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A Case Study of Prospective Teacher Students' Views on the Position of Mathematics on Human Civilization

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Abstract- In everyday life, mathematics is essential as a tool, language, mindset, and knowledge, such as numeration systems, currency exchange tools, etc. Therefore, we should know the role or position of mathematics in human civilization. The selected research is qualitative with a case study method. Five mathematics education study programs selected two students to be research subjects. The instrument used in this study was an open interview. Each student is asked questions about their knowledge of the position of mathematics in human civilization. The data analysis used in this research is thematic analysis. The results showed four categories of how mathematics education students responded to the position of mathematics in civilization. The categories are theoretical history student, religious history student, contextual history student, and scientific history student. The four categories will be described in detail in this paper.

1. Introduction

Mathematics is a unique aspect of human thought, and its history is unlike any other (Arrifada et al., 2016). Mathematics was born and developed at the beginning of human civilization. History records that mathematics has been widely used in society since ancient times, although in its simplest form, such as counting and measuring (Fathani, 2019). This shows that mathematics solves problems in various areas of social life.

The history of the development of mathematics shows That there is a real interaction between mathematics and its applications. This shows that many mathematical ideas were developed in the context of the social reality of society at that time, for example, geometry (Rahadian, 2018).

RANGKIANG MATHEMATICS JOURNAL
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This branch of mathematics developed in ancient Egypt, where many farmers measured their farmland around the Nile, whose farmland was triangular. This process creates a method for measuring the area of a triangle. From this practical experience, it develops into other flat shapes (I. A. Wulandari & Budiyono, 2022).

The development of the world has never been separated from the vital role of mathematics. So that the development of the world always refers to the development of mathematics. Almost all fields require the development of mathematics in technological, industrial, economic, and political developments (Simanjuntak, 2021). So, it can be said that everyone, especially the next generation's students, needs math differently, depending on their needs.

Given the importance of the position of mathematics to civilization, society, especially the next generation, should know the importance of the part of mathematics in culture from time to time. But, many people underestimate the history and development of mathematics and do not even know the position of mathematics in civilization.

2. Methods

This research is qualitative research with a methodological study. Qualitative research is research that collects data in the form of non-numerical data. The data obtained in this type of research are interviews with five classes chosen by two people from the mathematics education study program about the extent of their knowledge of the position and development of mathematics in human civilization.

This study aims to determine the understanding of students in particular and society in general about the importance of studying the history of mathematics for human civilization. The instrument used is an open interview. Interviews were conducted to obtain accurate data and appropriate data sources. Analysis of research data is done by digging deeper into information about questions related to the main topic, breaking down the data into units, categorizing them, choosing which ones to study, and drawing conclusions that can be presented to others. The data analysis process begins with the researcher asking questions related to the material and giving these questions to the respondents (two students from each class).

3. Results and Discussion

Based on interviews and observations that have been made, the authors can describe the answers of each respondent to the questions that have been given. In this study, the authors obtained results regarding the extent of student knowledge in understanding the position of mathematics in human civilization.

Student 1 from class A expressed his opinion about the position of mathematics in human civilization. Here are the results of the interview.

"Mathematics has an important position in human civilization since mathematics is used as a language to convey information, and since mathematics is used as a calculating tool and technological algorithms, the development of human civilization has been in line with the development of mathematics until now."

Student 2, also from class A, has an opinion about the position of mathematics in human civilization. Following his narrative

"I think mathematics has an important position in civilization. For example, in ancient times, mathematics made calendars useful for counting days and compasses to determine the cardinal directions."

In the interview results above, the author sees that student 1 directs the position of mathematics to calculating tools, for example, counting days, also stated by student 2.

Furthermore, the results of interviews from class B turned out to have the same opinion but were rather broad from students 1 and 2. Student 3 argued that mathematics has an important position in civilization, as stated by students 1 and 2. Below is the whole narrative.

The answers to the interview of 3rd-grade B students are as follows.

"In my opinion, mathematics is universal science, and mathematics has helped human life in civilizations. A simple example can be seen in the culture at the time of the prophet Muhammad SAW, who was unfamiliar with technology. They use mathematics to determine the Qibla direction, the beginning and end of prayer times, count days by making hijriyyah calendars, weather forecasts, and much more. In this day and age, mathematics is overgrowing with the times. Here we can see that mathematics is very influential in a civilization that is getting more advanced. "

Another opinion was followed by student four from class B about the position of mathematics in human

math.ppj.unp.ac.id Rangkiang Mathematics Journal Vol. 1, No. 2, 2022

civilization.

"In my opinion, the position of mathematics is very influential, as now every component in life contains elements of mathematics. Of course, at the time of the ancestors, they used mathematics to determine the number of captured animals, which later developed to the present day."

Based on the results of interviews with student 4, the author can show that student 4 thinks of math in terms of food (a necessity of life) in the days of their ancestors, when math was used to figure out how many animals were caught.

Student 5, who came from class C, expressed his answer about the mathematics of human civilization regarding advances in science and technology, which, according to him, will also make civilization more advanced. Below is the whole narrative.

"The position of mathematics dramatically influences the development of civilization, especially in science, because mathematics is often seen as the mother of science. For example, the computer science discovery by mathematicians; from there, we can see that mathematics is increasingly leading us to a more advanced civilization. "

Furthermore, student 6, who also came from class C, expressed his opinion about his knowledge of the position of mathematics in civilization. Here are the results of the interview.

"I think that mathematics will always exist following the development of civilization. Regardless of the times and technology, mathematics will always exist and be applied. The term "mathematics is the queen of science." can mean that mathematics is the source and knowledge of all sciences.

The opinion expressed by student six above was also confirmed by student seven from class D. According to student 7, there is not a single science in this world that does not contain elements of mathematics.

Some articles in the field of education, such as civic education, contain elements of mathematics, namely numbers. Physical education and sports involve aspects of mathematics in determining the length and width of a field. Science education, which includes physics, chemistry, and biology, contains many elements of mathematics. From these examples, mathematics has an important position in the world of education, which will undoubtedly make civilization more advanced.

Furthermore, the opinion statement by student 8, who came from class D, regarding his knowledge of the position of mathematics in human civilization. Here are the results of the interview.

"The position of mathematics in human civilization is as a tool. The tool here can be interpreted as both a communication tool and a tool. Mathematics as a communication tool is a way of modeling something with symbols or numbers. We can see the shape of the number system that continues to grow. That is how they symbolize something by adapting to their respective cultures. Then mathematics as a tool means that mathematics can be a tool that can be used to solve a problem.

They were followed by the opinion of student nine from the international class. Student 9 had the same opinion as student eight that mathematics acts as a tool. Here, Student 9 is more likely to say what he thinks about what Student 8 spoke about the tool's purpose, which is to help solve problems.

I also have the same opinion as student 8, that mathematics has a position as a tool, meaning that mathematics helps humans solve problems, for example, by finding out the distance between two cities, finding out the benefits of a sale of goods or services, seeing the results of data collection that has been done, etc. With symbols, pictures, or charts, information can be presented according to the search results. A presentation is a form of communication that allows people to obtain information related to the problem quickly. However, so that the data can be displayed factually and accurately, the notification must first be processed according to the rules of mathematics.

The opinion of 10 students from the international class had a statement about the position of mathematics in human civilization, namely in the buying and selling process.

I'll give an example of the process of buying and selling. Buying and selling here have existed since ancient times. People used to buy and sell by barter, namely the activity of exchanging goods without involving money as a means of transaction, because, at the time, it didn't have a known currency. Hence, people there barter, like exchanging five sweet potatoes for two fish. "From this example, we know that there is an element of mathematics in it, meaning that mathematics has a significant position in a civilization."

Based on the respondents' interviews, four categories of students are named and described in Table 1.

Table 1. The Categorization of the Position of Mathematics Against Human Civilization

Category	Description
Theoretical History Student	Students talk about the position of mathematics in civilization only based on the theoretical level without mentioning contextual examples.
Religious History Student	Students talk about the position of mathematics in

Category	Description
	a civilization based on the theoretical level and relate it to the context of religion.
Contextual History Student	Students talk about the position of mathematics in a civilization based on the theoretical level and relate it to various aspects of life such as technology, industry, economics, politics, law, etc.
Scientist History Student	Students talk about the position of mathematics in a civilization based on the theoretical level, relate it to various aspects of life, and tell it to fields of science, such as science, etc.

The findings of previous researchers' research are linked to the relevant theories that have been developed above. The research focus, namely the extent to which students know about the position of mathematics in civilization, which is categorized into four categories, including theoretical history students, religious history students, contextual history students, and history students' scientists; for this reason, researchers will discuss the findings and compare them with previous studies.

(a) Theoretical Student History

The researcher's findings regarding the theoretical history of students or those who talk about the position of mathematics on civilization are only based on the academic level without providing contextual examples. This research is supported by (Wiriani, 2021) in his study entitled "History of the Development of Mathematics in the World of Education": Mathematics is one of the most important sciences in the world of education and is the basis of other fields of study. Mathematics is also very influential in different areas of study because almost everything in life requires mathematics. Currently, the development of mathematics is very rapid.

Other findings that align with these findings are (Ethel Silva De Oliveira, 2017) in his research entitled "The Role of Mathematics in Building Islamic Civilization": Along with the development of world civilization, the complexity of life's problems requires reliable and competent human resources. In the 21st century, it is foreseen that more jobs will require high-level skills that involve critical thinking, problem-solving, conveying ideas, and effective collaboration in building mathematical science-based relationships.

In other words, we can conclude that the history of mathematics is the history of the development of civilization. The history of mathematics shows that whenever and wherever a nation can focus on its mathematical knowledge, it can create extraordinary progress in all fields. Conversely, when mathematical knowledge is ignored, it will destroy a civilization.

(b) Religious History Student

The research findings on religious history students describe the position of mathematics in a civilization based on the theoretical level and relate it to the context of religion (religion). The results of this study are supported by (Maula et al., 2018) in their research entitled "The Development of Mathematics in the History of Islamic Civilization": Mathematics is a science that forms the basis or basis of other fields of study. The development of mathematics today is very rapid. This attracted the attention of mathematicians and made mathematics one of the fields of study that played an essential role in the history of civilization. In the history of Islamic culture, for example, mathematical trigonometry was used as a basic science in determining Qibla's direction, the beginning and end of prayer times, and the hijrah calendar.

This finding is also supported by (Abdussakir, 2009) in his research entitled "Muslims Need to Master Mathematics": In today's daily life, there is almost no field that does not use mathematics. Muslims have been introduced to and required to understand mathematics even in religious practice. In prayer, Muslims have been introduced to the concept of numbers. For example, five obligatory prayers, 17 rak'ahs, repeated three times, and congregational prayer 27 times better than praying alone. To learn and practice afraid, Muslims need to understand the concept of fractional numbers and their operations. The Qur'an introduces the concept of numbers through the number of letters and verses and their contents.

The Qur'an, which is the word of Allah, also speaks of mathematics. The Qur'an talks about numbers,

algebra, geometry, measurement, and statistics. The Qur'an mentions 38 different numbers, consisting of 30 natural and eight fractional numbers. The Qur'an speaks of algebra, namely relations and number operations. Number relations in mathematics include links more than (fauna or akhara), less than (adna), and more than equal. Number operations in the Qur'an include addition, subtraction, and division operations. The multiplication operation is implied as repeated addition.

Al-Qur'an talks about geometry and measurement: time, length, area, mass, and velocity sizes. Al-Qur'an also discussed data collection, processing, and concluding statistics. The deeds of all humans are recorded and collected in a sophisticated database, namely, *lauh mahfudz*, and processed through a scale called Mizan, which determines whether they go to heaven or hell.

Mathematics and astronomy were the most favored sciences by Muslims in the 8th and 9th centuries AD. Muslim mathematicians studied it to calculate inheritance and create an Islamic calendar. Mathematics or astrogeography is needed to determine the Qibla direction. Astronomy is also required to determine the beginning and end of a prayer, Ramadan fasting, and Muslim holidays.

Another research that supports (Nasaruddin, 2018) research entitled "Islamic-based mathematics learning": The Koran also contains many aspects of mathematics, such as inheritance law, as well as the socio-moral economic impact in this case, including the elements of commerce or trade. Worship also requires calculations, such as determining prayer times. Besides that, there is also a form of prayer transformation, or the rotation of the angle made when praying. One of the eclipse prayers is related to the occurrence of solar and lunar eclipses. In the eclipse prayer, there are two bowings. Each bowing is at an angle of 90 degrees. If they add up, it becomes 180 degrees. In mathematics, this forms a straight line. Hundreds of years later, new experts discovered that eclipses occur because the moon, earth, and sun positions are in a straight line.

The Qur'an implicitly instructs Muslims to study mathematics regarding the problem of afraid, namely issues relating to the arrangement and distribution of inheritance for heirs according to the parts specified in the Qur'an. For the estate distribution, it is necessary to know the amount of all estate left behind, the number of heirs entitled to receive it, and how much each is entitled to receive. To better understand and be able to carry out foreign problems well, the things that need to be understood first are mathematical concepts related to fractions, equivalent fractions, the idea of division, the most significant common factor (GCF), the least common multiple (KPK), and the concept of measurement, which includes measurements of the area, weight, and volume.

(c) Contextual History Student

The research findings on religious history students describe the position of mathematics in a human civilization based on the theoretical level and relate it to various aspects of life, such as technology, industry, economy, and politics.

This finding is supported by (Sudrajat, 2008), which describes the position of mathematics in the field of technology, with the research title "The Role of Mathematics in the Development of Science and Technology": The rapid development of science and technology is due to the support of mathematics. The basis for its support is the strength of mathematics in its structure and reasoning. The development of mathematics often opens up new possibilities for application in various other fields of science. On the other hand, the demands of problem-solving in multiple areas of science and technology also encourage the development of mathematics. Many mathematics graduates have worked in numerous fields, such as computers, insurance, banking, aviation technology, production processes, research, planning, and development. The profession of lecturers and mathematics teachers also always requires mathematics graduates. The need for a Bachelor of Mathematics is also related to the world's leading problems. Today, population explosion, hunger, infectious diseases, energy crises, and environmental crises are increasingly threatening humans. These problems can be solved through mathematical studies, such as the formation of mathematical models and computer simulations.

Still, in education, other studies that support these findings are: (Geometry & Analysis, 2008): Mathematics is a science that continues to grow and plays a significant role in the development of modern technology. Almost all social strata have felt this monumental role. This can be seen in all human activities often associated with mathematics. The result of science and technology (IPTEK) is very dependent on the development of education and teaching in schools, especially mathematics education, so mathematics must be used as one of the compulsory subjects in elementary schools, middle schools, and universities to produce reliable and competent human resources. Able to compete globally. For this reason, it is necessary to have high-order thinking skills, think logically and critically, and be able to

work together and communicate proactively.

Other research that supports this finding is to describe the position of mathematics in economics (Ahmad, 2021) in his study entitled "Basic Concepts of Mathematics in Economics": Economic activity has been a part of human life for thousands of years. Some basic economic concepts are expressed in simple mathematical forms, such as integers and fractions, followed by simple operations, such as addition, subtraction, multiplication, and division. Economic activities are increasingly complex and interrelated with other activities, thus requiring complex solutions. The more complex a problem is, the more complex the analytical tools used to solve it are. A mathematical model is one tool that can express the complexity of the problem.

For example, if prices increase or decrease, demand tends to reduce or increase; if costs increase or decrease, supply tends to increase or decrease; if investment increases, national income tends to increase; if the government and household consumption increases, national income tends to rise; and other relationships that are often found in daily economic activities.

Other studies supporting this finding are: (I. A. P. A. Wulandari & Puspadewi, 2016) in his research entitled "Culture and Its Implications for Creative Mathematics Learning": Mathematics is part of a culture, applied and used for innovative analysis. In this case, the mathematical paradigm is thought of as thinking skills and tools to develop a superior culture. Mathematics tends to be theoretically linear in thinking, but when it is integrated with something soft like culture, the review becomes flexible. For example, think about the forms of architectural beauty. The building structure is arranged mathematically, but the ornaments use aesthetics. The flexibility arises when the design is not only considered in terms of shape (three-dimensional geometry) but also must consider the sense of the beauty of the form. Various cultural products inherited from our ancestors show artistic creativity that contains elements of mathematics. For example, batik motifs have two-dimensional geometric structures, carved ornaments, and architectural forms in traditional houses with three-dimensional geometric designs.

(d) Scientist History Student

The researcher's findings regarding history Student scientists talk about the position of mathematics against civilization based on the theoretical level and relate it to various aspects of life and fields of science, such as science, sports, etc.

These findings are supported by (adhi, 2020) in his research entitled "Application of Mathematics to Natural Sciences": Mathematics is a science that promotes science as it provides the basis for calculations and logic. Science is never separated from mathematics. Even science will not be able to develop without mathematics. Without mathematics, humans cannot know the distance from the earth to the moon, the length from the world to the sun, or the earth's circumference.

In the field of chemistry, supported by (Isana, 1991) in his research entitled "the role of mathematics in chemistry," chemistry cannot be separated from mathematics. Mathematics is basic science and is used to solve problems that arise in other sciences, including chemistry. Chemistry is concerned with calculations that need to be solved mathematically. Mathematics is required to solve the problems that exist in chemistry and to achieve a higher level of precision. By using mathematics, it will be possible to obtain time, cost, and energy efficiency information.

In the field of physics, supported by research (Haryadi, 2016) titled "Correlation Between Basic Mathematics and Basic Physics," based on his knowledge, mathematics is a tool to be able to solve physics problems because physics cannot be separated from mathematical calculations such as addition, subtraction, multiplication, differential, integral, and others. Other.

As supported by (Nayazik, 2012): mathematics and physics have a close relationship. The relationship between the two is that (1) mathematical methods are used in physics, and (2) concepts, opinions, and ways of thinking in physics are used in mathematics. Thus, the relationship between physics and mathematics should not be ignored in scientific disciplines.

In the field of biology, mathematics is beneficial in biological research. Research results are often used as a tool to interpret mathematics. For example, in monohybrid crosses (crosses with the same or different traits) between red-flowered peas and white-flowered peas, with the help of mathematics, Mendel finally concluded that in the second generation, the phenotypic comparison results were red-flowered peas with white-flowered peas = 3: 1. What is meant by phenotypic comparison is the comparison of traits that are visible (observable) to the eye. Mathematics is the basis of all sciences. For example, in biology, there is also a mathematical element in gene crossing.

How these categories are obtained cannot be separated from the learning environment. How children learn what is being taught depends on the experience of the students themselves, the teacher, and the environment. How these categories are obtained cannot be separated from the learning environment (Harisman et al., 2020; Harisman, Kusumah, & Kusnandi, 2019; Harisman, Kusumah, Kusnandi, et al., 2019).

4. Conclusion

Mathematics plays an essential role in civilization. There is nothing in this world that does not contain elements of mathematics. However, with the development of the times and technology, mathematics will always exist and be applied. We can understand this from the word "mathematics is the queen of science." which can be interpreted to mean that mathematics is the source and knowledge of all sciences. The results of the research that has been carried out show that the students who are informants of this author's study know the position of mathematics against civilization with different answers. From these various answers, the authors found four categories of students regarding their knowledge of the work of mathematics in culture. The four categories are 1) theoretical history student, 2) religious history student, 3) contextual history student and 4) history student scientist.

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