An Exploration Of Mathematics Education Students' Understanding Padang State University Of Babylonian Mathematics

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Article Info	ABSTRAK
	Mathematics, as a science that has existed since ancient times, has a long history that dates back to the Babylonian civilization. However, not all Mathematics Education students have a good understanding of the mathematics of that era. This research aims to find out and explore Mathematics Education students' understanding of Babylonian Mathematics. This research uses a qualitative approach with literature review and case study methods To achieve these objectives, this research uses two methods, namely literature review and case study. The literature review was conducted to study the development of mathematics in Babylon based on various sources. Meanwhile, case studies were conducted by interviewing five Mathematics Education students of class 2024 who had not completed the History of Mathematics course. The results of this study are expected to provide a clear picture of students' knowledge of Babylonian Mathematics, including the number system, historical heritage, and mathematical concepts developed at that time. In addition, this study will also test students' ability to solve problems related to Babylonian Mathematics. The implication and benefit of this research is to measure how far the understanding of prospective mathematics teacher students related to Babylonian mathematics.

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Introduction

The word "math" comes from the Greek language and originally had a broad meaning that encompassed many different types of learning. Over time, however, the meaning of the word became more specific and referred to the study of numbers, shapes and patterns (Ayu Wulandari et al., 2022). The history of mathematics examines how mathematical concepts were discovered and developed over time, such as calculation methods and symbols used (Warmi et al., 2019). Babylonian mathematics is one of the branches of mathematics developed by the ancient civilization of Mesopotamia, now Iraq. Around 2500 BC and 400 BC, the Babylonians had created a mathematical system that was quite advanced in its time. They developed various mathematical concepts such as the number system and geometry, which became the basis for future mathematical developments (Aurelia, 2018).

The development of Babylonian mathematics is an important part of the history of mathematics (Ayu Wulandari et al., 2022). It is important to know the development of Babylonian mathematics in order to understand what the number system was like during the Babylonian period. It is also important to know the legacy of Babylonian mathematics and the advantages and disadvantages of the Babylonian mathematical notation system. By understanding the number system and the legacy of Babylonian mathematics, we can learn how ancient human thought contributed to the advancement of mathematics.

As students studying mathematics education become educators, this research will help them understand how Babylonian mathematics developed, how the Babylonian mathematical number system works, and what it has to do with Babylonian mathematics. It is necessary for teachers to make math learning more interesting by inserting interesting stories about mathematical discoveries in the past. Also, it helps students understand mathematics as part of the history of human civilization. In addition, teachers can explain to students how mathematical concepts were discovered.

According to Harisman (2023) research, many students actually claim to know nothing about history because they consider it unimportant. This turned out to be in accordance with the research I conducted. This study took a sample of several mathematics students of class 2024 at Padang State University who had not completed the History of Mathematics course. It seems that some students still do not understand or do not know how Babylonian mathematics developed, the number system of Babylonian mathematics, and things related to Babylonian mathematics.

Many studies have been conducted to understand the mathematics developed by the ancient Babylonian civilization in the current region of Iraq. One of the studies conducted (Harisman et al., 2023) shows that prospective teachers still lack understanding of the development of mathematics in the Babylonian era. Babylonian mathematics is found on clay slabs inscribed with nails found since the 19th century. These plates are the main source for studying Babylonian mathematics. The number system they used was a 60-based number system, different from the 10-based number system that we use everyday. However, these two systems have similarities in writing numbers, namely the number on the left has a greater value (Harisman et al., 2023). From the research conducted by (Harisman et al., 2023) it is shown that there are four categories of prospective teachers' understanding of the development of Babylonian mathematics, namely Naive pre-service student, Unhistory and Unnumeration student, History student, History and numeration student.

Methods

This research is qualitative in nature and adopts two main methods: literature review and case study. The literature review in this study is not only limited to identifying existing theories, but also aims to develop new theories or find gaps between existing theories and the results of research that has been done before (Cahyono et al., 2019). Meanwhile, a case study is a research design used to investigate in depth a contemporary phenomenon in a real-life context. This research involves intensive data collection through various methods over a period of time to achieve a comprehensive understanding of the case under study (Assyakurrohim et al., 2022).

This case study was conducted by interviewing five mathematics education students at Padang State University class of 2024 who had not completed the "History of Mathematics" course. The research instruments that will be used in this study are open interviews with five respondents, namely students with the Mathematics Education study program Batch 2024 at Padang State University and literature reviews obtained from books, journals and relevant internet sites about the period of the spread of mathematics. The data analysis technique is a thematic approach.

The following are the questions asked to respondents:
1) What do you know about Babylonian mathematics?
2) Explain what you know about the numeration system of Babylonian mathematics,
3) What do you know about the discoveries related to Babylonian mathematics?

Result and Discussion

Babylonian Mathematics

The Babylonian civilization, located in central-south Mesopotamia, has made significant contributions to the development of mathematics. Babylonian mathematics refers to the entire mathematical system developed by the nations of the region from the early Sumerian civilization to the Hellenistic period (Lispika, 2022). The discovery of a large number of clay tablets written from left to right is strong evidence that the Babylonians are the oldest known civilization to use a left-to-right numeral writing system. The term "Babylonian mathematics" is used to refer to the mathematical system that developed in the Babylonian region, which was at that time a significant center of mathematical studies. The interaction between Babylonian mathematics with Greek and Egyptian mathematics in the Hellenistic period has played an important role in the evolution of Greek mathematics.
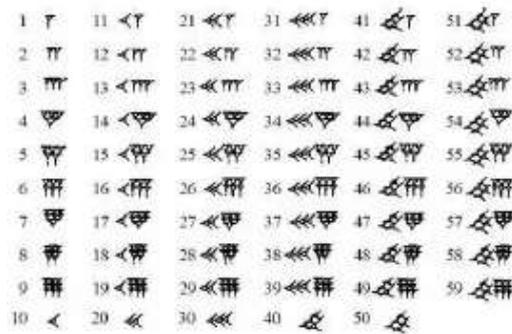

Figure 1. Babylonian Number System

The Babylonians developed a unique cuneiform writing, and they used a 60-based number system in their math. This number system greatly influenced the time and angle measurement systems we use today, such as the division of time into 60 seconds in a minute and 360 degrees for a full circle.(Lispika, 2022)

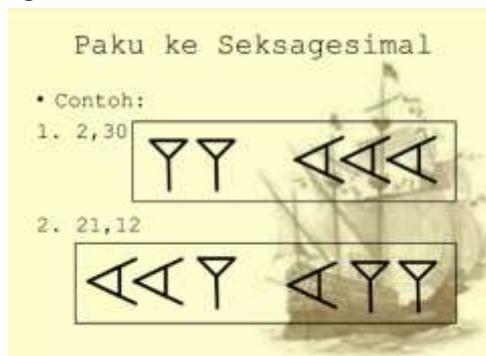Example:

1. Convert Nails to Sexagesimal

Figure 2. Converting Nails to Sexagesimal

2. Converting Sexagesimal to Modern Numbers
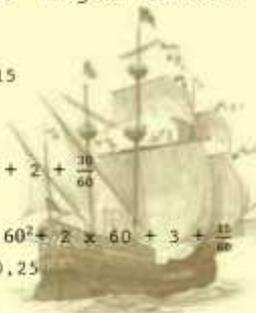
Figure 3. Converting Sexagesimal to Modern Numbers

3. Converting Modern Numbers to Sexagesimal
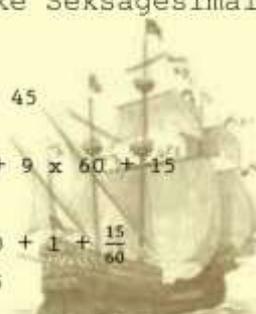
Figure 4. Converting Modern Numbers to Sexagesimal

4. Converting Fractions to Sexagesimal

Figure 5. Converting Fractions to Sexagesimal

5. Converting Sexagesimal to Fractions

Figure 6. Converting Sexagesimal to Fraction

Babylonian Math Legacy
1. Plimpton 322

Figure 7. Plimpton 322

The positional number system, which is the basis of the number system we use today, has been around since around 3100 BC. This system is characterized by the value of a digit in a number being determined by its position. The Plimpton 322 slab, an ancient artifact, provides empirical evidence of the Babylonians' deep understanding of the Pythagorean number concept, demonstrating the level of mathematical sophistication of the era.

2. Yale YBC 7289 Board

Figure 8. Yale YBC 7289 Board

The Yale board YBC 7289 is an ancient clay slab artifact from Mesopotamia. On the surface of this slab is a geometry diagram depicting a perfect square. This square has a side length of 30 units, which is clearly shown in the diagram.
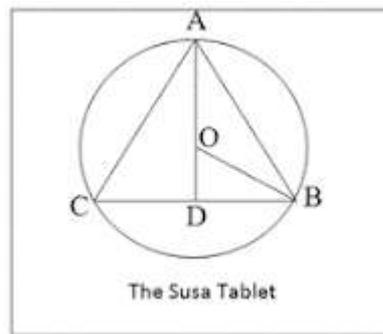
3. Susa Board

Figure 9. Susa Board

The Susa board is an ancient artifact that provides clues about geometric calculation methods in Babylonian times. The diagram on the board visually depicts the steps to determine the radius of the inner circle of an equilateral triangle. Using triangle ABC as an example, it shows how the line AD drawn from corner point A to the midpoint of side BC can be used to find the center of the circle and calculate its radius.

4. Tell Dhibayi Board

Figure 10. Tell Dhibayi Board

The Tell Dhibayi board is a mathematical artifact that presents a geometry problem. The problem aims to determine the length of a side of a square, with information provided in the form of the area and diagonal length of the square.

Advantages of Babylonian Mathematical System
1.   Recognized spatial shapes such as triangles and cubes.
2.   Already recognized the value of phi.
3.   Familiar with phytagoras theory.

Weaknesses of the Babylonian Mathematical System
1.   Did not recognize the comma to make decimal numbers
2.   Did not recognize the number zero
3.   No (-) sign yet
4.   Addition, subtraction, multiplication and division are still unclear.

Case Study of Mathematics Education Students of Universitas Negeri Padang Batch 2024 related to Babylonian Mathematics
After conducting interviews with five mathematics education students at Padang State University class of 2024 who had not completed the "History of Mathematics" course, questions 1) What do you know about Babylonian mathematics?, question 2) Explain what you know about the numeration system of Babylonian mathematics, and question 3) What do you know about the discoveries related to Babylonian mathematics?

The result is:
Researcher: "What do you know about Babylonian math?"
Student 1: "Babylon is the ancient name of the region now known as Iraq. Therefore, Babylonian math refers to the mathematical system that developed and was taught in the Mesopotamia region, which includes modern Iraq.
Researcher: "Explain what you know about the Babylonian mathematical numeration system?"
Student 1: "I don't know enough"
Researcher: "What do you know about the discoveries related to Babylonian mathematics?"
Student 1: "I don't know enough"

Researcher: "What do you know about Babylonian math?"
Student 2: "Babylonian mathematics refers to the mathematical system developed by the Mesopotamian civilization, which is now Iraq. One of the characteristics of Babylonian mathematics is the number writing system that starts from left to right, different from the number writing system commonly used today."
Researcher: "Explain what you know about the Babylonian mathematical numeration system?"
Student 2: "The Babylonian numeral writing system utilized a cuneiform script that was pressed on a wet clay slab. After the writing was completed, the slab was dried in the hot sun until it hardened and became immortal as a historical record."
Researcher: "What do you know about the discoveries related to Babylonian mathematics?"
Student 2: "Babylonian clay slabs"

Researcher: "What do you know about Babylonian math?"

Student 3: "Babylon was an ancient civilization located in the south central region of Mesopotamia."

Researcher: "Explain what do you know about the Babylonian mathematical numeration system?"

Student 3: "Babylonian mathematics used a 60-based number system, called sexagesimal. This system is still used today in measuring time and angles. For example, an hour consists of 60 minutes, and a full circle has 360 degrees."

Researcher: "What do you know about the discoveries related to Babylonian mathematics?"

Student 3: "Yale board YBC 7289, Plimpton 322, Susa board, and Tell Dhibayi board."

Researcher: "What do you know about Babylonian math?"

Student 4: "The Babylonian number system is the earliest known system of writing numbers where the value of a number is determined by its position in a number. This means that place value is very important in this number system."

Researcher: "Explain what you know about the Babylonian mathematical numeration system?"

Student 4: "Babylonian math uses a 60-based number system, or what we know as the sexagesimal system. This system is the basis for dividing time into 60 seconds in a minute, 60 minutes in an hour, and dividing angles into 360 degrees in a circle."

Researcher: "What do you know about the discoveries related to Babylonian mathematics?"

Student 4: "Plimton."

Researcher: "What do you know about Babylonian math?"

Student 5: "Babylonian math is one of the oldest mathematical systems originating from the Mesopotamia region, now known as Iraq."

Researcher: "Explain what you know about the Babylonian mathematical numeration system?"

Student 5: "The sexagesimal number system, you can say it uses repetition of numbers every 60 or base 60."

Researcher: "What do you know about the discoveries related to Babylonian mathematics?"

Student 5 : "I don't know much"

Table 1. Understanding categories of five Padang State University students with mathematics education study program Class of 2024

No.	Category	Description
1.	*very knowledgeable student*	Students who are very familiar with the historical development of Babylonian mathematics

No.	Category	Description
2.	*knowledgeable student*	Students who know the historical development of Babylonian mathematics
3.	*unknowledgeable student*	Students who do not know the historical development of Babylonian mathematics

From the results of the above research, it can be categorized as the ability of understanding related to Babylonian mathematics of mathematics education students of Padang State University class of 2024 in three categories, namely very knowledgeable student, knowledgeable student, unknowledgeable student.

Very Knowledgeable Student
Firdaus (2021) reminds us of the importance of studying history, even in this modern era. Students' interest in topics such as Babylonian mathematics shows that the younger generation is still curious about past civilizations.

Knowledgeable Student
The history of mathematics has a very crucial role in the learning process of mathematics. This awareness of the importance of history has encouraged some students to dig deeper, one of which is by studying Babylonian mathematics (Efendi et al., 2021).

Unknowledgeable Student
Efendi et al., (2021) found that not all students have a good understanding of Babylonian mathematics. One of the factors causing this is the lack of integration of the history of mathematics in the education curriculum in Indonesia. This condition causes students to have difficulties in learning mathematics and less aware of the importance of history in the development of mathematics, especially Babylonian mathematics.

Conclusion
Mesopotamia, which is now Iraq, was home to the Babylonian civilization that was famous for its achievements in mathematics. Around 2500 years BC, the Babylonians already had a complex and unique number system. One of the hallmarks of their number system was writing numbers from left to right, an innovation that was later adopted by subsequent civilizations.

This research provides a deeper understanding of the history of Babylonian mathematics, from the unique numeration system to significant mathematical discoveries. The results also identified three categories of student understanding of this topic, which can be the basis for developing more effective learning strategies. These categories are very knowledgeable student, knowledgeable student, unknowledgeable student.

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