

Ethno-mathematic Design in Statistical Analysis Content (Numeracy Literacy Development Study)

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Abstract:

The mathematics learning process can be carried out by using and utilizing social phenomena, culture, and other aspects. In the past and currently, mathematics has developed in culture and society, even integrating culture with mathematics. Therefore, it is necessary to involve existing phenomena to overcome various existing problems, including mathematical problems. Therefore, it is necessary to teach mathematics in schools by depicting the context of the origin of mathematical ideas by utilizing culture so that it becomes meaningful learning for students, in this case called ethnomathematics. This short article tries to examine Ethnomathematics Design. In Statistical Analysis Content (Numeracy Literacy Development Study). The method used in this research is ethnography with a qualitative approach. The research results show that the development of ethnomathematics design can go through the definition stage to the initial development stage. From this development stage, an ethnomathematics design in statistical analysis content was produced. The design of ethnomathematics in statistical analysis content is a must-see for the philosophical value of ethnomathematics in its development.

Keywords: Statistical analysis, Ethnomathematics, Numeracy literacy.

Introduction

Mathematics learning that presents materials, concepts, propositions, theorems and even axioms is access that has a close relationship between mathematics and human life. Mathematics also forms a person to have accuracy in solving a problem. Other abilities also lead to critical, systematic and structured thinking. Despite the fact that there are still many ideas, the idea in a study states that mathematics is something abstract and has not yet become the main activity in learning as a science that is familiar with life values and has "close ties to culture" (Hardiati: 2017). There are many cultures that can be used as learning resources, including studying mathematics.

Epistemologically, mathematics is a science that is factual, procedural and at the same time contains social values in it, in particular there are quite a few studies that examine the science of mathematics against the cultural values of society or what is usually called ethnomathematics. The term ethnomathematics can be said to be an old study but is still new enough to be internalized in mathematics learning.



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Ethnomathematics is carried out to identify ways or modes, arts, styles, and techniques that are inherited and regulated by various cultural groups . The community is to learn, explain, understand and to carry out various activities and overcome various problems involving the natural, social, cultural and imaginary environments (D' Ambrosio in Turmudi, 2016). This is in line with the view of Knijnik (1994), that mathematics is cultural knowledge that grows and develops to connect human needs.

By implementing ethnomathematics research, researchers will better understand people from different cultures regarding how they think , work, and relate to other people who have different cultures from one another. Ethnomathematics can help humans to understand activities, symptoms, phenomena and more importantly, help humans to understand what is related to mathematics in various cultural groups and its relationship to mathematics in the learning process at school. Ethnomathematics can help to know, recognize, appreciate and maintain human culture. Bishop (1994) States that mathematics is a form culture. Mathematics as form culture, actually has integrated in all over aspect community life.

However, various kinds of problems in the field regarding research, especially in West Kalimantan, have not yet been specifically recorded and recorded information on ethnomathematics values that can be explored, especially in the content of statistical analysis. So far it has only been limited to the culture and habits of certain tribes in the West Kalimantan area . Even though ethnomathematics is not limited to certain ethnic (ethno) cultures, it is ethnomathematics can linked with problems in everyday life and around activity man . This point of view involves regarding mathematics not only as a subject, but as a human activity, which is very closely related to local culture. This is in line with the views of Freudental and Gravemeijer , that mathematics is a human activity (Athar , 2012). According to Freudental (Heuvel & Panhuizen , 1996), mathematics must be connected to reality, remain close to children and be relevant to people's lives , including analysis statistics .

In a study, statistical analysis is one of the stages carried out in the research. Apart from being used for academic purposes, research can be used for the benefit of companies, government, industry, health and so on. Meanwhile, statistical analysis is an activity to analyze data which is the result of collection and measurement obtained repeatedly. Of course, the more data obtained, the closer the measurement and calculation results will be to the actual values and conditions. So the ideal measurement is a measurement with infinite data. However, in reality measurements always use limited data. And the statistical analysis that is commonly carried out is calculating the average value (Puriyanto, RD, & Rosyady, PA, 2021).

So statistical analysis is a data processing process which includes collecting, selecting, examining, changing, processing, calculating and modeling data. The aim is to obtain important and useful information so that it can be used as a basis for drawing conclusions and decisions. In carrying out this process, certain statistical methods or techniques will be applied that are adapted to the data conditions . Because there are

many types of statistical data that are usually used both in terms of acquisition methods consisting of primary data and secondary data. Based on nature, the data consists of qualitative data and quantitative data, and judging from measurements, there are nominal data, ordinal data and interval data.

When related to ethnomathematical design, what is meant is a process of processing data which includes collecting, selecting, examining, changing, processing, calculating and modeling data based on cultural, social and community phenomena. This process needs to link the researcher's experience with the social culture in the location or area of the research being conducted. The goal, of course, is to find useful information so that you can make decisions and conclusions based on ethnomathematics studies. And this is related to everyday life for students in the learning process. The hope is that mathematics can become a science that will be used to solve their various problems.

Why is ethnomathematics-based statistical analysis important? Because not everyone can read large amounts of raw data. Therefore, by analyzing the data, the data that has been collected will be processed in such a way that it is easy for other people to understand and comprehend, especially based on ethnomathematics which is appropriate to existing social and cultural conditions. Mathematics learning based on ethnomathematics is to combine, integrate and integrate mathematics learning with community culture. All activities in mathematics learning, including finding, calculating, drawing, measuring, designing, will be developed during the learning process and connected to cultural elements. When this learning process is linked to existing culture in accordance with students' daily life experiences, students can understand the mathematical concepts and material.

Various mathematical concepts that are outside educational institutions but are related to the culture and habits of society can be combined with mathematical concepts in educational institutions. So it is hoped that regional culture and community habits can be known and preserved as well as being a source of learning and a process of instilling mathematical concepts that are understood by students. The aim is for learning to be meaningful and can be interesting learning because it is in direct contact (*integration-interconnection*) with cultural realities and daily habits. Therefore, how to design development in ethnomathematics-based statistical analysis content , and can the philosophical values of ethnomathematics in statistical material be developed? As for This research aims to determine the ethnomathematics design in statistical analysis content in studies of student numeracy literacy development.

Ethnomathematics Values

Social, cultural and cognitive phenomena cannot be separated from each other in mathematics learning (Shoenfeld, 1989). Various approaches to mathematics learning, including contextual approaches, open-ended approaches, realistic approaches to mathematics, problem solving approaches, problem-based learning

approaches, have been attempted as solutions in the process of understanding mathematics. However, as time goes by, with the development of the learning process, a learning process that is linked to culture is also needed which can be combined with existing learning approaches. On the other hand, in the context of research, students in the experimental class generally have better results than the control class, but the results are still not satisfactory. Therefore, constructivism-based learning has developed which facilitates students to construct their own knowledge and this is based on the experiences they have had previously.

Ethnomathematics is mathematics applied by a group, be it a cultural group, a work group (farmers/laborers), or children from certain social classes, special professional classes, and so on (Gerdes & Tandiling in Hartono & Irvandi, 2020). Ethnomathematics experts are of the opinion that basically the development of mathematics will always be inseparable from the culture and values that exist in society. Ascher and Ascher (1997), ethnomathematics is more or less "the study of mathematical ideas from people who cannot read and write" (*non-literate*, illiterate). This definition suggests that mathematics is seen as containing a cultural component only when discussing mathematics from people who cannot read and write (Borba, 1990).

From this definition, ethnomathematics has a broader meaning. If viewed from a research perspective, ethnomathematics can be defined as cultural anthropology of mathematics and mathematics education. Mathematics, which is referred to as a basic science, needs to study and examine the basics of arithmetic or computing as applied in society to enrich the development of mathematics.

Ascher and D'Ambriaso (Dominikus in Hartono & Irvandi, 2020), emphasize that the focus of ethnomathematics is on people who have little or never studied mathematics at school. Furthermore, the meaning of culture was expanded not only to include ancient societies but also to cultural groups that were broader in scope.

Ethnomathematics can be referred to as mathematics that is practiced in various cultural groups such as ethnic groups, worker groups, children, certain age groups, professional groups and others. "Ethnomathematics is the mathematics which is practiced among identifiable cultural groups, such as national tribal societies, labor groups children of a certain age bracket, professional classes, and so on" (Dominikus, in Hartono & Irvandi, 2020). According to Borba and Meaney (Dominikus in Hartono & Irvandi, 2020), ethnomathematics is mathematical knowledge expressed in code, the language of a particular sociocultural group.

The several definitions of ethnomathematics above illustrate that ethnomathematics is related to mathematical practices, mathematical ideas, mathematical knowledge from a socio-cultural group of people which is related to calculations, grouping, sorting, inferring and modeling. (Hartono & Irvandi, 2020). Thus, a detailed analysis and description of the relationship between modern

mathematical concepts and ethnomathematics is needed so that it contributes to mathematics and mathematics education.

In a research context, ethnomathematics is a research program in the history and philosophy of mathematics with pedagogical implications for mathematics education, focusing on the arts and techniques (tics of techne) in explaining, understanding and facing/overcoming different socio-cultural environments (ethno) (D' Ambrosio and Horsthemke in Dominikus in Hartono & Irvandi, 2020). Gerdes suggests that ethnomathematics is a field of research that seeks to study and research mathematics or mathematical knowledge in relation to the overall culture and social life of certain cultural groups (Gerdes in Dominikus in Hartono & Irvandi, 2020).

So it can be understood that ethnomathematics is the study of the relationship between culture and mathematics. It refers to a group of ideas ranging from different numerical and mathematical systems. The aim of the study of mathematics is to contribute not only to understanding culture and understanding of mathematics, but especially to appreciating the relationship between mathematics and culture. (Hartono & Irvandi, 2020)

The Relationship between Mathematics Learning and Culture

According to the National Research Council (Cowan, 2006: 25 in Rahmita, 2010: 184-185), to develop mathematical thinking and the ability to solve problems, students need to "do" mathematics. This means that students need to interact with activities such as solving challenging problems, understanding patterns, formulating conjectures and checking them, drawing conclusions through reasoning and communicating these ideas, patterns, conjectures and conclusions. Based on this opinion, mathematics is important and must be mastered by students in a comprehensive and holistic manner, meaning that mathematics learning should optimize the existence and role of students as students.

Meanwhile, according to UNESCO (Sugiman 2009:415 in Rahmita, 2010:184-185), the trend of education contains four main pillars, namely: (a) *learning to know* ; (b) *learning to do* ; (c) *learning to live together* , and (d) *learning to be* . Based on these four points, mathematics learning is not just students' ability to understand (*learning to know*), but also includes students' ability to carry out mathematical activities (*learning to do*), students' ability to achieve achievements in mathematics (*learning to be*), to students' ability to communicate mathematics in everyday life (*learning to live together*).

Culture is all aspects of human life in society, which are acquired through learning, including thoughts and behavior (Marvins in Choirudin , 2020). Culture is the total knowledge of humans as social creatures which is used to interpret and understand the environment they encounter and to create and encourage the realization of behavior (Suparlan in Choirudin , 2020).

One cultural integration can be seen from mathematics learning, known as ethnomathematics . Ethnomathematics is a science that focuses on the relationship

between cultural relations and mathematics (Albanese & Perales , 2015). Ethnomathematics is an effort that can be made to bridge abstract mathematical concepts (Brandt & Chernoff , 2015). In addition, ethnomathematics has the potential to make students develop a more significant interest in learning and has the potential to be a solution to increase students' focus and ability to understand mathematical problems (Ogunkunle & George, 2015; Fitra & Gunawan, 2021).

According to Matlin (Sugiman, 2009, in Rahmita, 2010: 184-185), so that mathematical concepts can be useful and stored for a long time in students' *long-term memory* and not only stored in short-term memory, the learning carried out should pay attention to the principles -the following principles: 1) learning must be meaningful for students, 2) students are encouraged to develop what they learn, 3) students encode when studying mathematics in the form of elaboration, 4) students relate the learning material to their own experiences . Based on this, meaningful learning is very necessary so that the knowledge gained by students can stick in students' memories longer.

Saunders Mac Lane (1981, p. 465, Barton and Frank in Turmudi, 2018), as an algebra expert once stated that: " *Mathematics starts from a variety of human activities, disentangles from them a number of notions which are generic and not arbitrary, then formalizes these notions Thus... mathematics studies formal structures by deductive methods...* ". This means that mathematics originates from various activities in human life with a number of understandings and is derived until it is formalized, ultimately mathematics studies formal structures using deductive methods. And this shows that mathematics began as a human activity which gradually became the daily habits and culture of society.

Statistical Analysis

Statistical analysis is one of the stages carried out in research. Apart from being used for academic purposes in the form of research, statistical analysis is also used for the benefit of companies, industry, health, government and so on. Statistical analysis itself is an activity to analyze data which is the result of collection and measurement obtained repeatedly. Of course, the more data obtained, the closer the measurement and calculation results will be to the actual values and conditions. So the ideal measurement is a measurement with infinite data. However, in reality measurements always use limited data. And the statistical analysis that is commonly carried out is calculating the average value. (Puriyanto, RD, & Rosyady, PA, 2021). Data is a description of facts, meaning instructions that can be conveyed and processed by humans or machines. Data processing is a form of processing data to make the data useful according to the desired results so that it can be used. A data processing system is a system that carries out data processing .

analysis is a data processing process which includes collecting, selecting, examining, changing, processing, calculating and modeling data. The aim is to obtain

important and useful information so that it can be used as a basis for drawing conclusions and decisions. In carrying out this process, certain statistical methods or techniques will be applied which are adapted to the existing data conditions.

Statistics is a science that is always related to data. The more data obtained, the easier it will be to do a job. Therefore, statistics also have a big influence on quality improvement or improvement in quality. Why is that? As has been said previously, the more data collected, or the better the previous hypotheses obtained, the easier it will be to improve or improve the quality of a product. Likewise in planning a product planning), of course planning a product will be easier to do if we already have data that can support the product planning. This is also why statistics are considered important in making *yearly reports* , *personnel management* , and *market research* . Because statistics discusses the management, collection and interpretation of this data . (Meimaharani , R., & Listyorini , T. (2014))

As for the relationship with literacy, statistical literacy is an important ability to face the industrial revolution 4.0. According to Eza (2021), descriptive statistical calculations and making diagrams are found in all elementary school mathematics curricula from 2004 to 2020. In the 2013 curriculum and after, competencies related to data collection and data interpretation are also found. Competencies related to opportunities are only found in the 2013, Cambridge and 1975 curricula. There is still a need for curriculum development in statistical problem solving process competencies as well as deepening the use of descriptive statistics and diagrams appropriately. This means that learning statistics and statistical analysis content can start from elementary school to college.

Research Methods

Methods relate to subjects or respondents, research design, research procedures, and instruments used. This research uses descriptive research methods in the form of a literature review. Meanwhile , ethnomathematics research uses ethnographic research with a qualitative approach. According to Sugiyono (2014: 14) qualitative research methods are usually called naturalistic research methods because the research is carried out in natural conditions (*natural settings*) or also known as *ethnography methods* , because at the beginning this method used a lot of cultural anthropology research which is also called qualitative methods because of the data. collected and the analysis is qualitative.

In this research, library study techniques were used. Library studies or literature studies are activities to collect information that is relevant to the topic or problem that is the object of research or the topic of the story that is presented in a non-scientific written work. In general, literature studies are more often carried out by writers of scientific papers because they have stricter rules and regulations, compared to non-scientific papers. Then this term became familiar for research activities, because

at the beginning of research it was necessary to make a research plan proposal. Literature study to see expert opinions, books and research results.

As for the research steps, first carry out an analysis of the ethnomathematics content in statistics both in terms of study analysis and examining the materials, students' conditions, learning processes, assignments and evaluation. The next step is to examine the content analysis of the curriculum and materials at the educational level, and conduct a cultural study and its relationship to educational numeracy literacy. After that, conclusions and suggestions are made regarding the development of statistical analysis content that can be carried out.

Meanwhile, data analysis is the process of systematically searching and compiling data obtained from literature studies, field notes, etc. so that it can be understood and the findings can be informed to other parties. Data analysis is carried out by organizing data, describing it into units, synthesizing it, arranging it into patterns, choosing what is important and what will be studied, and making conclusions so that they can be conveyed to others. This research was carried out within the Mathematics Education Study Program of IKIP PGRI Pontianak which is located at Jalan Ampera No 88, Kota Baru, Pontianak, West Kalimantan.

Results and Discussions

Developing an ethnomathematics design in statistical analysis content can be done through research and development approach (R & D) steps. This method can be followed through four stages, namely defining, planning, developing and disseminating. However, before carrying out these four stages, it is necessary to carry out a needs analysis first. Before using traditional learning methods, a teacher must carry out a needs analysis. Although in theory this is logical and expected, in practice, many times various obstacles do not allow this to occur and this must be taken into consideration when using traditional learning methods (Hartono & Irvandi, 2020).

The needs analysis includes analysis of students, starting from physical, emotional and student perceptions which are important to assess. Some of these characteristics include attitudes, abilities, interests, and expected rewards. In terms of gender, it is necessary to know the differences between men and women in order to provide balance in learning. Different family backgrounds, some rich and some simple, also need to know the demographics of students, especially when using technology.

Apart from that, it is also necessary to analyze the appropriate learning media that will be used, especially when developing media from an ethnomathematics perspective. Among them, several traditional games can be used as a means and medium for learning statistics. One game that can be used is the traditional game congklak. This traditional learning also aims to help and reintroduce students to what students already know and what they need to learn to achieve the set goals.

The next analysis is task analysis. Statistics lessons at any level need to be known so that the assignments given are appropriate to the topic given and in line with students' daily lives. This is done to achieve the desired learning outcomes, a systematic teaching and learning process must be carried out in place, which is called "task analysis". Students must also understand concepts in mathematics subjects, especially concepts in statistics material. Therefore prerequisite knowledge for studying certain topics in statistics is also required. In this case, it is necessary to draw up an outline of the planned activities, what the students or students will do.

In evaluating if and at what level learning has occurred, assessment consists of formative and summative. In (Djunaedi, 2009) Planning for evaluating learning outcomes generally includes 6 types of activities, namely: (1) Formulating the objectives of carrying out the evaluation, (2) Determining the aspects that will be evaluated, for example cognitive, affective or psychomotor aspects, (3) Selecting and determine the techniques that will be used in carrying out the evaluation, (4) Develop measuring tools that will be used in measuring and assessing student learning outcomes, (5) Determine benchmarks, norms or criteria that will be used as a guide or benchmark in providing interpretation of the data evaluation results (6) Determine the frequency of learning outcomes evaluation activities.

Philosophical Values of Ethnomathematics

According to Eza (2021), descriptive statistical calculations and making diagrams are found in all elementary school mathematics curricula from 2004 to 2020. In the 2013 curriculum and after, competencies related to data collection and data interpretation are also found. Competencies related to opportunity are only found in the 2013, Cambridge and 1975 curricula. There is still a need for curriculum development in statistical problem-solving process competencies as well as deepening the use of descriptive statistics and diagrams appropriately. This means that learning statistics and statistical analysis content can start from elementary school to college.

So a study of philosophical values and paying attention to levels and stages in the mathematics learning process is very necessary to determine the differences in ethnomathematics values that will be processed into learning. However, you can also pay attention to students' development in the thinking process to understand the various phenomena they have acquired. So from the experience process that can emerge in mathematics learning which contains social and cultural values is as follows:

Table 1. Studies (Philosophical Values) in Learning Statistical Analysis Content

<i>No.</i>	<i>Material</i>	<i>Class</i>	<i>Philosophical Values (Life Application)</i>
1	Statistics	IV	Calculation: the basis for obtaining a value with clear and precise calculations. Examples in life that

<i>No.</i>	<i>Material</i>	<i>Class</i>	<i>Philosophical Values (Life Application)</i>
			are often used are to measure population growth, financial management, Logical : the use of statistics in the scientific thinking process based on inductive logic as a method for making decisions or conclusions. This inductive thinking starts from a number of specific things to arrive at a general formulation as a scientific law. For example, wanting to prove a temporary hypothesis requires further investigation and the use of appropriate (special) formulas until certainty is obtained through proof.
2	Data Collection and Presentation	V	1. Election of class president 2. Population census 3. Sales data for a company in 2020
3	Statistics	VI	Order : in statistical material there is a presentation of data where data is usually presented in order of smallest value to largest value. This is the same as when we live life, which of course starts from small things first to get big things. Balance : the presentation of data in statistics can be presented in a circle diagram, which can be applied in life, whichever is a basic need in life then it has a larger portion in the diagram. Dynamics : the presentation of data in statistics can be presented in a line diagram, the movement in this line diagram is not always constant, meaning that sometimes it decreases, sometimes it increases, just like the journey of human life which does not always run smoothly.
4	Statistics	VIII	Statistics play a very important role in everyday life and statistics play a role in explaining the relationship between variables, making plans, dealing with change, and making decisions. Statistics We can encounter in everyday life, namely: - Juvenile delinquency rate - Cost of living level - Traffic accident rate

<i>No.</i>	<i>Material</i>	<i>Class</i>	<i>Philosophical Values (Life Application)</i>
			- Income level per month
5	Statistics	XII	The philosophical values in the "Statistics" material are very useful in mathematics subjects, statistics can be useful in everyday life and are even used in all scientific fields, such as economics, sociology, health and even used in the office world. According to Boediono and Koster (Nisa & Susanti, 2019) stated that one country, namely Japan, has succeeded in applying the science of statistics, especially in the science of opportunities, in marketing various products made by its children, such as cars, motorbikes and even other electronic goods.

(Nisa & Susanti, 2019) stated that one country, namely Japan, has succeeded in applying the science of statistics, especially in the science of opportunities, in marketing various products of its children, such as cars, motorbikes and even other electronic goods.

Philosophical values in ethnomathematics-based mathematics learning should pay attention to the following principles: 1) Lessons must be meaningful for students. 2) Students are encouraged to develop what they learn richly. 3) Students encode when studying mathematics in the form of elaboration. 4) Students relate the lesson material to their own experiences as a form of self-reference effect. Based on this description, meaningful learning is needed so that the knowledge students gain from the learning process can stick in students' memories longer.

Lessons must be meaningful to show that the philosophical values above include religious values, motivation, orderliness, dynamics, equality or justice, rationality, regularity, proportionality, consideration, carefulness and thoroughness, honesty, calculation or consideration, and logic.

Students can also develop what they learn by carrying out various forms of solutions and various solutions. It is associated with various phenomena. Regarding students doing encoding in the form of elaboration, including with calculations, accuracy, accuracy and so on, supporting facilities are needed in terms of digitalization and databases. In the industrial revolution 4.0, it is necessary to revisit ethnomathematics learning which is linked to technological developments.

Meanwhile, linking learning with personal experience, including family relationships, making food, observing residential areas, vehicles, community needs in the form of water, distance, tourist areas, houses and residences, objects of various shapes, sales data, leadership elections, ranking order of performance and achievements, grouping phenomena, competitions, buying and selling transaction

processes in the market, savings, hobbies, currency, various games and sports, bridges and construction, nature, weather and natural disasters, crime incidents, work and income, business, technology, digital and computers.

From the explanation above, it is precisely what was stated by an algebra expert, Saunders Mac Lane (1981, p. 465, Barton and Frank in Turmudi, 2018) that: "Mathematics starts from a variety of human activities, disentangles from them a number of notions which are generic and not arbitrary, then formalizes these notions. Thus... mathematics studies formal structures by deductive methods...". This means that mathematics originates from various activities of human life, apart from them, a number of ideas are inherited and are not arbitrary, then these understandings are formalized so that mathematics studies formal structures using deductive methods. This shows that mathematics started as a human activity which gradually became the daily habits and culture of society

Based on the explanation above, it can be concluded as follows. First, the philosophical values of ethnomathematics in mathematics-based learning are carried out starting from various grade levels, levels of thinking and student development. From this stage various kinds of philosophical values are produced which can be applied in the form of media and teaching materials. Second, these ethnomathematics values adhere to the following principles: 1) Meaningful lessons for students. 2) Students can develop what they learn. 3) Students can adapt to technology by encoding when studying mathematics in the form of elaboration. 4) Students relate the lesson material to their own experiences as a form of self-reference effect.

Meanwhile, based on the weaknesses that have been revealed, the following are recommended. There is a need to develop media and teaching materials related to ethnomathematics values in mathematics learning. Next, specifically in the industrial revolution 4.0, the existence of digitalization and databases can be developed to support ethnomathematics-based mathematics learning, so it is necessary to carry out further studies regarding this matter.

Conclusions and Suggestions

Based on the research results, the development stages of the ethnomathematics design have been carried out starting from the definition stage to the initial development stage. From this development stage, we can design ethnomathematics designs in statistical analysis content. Ethnomathematical design in statistical analysis content can look at the philosophical values of ethnomathematics in its development, especially those that direct the development of numeracy literacy for students who are different at each level, level and thinking ability.

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