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OVERVIEW OF THE PHILOSOPHY OF MATHEMATICS: DESCRIPTION OF THE DIALOGUE METHOD OF SOCRATES AND PAULO FREIRE AND ITS IMPLICATIONS IN MATHEMATICS LEARNING

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ABSTRACT

Mathematics has an important role for improving attitudes and behavior through critical thinking. The learning method that can be applied to improve critical thinking skills is the dialogue method. Dialogue activities will provoke students to be more active in learning and educators can gather information, generate responses, focus students' attention, and test students' understanding. Socrates and Paulo Freire are two important figures who apply the dialogue method in learning. This research aims to describe the philosophical review of Socrates' dialogues and Paulo Freire's dialogues and their implementation in learning mathematics. The research method used is qualitative with library research. The result of this study is that the researcher found that the dialogue method can create an interesting and interactive classroom atmosphere. Through the dialogue process, educators can facilitate students to hone and improve their critical thinking skills.
Keywords: *dialogue method*, Socrates, Freire, *critical thinking*

INTRODUCTION

The development of science and technology in the era of globalization requires every country to prepare generations to become quality human resources. Education is the main capital in efforts to improve existing human resources. Education is expected to shape a person into a productive, creative, innovative, independent, and responsible individual. To achieve these educational goals, a learning process in schools is needed that is carried out optimally, including mathematics subjects.

Mathematics has been formally introduced since elementary school and continues to be studied until college, showing the magnitude of mathematics's influence in everyday life. From an educational point of view, mathematics has a significant role because it is a forum and means to improve attitudes and behaviors through critical thinking (Syarifuddin et al., 2021). Critical thinking is part of *higher-order thinking skills* so it is very important to be prepared for education in the 21st century. The critical thinking ability of students in Indonesia currently needs special attention because according to the Program for International Student Assessment (PISA) results in 2018, Indonesia is in the bottom 7 out of 73 countries listed in the mathematics category. The PISA test maps students' mathematical critical thinking skills from various parts of the world (Yunika &; Gustin, 2022).

Critical thinking skills can help learners in solving simple problems and complex problems. Critical thinking also facilitates learners to find the truth and process information logically to determine which information is important, irrelevant, or useless (Amin et al., 2019). Individuals with critical thinking skills are characterized by their ability to analyze and evaluate information and ask important questions.

Ennis (1993) explains that critical thinking is a process that aims to make decisions so that what people think is the best about a truth and they can do something right. Every individual must strive to obtain true knowledge related to the existence of everything, namely by going through the thought process to know what, from where, and how the purpose of the existence. The presence of mathematics is to provide convenience and overcome various life problems. To know the position and role of mathematics clearly, philosophy which is said to be a thought process clarifies the meaning of the presence of mathematics itself (Sadewo et al., 2022).

According to Sinaga et al. (2021), the philosophy of mathematics is a reflection on mathematics that emphasizes the meaning of questions and answers to mathematics itself. Nugraheni et al. (2021) define mathematical philosophy as reflective thinking about mathematics education to clarify the components in mathematics education. Thus, it can be concluded that the philosophy of mathematics is positioned as a way, effort, or way to explore the position of mathematics.

The teaching and learning process is a benchmark in realizing educational success that requires special attention, carefully planned, and prepared appropriately to achieve maximum learning outcomes. For this reason, schools should give freedom to students to carry out a process of reflection and correction or even critical of what has been conveyed and not only create a learning process that makes students the object of delivering material delivered by educators (Maufur, 2009). In this case, it is expected that educators provide opportunities for students to develop the abilities or ideas they have in mind.

The educational curriculum continues to develop to shape the character of independent, creative, and innovative students. Using the right learning approach is the first step to develop students' mathematics learning. One of the learning strategies that can be applied to liven up the learning atmosphere in the classroom is to create dialogue.

A dialogue is a conversation that takes place between two or more people. Dialogue activities will provoke students to be more active in learning and educators can explore information, generate responses, focus students' attention, and test students' understanding. In addition, through dialogue conducted by educators, students will be more motivated and feel challenged to think about finding answers, which is expected to hone students' critical thinking skills. In dialogue, an interaction process allows students to criticize and construct their knowledge (Yunika &; Gustin, 2022). This is a challenge for educators in creating critical conversations for students in the learning process in the classroom.

The process of dialogue dates back to ancient Greece when Socrates used the dialectic method (dialogue) to prove a truth. In the beginning, Socratic strategies were taught through question-and-answer dialogues that aimed to guide and deepen learners' level of understanding with regard to the material taught so that learners get their own thoughts from the results of resolved cognitive conflicts (Johnson & Johnson, 2002). Conklin (2007) states that Socratic dialogue is an excellent method to improve learners' thinking skills, where the process that takes place is intellectual discussion in the basis of the content studied. Picciano (2009) also mentions that Socratic dialogue is a method of learning through raising questions to help learners develop critical thinking skills. From the educator's point of view, Socratic dialogue can help educators motivate students to actively discuss learning topics critically to find several solutions to problems to an issue raised.

Another important figure who links dialogue to learning is Paulo Freire. Freire's work "*Pedagogy of the Oppressed*" (2005) explains that open and communicative are

natural human phenomena and the word becomes the core of every dialogue. Freire argues that the learning process can become freer and humanize students with open and communicative dialogue. Free means that students can convey what they think, so the teaching and learning process is not only centered on educators. Meanwhile, the purpose of humanizing students is a learning process that allows them to seek their knowledge through open and communicative dialogue.

Problems in learning mathematics indicate that parts are not well connected in learning mathematics. This section can come from educators, students, teaching materials, or learning media. Difficulties in learning mathematics become homework that must be resolved immediately. Up to this point, there is still no clear realization of philosophy into mathematics learning. The philosophy of mathematics is one of the sciences that must be mastered by prospective educators in order to be able to deliver mathematical material comprehensively (Suyitno &; Rochmad, 2015).

Based on the background that has been described, the focus of this study is to describe the dialogue of Socrates and the dialogue of Freire and its implications for learning mathematics. The benefit expected by the researcher is to provide educators with knowledge and an overview of the role of the Socratic dialogue method and Feire dialogue in mathematics learning.

METHODS

This research uses qualitative research methods with *library research* design. This research will examine and describe the knowledge, ideas and discoveries in the literature to provide information related to the dialogue of Socrates and Paulo Freire and its implications for mathematics learning. Data collection techniques are carried out by identifying related information from books, journals, research reports and relevant official documents.

RESULTS AND DISCUSSION

Dialog Socrates

Etymologically the word "dialogue" comes from Greek which consists of two words, namely "he" which means "through" and "logos" which means "meaning" (Bohm, 1996). Socratic dialogue was first introduced by Socrates (469-399 BC), who played an important role in introducing philosophy to education. Socrates is one of the most influential philosophers in history. People remember Socrates for his speaking skill and cleverness of thought (Atmojo &; Danawak, 2022). Socratic thought influenced his student Plato and later Aristotle, a student of Plato. One of his students, wrote: "Socrates set himself as an example to them as men of honor and good character." Socrates achieved fame for involving others in conversations whose goal was to define broad ideas such as benevolence, beauty, justice, courage, and friendship by discussing their ambiguity and complexity (Delić &; Bećirović, 2016). All this is shown in dialogues later written by his student Plato.

Initially, the Socratic dialogue was taught based on a question and answer dialogue which aimed to bring students to deepen the level of knowledge related to the material taught by the educator so that students were able to find their train of thought based on the results of resolved cognitive conflicts (Susiani &; Suranata, 2017). Maxwell in (Damayanti et al, 2015) defines Socratic dialogue as a process of various inductive questions that can lead a person to gain knowledge step by step.

The main point in Socratic dialogue is "how to ask." In its application, Socratic dialogue will direct educators to convey questions that build knowledge and thinking skills so that students will find out the truth of understanding the concepts they have and then

draw a correct conclusion. Moreover, the questions given must be adjusted to learners' abilities. However, Chan et al. (1998) argue instead that questions should be more difficult to improve students' reasoning and evaluate the concepts they understand. With his method of dialogue, Socrates made the transition to a human-centered model of education from an authority-centered one and Socrates made a strong emphasis on the importance of the great learning capacity and creativity of each individual.

Chang et al. (1998) explain three important points in the Socratic method when applied to learning. First, "inquiry" learning whose purpose is not to completely oppose the student's original argument, but to partially modify their original argument. Second, there is a dialogue between students and educators. The role of educators is to ask questions, while the role of learners is to explore their knowledge to answer the questions given. Third, it involves not only interactive dialogue between teachers and students, but also inductively. Educators will direct students to reason incorrectly then use counter-examples to clarify problems.

Johnson W. D and Johnson R. T (Pahlavi et al., 2014), describe the steps of the Socratic dialogue as follows.

1. Provide and prepare questions to ask students and mark or code when needed.
2. Educators provide prepared questions to learners in the hope that learners can answer them.
3. Teach and explain the importance of knowledge to solve a problem.
4. Guide students to explore.
5. If students can answer the questions, the educator will provide follow-up questions until all questions or problems can be resolved.
6. If there is a question that has not been found a solution, the educator will repeat the question and provide illustrations related to the question to make it easier for students to find solutions and find the right answer.

The advantages of Socratic dialogue according to Lammendola (Sholihah &; Shanti, 2017) are: (1) stimulating learners to think critically; (2) students with careful preparation will be able to follow learning well because they can consider broader implications; (3) fostering the motivation and courage of students in expressing their own opinions and thoughts; (4) cultivate self-confidence; (5) create an interactive and engaging learning environment; and (6) instilling discipline in the classroom. However, Socratic dialogue also has shortcomings according to Lammendola (Atmojo &; Danawak, 2022), namely: (1) generating disputes between students when there are differences of opinion; (2) make the learning atmosphere frightening for students who are not very good at arguing in front of the crowd; and (3) generally requires a long time in the learning process.

The application of Socratic dialogue may create quite tough arguments. However, keep in mind that the purpose of dialogue that leads to arguing is not to "win" and make the other person feel ashamed, but to find the truth, or at the very least, to broaden the horizons. When done right by a great professor, Socratic dialogue creates a lively, engaging, and intellectual classroom atmosphere. Similarly, Alro & Skovsmose (2003) revealed that dialogue is based on equality, no winner or superior to others.

Dialog Paulo Freire

Paulo Freire (1921 - 1997) was an educational figure from Brazil and an influential educational theorist worldwide. Freire's works have special significance for contemporary education in many countries. Freire made strong contributions to the approach of education as a "practice of freedom" and explored many significant key terms for alternatives to traditional educational models, which he referred to as banking education. Banking education means knowledge is transferred from educators to

learners. This creates a stigma that educators know everything, while students know nothing. Educators will deliver and determine the material students must receive to be memorized and repeated systematically. As for Freire (Prastowo, 2020), the education system is an instrument of oppression that prohibits and hinders inquiry, creativity and dialogue.

Freire (Prastowo, 2020) stated that liberation education must include the following aspects.

1. She is positioning oneself as a demythologizing agent in the face of problems.
2. Regard dialogue as non-negotiable in terms of cognition actions that reveal reality.
3. Encourage learners to think critically and systematically.
4. Based on creativity and stimulating reflection and meaningful action towards reality.
5. Acknowledge the history of humanity as a start.

According to Shor &; Freire (Syarifuddin et al., 2017), changes in the learning process can be seen through *reinventing*, recreating, *and rewriting students*' knowledge. Freire offers a dialectical concept of education, where students are forced to dialogue and learn with fellow students and between students and educators, so that it can enable students to understand social reality and respect each other.

Freire explained that education is a series of actions and thoughts, meaning that when students act and think, they display the results of their actions and thoughts in sentences or expressions. Such a learning process makes students directly involved in the problems of the reality of the world they experience (Darwis, 2016). Freire's educational concept aims at critical, creative, and mature learners so that the concept of education is known as; "Education for Consciousness", "Education for Liberation", even "Education for Humanization." For Freire, the dialogical process is the most appropriate way to arouse students' consciousness. While one of the characteristics of maturity in question is thinking before acting and understanding what it does, also realizing the risks resulting from what it does. Freire strongly opposed monologue learning methods that did not develop the potential of learners. Freire succeeded in alleviating poverty and backwardness in Brazilian society through the education system he brought. (Prastowo, 2020).

In his work entitled "*Pedagogy of the Oppressed*" (1970), Freire explored the term dialogue philosophically. Freire did not see dialogue as merely an interaction between people to explore the world together, but also as a sign of freedom, equality, and responsibility in discovering and changing the world of each individual. Freire considered dialogue to contain reflection and action. Thus, dialogue is not only a theoretical activity but also a practical activity.

Shih (2018) writes the elements of Freire's dialogical learning.

1. Humility. Educators who teach sincerely will provide comfort to learners.
2. Hope. The dialogue activities carried out are expected to provide new insights.
3. Faith. Educators must be confident that each student has potential and strengths.
4. Love. Do not hesitate to show care, praise, and respect for others.
5. Critical *thinking*. Dialogue done correctly will hone and improve one's critical thinking skills.

Freire (Shih, 2018) considers that education is a very valuable and meaningful activity so that it is expected to foster critical awareness of students and represent student subjectivity. Critical awareness was at the heart of Freire's unique view of education. Freire paid much attention to developing critical awareness and considered promoting people's critical awareness to liberate themselves. Freire emphasized that the cultivation of critical awareness occurs through dialogue between educators and

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learners during the learning process. For Freire, education should not only be an addition to knowledge, but a process of awareness or a term known as *critical consciousness*. How can we, with education, be critical, interpret problems, and understand the causal relationships. Freire's dialogue method is certainly very interesting to be applied in school learning in improving critical thinking, but no related journal explains in detail how to practice Freire's dialogue in the classroom.

Implications of the Dialogue Method in Mathematics Learning

Dialogue activities will provoke students to be more active in learning and educators can explore information, generate responses, focus students' attention, and test students' understanding. In addition, through dialogue conducted by educators, students will be more motivated and feel challenged to think about finding answers, which is expected to have an impact on improving students' critical thinking skills. In dialogue, an interaction process allows students to criticize and construct their knowledge (Yunika &; Gustin, 2022).

Critical thinking is the ability to analyze and evaluate information, ask important questions, formulate problems, collect and assess relevant information, use abstract ideas, think openly, and communicate effectively with others (Wulandaril, 2017). Critical thinking also helps learners find truth and process information logically to determine which information is important, irrelevant, or useless (Amin et al., 2019). While mathematical critical thinking according to Krulik and Rudnick (NCTM, 1999) is defined as a thinking process that tests, questions, relates, and evaluates all aspects of a situation.

Based on the presentation delivered, Socratic dialogue is an excellent method to facilitate students in improving critical thinking skills. Picciano (2009) explains that Socratic dialogue is a learning method through raising questions to help learners develop critical thinking skills. Tucker & Neely (2010) also stated that Socratic dialogue can help educators motivate students to actively discuss learning topics critically, in dialogues that challenge students to actively think about solving problems on an issue presented.

Meanwhile, Paul & Elder (2001) explain that the Socratic dialogue method is closely related to the concept of critical thinking because the two have similar end goals. Critical thinking aims to establish thinking in a firm or disciplined manner, whereas Socratic dialogue seeks to cultivate an inner voice, through models and strategies of interrogation, and discipline the mind. Critical thinking is developed through processes that shape a person's thinking, focusing on reasoning. In the Socratic method of dialogue, asking the right questions is important, because good thinking comes from thought-provoking questions (Elder & Paul, 2010).

In line with Paulo Freire's thoughts on liberation education, educators should make students active subjects and can facilitate students to relate mathematical concepts to real life through critical skills they already have. Thus, there will be intellectual freedom in teaching and learning mathematics activities in schools. Students are required to think critically in the process of learning mathematics at school, it is because one of the goals of achieving mathematics lessons is the ability to think critically itself, so that thus students are expected to achieve the goals of mathematics lessons. In addition, the purpose of forming critical thinking skills in students is so that mathematics learning is centered on the problem of why and how students know to provoke students to be more active in the learning process and form their knowledge.

The implications of the Socratic dialogue (Atmojo &; Danawak, 2022) on educator teaching can be summarized as follows: (1) educators provide questions that provoke pros and cons between learners; (2) educators provoke learners to think critically; (3)

educators invite students to seek the truth of the answers; (4) the educator confirms the learner's answers; and (5) the educator provides confirmation of the correct answer. Meanwhile, the implications of Paulo Freire's dialogue (Shih, 2018) on educator teaching include: (1) practicing love-based teaching; (2) develop humility-based teaching; (3) fostering hope-centered teaching; (4) enrich humor-based teaching; (5) educators should encourage students' critical thinking skills in their teaching; and (6) educators need to believe that each learner will achieve better skills.

CONCLUSION

Based on the presentation delivered, Socratic dialogue is an excellent method to facilitate students in improving critical thinking skills. The application of Socratic dialogue can increase students' curiosity and enthusiasm for learning through raising questions to help students develop critical thinking skills. In line with Paulo Freire's dialogue emphasizing liberation education, educators should make students an active subject. They can facilitate students to associate mathematical concepts with real life so that students will be provoked to think and help improve their critical abilities.

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