medium academic level in indicators number 1,2,3, and 4 has the lowest percentage in the category of academic level.

Figure 2.

Comparison of the Percentage of Students' Mathematical Curiosity Academic Levels Based on Indicators



Students' Mathematical Curiosity Based on Gender Differences

Apart from being viewed from the academic level, curiosity can also be seen from gender. Here are the details of curiosity based on gender.

Table 8.

Descriptive Analysis of Mathematical Curiosity Based on Gender

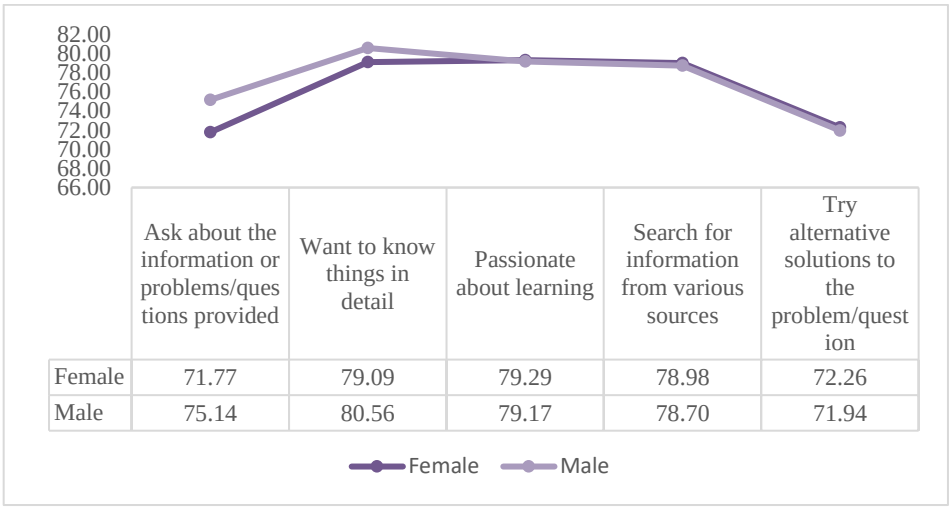
No	Gender	Number of Students	Curiosity Percentage	Criteria
1	Woman	92	76.43%	Strong
2	Man	14	77.5%	Strong
Total		106	76.96%	Strong

From the table 8, it can be seen that female students are more dominant in this research. It's quite common in the Faculty of Education. However, male students' curiosity is better than that of female students. Next, curiosity can be viewed from the indicators given on the questionnaire, as explained in the figure 3.

The figure below illustrates that there's a slight difference in the percentage of male and female students. In total, male students have a higher level of curiosity than that of female students. For both genders, indicator 2 (wanting to know things in detail) has the highest percentage of the others. Meanwhile, indicator 5 (trying alternatives from problem-solving) has the lowest percentage.

Figure 3.

Comparison of Percentage Mathematical Curiosity of Men and Women by Gender



	Ask about the information or problems/questions provided	Want to know things in detail	Passionate about learning	Search for information from various sources	Try alternative solutions to the problem/question
Female	71.77	79.09	79.29	78.98	72.26
Male	75.14	80.56	79.17	78.70	71.94

DISCUSSION

From the result of data analysis, it was found that students' mathematical curiosity during online learning is classified "Good". The percentage from the three courses reached 75,17% with Strong category. Therefore, it can be said that the courses are not quite different in terms of curiosity about the learning (2 mathematics science courses and 1 mathematics education course). Likewise, in terms of academic level and gender, there is no significant difference. It is in line with previous studies about students' curiosity. One of the factors to determine the difference in curiosity, both based on courses and academic level, gender, is direct learning (offline). There is a direct interaction among the students and teachers, and instilling curiosity will have more significant effect (Zetriuslita, et.al, 2021).

In terms of the indicators used, all of them are in "Good" category. In other words, online learning in three courses gave a positive effect on students' curiosity.

Students' difficulties, ranging from technical issues (internet data) to the lack of motivation, led to a slight decrease in the curiosity of some students. The researcher also found this difficulty during the learning process; students were also less enthusiastic about participating and had not taken the initiative to look for answers.

If curiosity can be seen from the academic level, students with a medium level of academic dominated with a percentage of 76,5%. When the research occurred, low-level students were too rushed, anxious, and panicked. Therefore, the researcher argued that this condition made students' academic levels in Good criteria. Curiosity is correlated with critical thinking, because one of the indicators is analyzing skill, one that can be performed if there is enthusiasm in looking for information from various sources. It is also an indicator of curiosity. In a previous study, there is no significant difference in students' critical thinking in terms of academic level (Zetriuslita et.al, 2016).

In terms of gender, the category is strong/good, there is no slight difference between men and women, adjacent to the past studies in Integral Calculus course, there is no difference in terms of gender (Zetriuslita et al., 2016b).

The result of this questionnaire is also supported by the result of online interviews using Google Classroom, generally used as an online learning platform during the Covid-19 pandemic. It has not fully improved their curiosity. One of the factors is the network issues. When the students tried to listen to the lecturer's explanation or play a learning video on Google Meet, they were not able to follow. Some respondents suggested that the lesson should be delivered via the Whatsapp group only if the internet was not working well because it could not be interrupted. For the students with no network issues, they hoped that there will be more materials through learning videos with explanations. Generally, the implementation of online learning did not encourage the students to be curious about the lessons.

However, a study showed that online learning gave a positive impact because it allows students to be more flexible so they can learn anywhere and anytime. They are free to do their tasks everywhere (Ferazona & Suryanti, 2020). In addition, theoretical learning is proven to be more effective than a practical approach in Health Department (Nadeak, 2020).

Based on the analysis of a questionnaire and online interviews, it can be concluded that students' mathematical curiosity during the Covid-19 Pandemic is good and the alternative of online learning has run properly, even though it met several constraints in the implementation and curiosity about mathematics learning doesn't rely on academic level and gender differences throughout online learning in the Covid-19 pandemic era.

From the results of this study, it can be said, during the covid-19 pandemic, by implementing bold learning using various ways such as what the researchers did, namely by sharing learning videos, presenting material in pdf form via google classroom, discussion and presentation of material, giving a positive effect on curiosity. students' mathematics, both for mathematics science (Integral Calculus and Number Theory) and mathematics education (Lesson Planning). This research contributes to the growing body of knowledge on mathematical learning in the digital age and offers practical recommendations for fostering mathematical curiosity in online

CONCLUSION

From the study and data analysis, some conclusions can be drawn. Mathematical Curiosity of students in online learning taken from three courses (number theory, integral calculus, and lesson planning) are described in the Strong criteria with a percentage of 75.17%, for low, medium, and high academic levels are included in the strong criteria with a percentage of each reached 74.07%, 76.5%, and 75.1 respectively, as for gender differences, male and female students were included in the strong criteria with the percentages reaching 76.43% and 77.5%, respectively. From the data analysis, it can be concluded that students' curiosity about learning mathematics does not rely on academic level and gender differences with online learning. The

recommendation from this study is that teachers can use various learning models to develop mathematical curiosity.

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