Humanistic mathematics learning in a scientific approach: what and how to implement it?

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**Abstract**. The purpose of this research is to describe what is meant by humanistic mathematics learning in a scientific approach and how to implement it. This research uses a literature study. Researchers examine ideas/concepts about humanistic learning and combine them with a scientific approach. Humanistic mathematics learning in a scientific approach is a learning innovation that can create a comfortable learning atmosphere and enable students to study mathematics with enthusiasm. The learning process with humanistic mathematics learning in a scientific approach pays attention to aspects of student psychology and aspects of humanity such as emotions, feelings, thoughts, and moods of students. During the learning process, in addition to providing a sense of comfort, the teacher also builds harmonious social relationships with students. Researchers conclude that humanistic learning in a scientific approach has the following learning steps. First, the teacher provides motivates the beauty and usefulness of mathematics in everyday life. Second, in observing activities, students make observations based on a harmonious relationship between teacher-student and student-student. Third, in questioning activities, the teacher provides opportunities to all students, regardless of differences. Fourth, in gathering information, activities are carried out based on trust from teachers to students. Fifth, in the process of reasoning, activities are carried out with mutual respect for the opinions of group members and teachers to maintain the stability of the spirit of student discussion. Sixth, students present the results of the discussion and get appreciation from the teacher.

1. Introduction

In the 21st century, every student is required to have excellent abilities and competences. The competences do not necessarily become good without going through a process, namely the learning process. Learning can help students to develop competencies that exist in themselves. Besides, learning is a factor that can determine student learning outcomes [1].

The learning process currently carried out in Indonesia is learning following the 2013 curriculum, which is a curriculum designed with the hope of balancing the development of spiritual and social attitudes, curiosity, creativity, cooperation, and psychomotor in students [2]. The 2013 curriculum suggests learning with a scientific approach through the 5M teaching and learning process [3]. The 5M process includes observing, questioning, gathering information, reasoning, and communicating [4]. The scientific approach is present to develop students' knowledge, skills, and scientific attitudes [5]. The teaching and learning process with a scientific approach makes students more active and not easily bored [6]. Students can build their knowledge and skills through the information found after conducting field investigations. Some mathematics teachers believe that a scientific approach is essential, has a good impact on student learning progress, and achieves learning mathematics [7].

The process of implementing the scientific approach in the 2013 curriculum has entered its 7th year at this time. Many researchers have researched the application of the scientific approach in the teaching and learning process in schools at all levels of education to improve student achievement and other abilities. The results of research conducted by Atika et al. and Indarti et al. showed that the scientific approach could improve student mathematics learning outcomes, which are marked by an increase in the average student learning outcomes [8][9]. The results of research by Nuralam and Eliyana showed that students' mathematical problem-solving abilities were better after learning with a scientific approach [10]. Another study was conducted by In'am and Hajar, the results showed that a scientific approach can improve student learning outcomes on geometry material [11]. Some of the results of these studies show a positive effect from scientific approach on mathematics learning outcomes. However, some abilities are still lacking even though a scientific approach has been applied. Mathematics learning outcomes are not only influenced by the learning approach. Many factors influence mathematics learning outcomes. When viewed from the psychological aspect of students, of course, anxiety in learning mathematics and students' belief in seeing mathematics are essential factors that affect mathematics learning outcomes. So that, the teachers should be aware of these factors.

Anxiety in learning mathematics or math-anxiety is a significant factor that affects mathematics learning outcomes. Students who have high math-anxiety levels will have low math learning outcomes [12, 13]. This condition occurs because students who have excessive anxiety tend to be afraid of mathematics and do not want to deal with mathematics.

Therefore, to answer these problems requires innovation in mathematics learning. Humanistic mathematics learning in a scientific approach presents a form of innovation with a modification between humanistic theory and scientific approach, which is a solution to improve student mathematics learning outcomes and overcome student anxiety in learning mathematics. Several studies have shown that humanistic mathematics learning can overcome math-anxiety and improve learning outcomes [14]. This research discuss: (1) what is humanistic mathematics learning in a scientific approach, and (2) how to implement humanistic mathematics learning in a scientific approach. With this research, humanistic mathematics learning in a scientific approach can be an alternative learning model to overcome math anxiety and improve student mathematics learning outcomes and be appropriately implemented in schools.

1. Method

This article discusses humanistic mathematics learning in a scientific approach to provide general and scientific information. The method used in this article is a literature study on the concepts, definitions, and research results of humanistic mathematics learning and a scientific approach with the following steps: (1) research question, (2) data collection, (3) data analysis.

* 1. *Research question*

The research aims to answer what is meant by humanistic mathematics learning in a scientific approach and how to implement humanistic mathematics learning in a scientific approach.

* 1. *Data collection*

In the data collection process, the first thing to do is search for research articles. Research articles are collected from reputable journals such as Science Direct, ERIC, Springer, and Taylor&Francis, which focus on the subject of mathematics education. The keywords used are *humanistic*, *humanistic mathematics*, and *scientific approach*. After the articles collected, the articles selected using the following criteria: (1) research articles that contain empirical evidence of the influence of scientific and humanistic approaches on mathematics learning outcomes, (2) the research subjects are students at the primary and secondary school level at the formal education level.

* 1. *Data analysis*

The data collected will then be analyzed in the form of literature that discusses humanistic mathematics learning and scientific approaches. In this article, some definitions, concepts, and forms of implementation of humanistic learning in a scientific approach to mathematics learning will be described. After conducting the analysis, they are then reducing the data by selecting literature that contains ideas about the implementation of humanistic learning and scientific approaches. The last is to make conclusions about the concept and implementation of humanistic mathematics learning in a scientific approach.

1. Discussion
   1. *Scientific approach*

The scientific approach is an approach suggested in the 2013 curriculum. Because the scientific approach is expected to develop three aspects, such as attitudes, knowledge, and skills. Through the development of these aspects, students can become polite, know, and have skills for a better life [15]. The learning process is carried out with a scientific approach through a scientific process. The scientific process is the most important means of organizing and producing the information found [16]. Students can construct their knowledge by making observations, asking questions, taking measurements, collecting data, interpreting data, making hypotheses, conducting experiments, then concluding and communicating them. Permendikbud no 81a of 2013 explains that the scientific approach is implemented in five steps. The steps are described as follows:

1. *Observing*. The observing stage is the stage of fulfilling students' curiosity. Students can make extensive observations on objects that have been presented by seeing, listening, listening, or reading. The observing stage prioritizes the meaning of learning.
2. *Questioning.* At the questioning stage, the teacher will provide the widest possible for students to ask questions about objects that have been observed. If students are still constrained and confused in asking questions, the teacher can provide a stimulus to provoke student curiosity. In the questioning stage, students will practice formulating questions and can form students' critical thinking.
3. *Collecting information.* Collecting information is a follow-up to the questioning activity. At this stage, students can collect and explore various information from various sources and in various ways.
4. *Reasoning.* In this stage, information obtained and collected will be processed and then look for the relationship between the information. Reasoning activity can also be interpreted as a logical and systematic thinking process based on information to arrive at conclusions and knowledge.
5. *Communicating.* After getting a conclusion, the teacher will provide opportunities for students to convey the ideas or knowledge they have obtained to other friends. This stage aims to develop students' competence in systematic thinking and expressing opinions concisely and clearly.
   1. *Humanistic theory in learning*

Humanistic theory is a learning theory based on psychology. The main contributors to the humanistic theory are Carl Rogers and Abraham Maslow. In humanistic theory, a teacher must understand his students' psychological condition, which includes the state of the heart, emotions, and feelings, so that during the learning process, students can feel comfortable, feel they are getting attention, and do not feel differentiated.

Humanistic theorists have the view that every student has confidence in his or her abilities, and this affects student motivation in learning [17]. For example, a student who has low self-confidence when faced with a new difficult problem will have the belief "I am not capable" in contrast to students who have high self-confidence will immediately be able to adjust the problem and have the belief that every human can change according to their needs.

The humanistic theory defines learning as the needs of every human being, which includes cognitive, emotional, and interpersonal aspects [18]. So, what is meant by fulfilling these three aspects is by paying attention to the relationship between the performance of students' thoughts and feelings during the learning process. Rogers [19] mentions some of the basics of humanistic learning as follows:

* Humans can learn.
* Good learning outcomes occur when learning matches student interests.
* Learning that is different from students' perceptions is considered a threat, and students tend to reject it.
* Threatening study assignments will be easier to assimilate if external threats are reduced.
* If the threat to students is low, the experience can be gained in various ways.
* Students will obtain meaningful learning by doing it.
* Humanistic learning occurs when students are involved in the learning process and decision making.
* The learning process acquires knowledge based on the student's personality, both feelings, and intelligence.
* With confidence, creativity will be easier to achieve.
* Learning is learning that focuses on the process.
  1. *Pembelajaran matematika humanistik dalam pendekatan saintifik*

Learning is a reciprocal process that involves students and teachers in a learning environment. Learning can also be interpreted as the process of transferring knowledge from teachers to students so that students can achieve competence. In process transferring knowledge, a teacher monitors students to understand the needs and circumstances of students. Teachers must realize that not all students in their class like mathematics lessons, and some students have dismay on mathematics lessons. If learning is still carried out without considering this, of course, student learning outcomes will not be optimal. So, the teaching and learning process the teacher teaches using an approach that pays more attention to students' situations.

Learning that pays attention to the psychological and human condition of students is humanistic learning. Learning mathematics that is carried out in a humanistic manner can be called humanistic mathematics learning. Tenant [20] explained that the primary goal of humanistic mathematics learning is students understand their understanding of mathematics in a creative, collaborative, and fun way, then keep students away from thinking that mathematics is a monotonous set of rules in solving a problem or practice has a useful purpose. Tenant's point of view, humanistic mathematics learning, is a lesson that tries to explore the human side of mathematical thinking and learning that leads students to discover the beauty of mathematics. A class that uses this learning makes students more excited and motivated to learn mathematics.

In implementing humanistic mathematics learning, Cibulskaite [21] has three main formulas that need to be considered when implementing humanistic mathematics learning. First is the learning material, where the teaching materials used contain complete explanations and highlight humanistic values ​​in it to stimulate students' humanistic feelings. The second is the method used in the teaching and learning process. The method used must create a conducive atmosphere for discussion, communication, and collaboration, creating a creative and active learning environment both individually and in groups. The third is the educational relationship between teachers and students and students with themselves. The teacher must create a harmonious classroom atmosphere between the teacher and students and the students themselves.

To create a harmonious classroom, teachers need to create a learning environment and atmosphere based on mutual respect and trust. Widjajanti [22] also explained some important things that teachers need to consider to make mathematics learning classes more humanistic. First, motivate before learning begins by explaining the benefits or beauty of mathematics. Second, not starting learning by providing definitions or formulas directly. Third, controlling student emotions and student enthusiasm during learning. Fourth, giving full attention to all students. Fifth, teacher must give appreciation for each student's learning progress. Sixth: making learning activities more varied, such as watching videos, holding outdoor classes, doing simple research, or playing games.

The form of implementation of humanistic mathematics learning has shown that mathematics learning needs to be combined with a learning approach that following humanistic criterion. Student-centered learning is a scientific approach. If the scientific approach is implemented humanistically, it will create a learning environment conducive to being in groups, active and creative. So with the modification of the humanistic mathematics learning model in the scientific approach, the objectives of learning mathematics can be better achieved. Then, students can study mathematics with great spirit and away from the feeling of anxiety. The steps of humanistic mathematics learning activities in a scientific approach can be seen in figure 1.

Figure 1 explains the steps of learning with a humanist scientific approach where at every scientific stage, the teacher always pays attention to students' personal conditions. Before learning begins, the teacher will motivate by showing the beauty and usefulness of mathematics in everyday life. Corotis [23] stated that making art requires mathematical activities and doing mathematics is an artistic endeavor. After providing motivation, the teacher forms groups in which decision making involves students to form a harmonious relationship between teacher and students. Hughes and Kwok [24] stated that the quality of teacher-student relationships has a positive effect on student motivation and subsequent learning activities. With a good start, students can start observing activities voluntarily and happily. After observing, all students are allowed to ask questions about all things related to the material being studied. In questioning activities, the teacher does not differentiate between students based on intelligence or personality backgrounds. All students are given the same opportunity. Next is the information gathering stage. At this stage, the teacher maintains the stability of the students' enthusiasm for discussion. After the data is collected, the data will be analyzed at the reasoning stage. At the reasoning stage, the teacher gives students confidence that they can discuss and work together in groups. Teachers cultivate mutual respect for the opinions of others. The last stage is to communicate the results of the discussion in front of the class. At this stage, the teacher will appreciate groups who can explain the results of the discussion well and do not forget to motivate groups that are still not good enough to continue learning. Each learning stage that has been described plays an essential role in the process of learning mathematics.

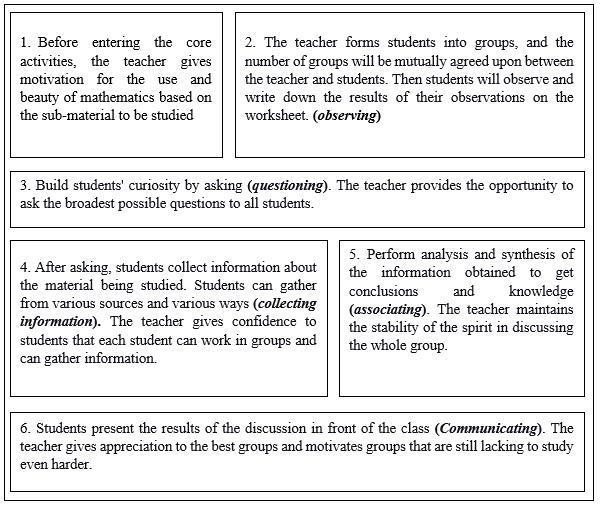


Figure 1. The step of humanistic mathematics learning with the scientific approach

1. Conclusion

Mathematics is one of the subjects that causes anxiety in students. Not all students like math. So that, the teachers need to apply learning methods that can reduce anxiety and increase student enthusiasm in learning mathematics. One of the lessons that can be applied is humanistic mathematics learning in a scientific approach, namely learning that pays attention to cognitive aspects in the scientific process and pays attention to students' feelings and emotions and forms a comfortable and active learning environment when learning mathematics.

Some things that need to be considered in implementing humanistic mathematics learning in a scientific approach, namely: (1) learning begins by motivating the beauty and usefulness of mathematics in everyday life, (2) the observing process is carried out based on a harmonious relationship with group members and teachers, (3) in questioning activities the teacher provides opportunities to all students regardless of differences, (4) the process of gathering information is carried out based on the trust of the teacher, (5) The reasoning stage is carried out with mutual respect and respect for the opinions of group members then the teacher maintains the stability of the spirit of discussion students, (6) Students present the results of the discussion and get appreciation from the teacher.

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