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Model Eliciting Activities in Mathematics Learning: Epistemological Beliefs

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Abstrak:
Penelitian ini Aims untuk mengetahui keyakinan epistemologis, keyakinan pembelajaran matematika dengan model eliciting activities serta hubungan keduanya pada calon guru matematika. Metode penelitian kuantitatif dengan menggunakan survei, yang dilakukan kepada 52 orang mahasiswa calon guru matematika. Pengumpulan data dilakukan dengan menggunakan kuisioner. Penelitian ini menggunakan kuisioner dari TEDS-M yang menginvestigasi keyakinan calon guru matematika mengenai pengajaran matematika. Analisis data akan dilakukan secara kuantitatif baik secara deskriptif maupun secara korelasi . Hasil penelitian menunjukkan bahwa 1) calon guru matematika memiliki keyakinan campuran yaitu statis dan dinamis, namun lebih kepada keyakinan statis akan epistemologi matematika yang dominan: 2) Penerapan pembelajaran model eliciting activities, calon guru matematika memiliki keyakinan campuran yaitu konvensional dan kontruvisme, namun lebih pada keyakinan konstruktivis yang dominan dan 3) implikasi praktis pada calon guru matematika dan penerapan model pembelajaran harus dimulai dengan menguji ataupun memahami keyakinan calon guru matematika mengenai epistemologi matematika.

Kata Kunci: Pembelajaran matematika, Model eliciting activities, Keyakian epistomologi

Abstract:
This study aims to determine epistemological beliefs, beliefs in learning mathematics with eliciting activities model, and the relationship between the two on prospective mathematics teachers. Quantitative research method using a survey, which was conducted on 52 students of prospective mathematics teachers. Data collection is done by using a questionnaire. This study uses a questionnaire from TEDS-M which investigates the beliefs of prospective mathematics teachers about teaching mathematics. Data analysis will be carried out quantitatively, both descriptively and by correlation. The results showed that 1) mathematics teacher candidates had mixed beliefs, namely static and dynamic, but more static beliefs about the dominant mathematical epistemology: 2) The application of eliciting activities model learning, mathematics teacher candidates had mixed beliefs, namely conventional and constructive, but more on dominant constructivist beliefs and 3) practical implications for prospective mathematics teachers and the application of learning models must begin with testing or understanding the beliefs of prospective mathematics teachers regarding the epistemology of mathematics.

Keywords : Mathematics learning, Model eliciting activities, Epistemological beliefs

Introduction

In terms of applying a learning approach in the classroom, teachers tend to be influenced by epistemological beliefs and understanding of teaching and learning concepts that they adhere to (Cephe & Yalcin, 2015). The epistemological beliefs about knowledge and knowing (Döhrmann et al., 2014; Felbrich et al., 2012; Op't Eynde et al., 2002). In learning

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mathematics, belief in mathematics will determine how mathematics is expressed in classroom situations (Beswick, 2012; Felbrich et al., 2012). This means that teachers' epistemological beliefs about mathematics are influenced by beliefs in learning mathematics. Thus, the epistemological beliefs of a teacher can be passed on to students because these beliefs are reflected through learning activities carried out in the classroom.

In the context of education, several schemes for categorizing the epistemological beliefs of teachers and prospective mathematics teachers have been developed. There are three epistemological beliefs, namely the Platonic view, the instrumentalist view, and the problem-solving view (Ernest, 1989). Instrumentalists see mathematics as an unrelated accumulation of facts, skills, and rules. While the Platonists view mathematics as a static entity, knowledge is highly structured, interrelated, and must be discovered. The problem-solving view understands mathematics as a dynamic and relative human invention and emphasizes the mathematical process. However, empirically, Grigutsch et al., (1998) and Felbrich et al., (2012) show that the division above (dividing into three or four categories) can be grouped into two overarching perspectives on mathematics. The Formalism-related and Scheme-related views classify mathematics as a static science, while The Process-related and The Application-related classify mathematics as a dynamic process.

Teachers' beliefs about learning and teaching mathematics refer to teachers' views about teaching mathematics they like and views of how mathematics is learned (Kohar et al., 2019). These beliefs include conceptions of ideal classroom teaching and learning activities, teacher roles, student roles, behaviors, and mental activities involved in learning mathematics (Chan & Elliott, 2004; Ernest, 1989). As with epistemological beliefs, there are variations in the categorization of teachers' beliefs about learning and teaching mathematics. In terms of teaching mathematics, teacher beliefs can be divided into three different views, namely learner-focused, content-focused with an emphasis on performance, content-focused with an emphasis on understanding. with an emphasis on understanding) (Beswick, 2012; Van Zoest et al., 1994). Other researchers make the categories of belief in teaching mathematics into teacher-centered teaching ('teacher-centered teaching beliefs) and student-centered teaching ('student-centered teaching beliefs) (Beswick, 2012). The category of teacher-centered teaching aligns with content-focused beliefs while student-centeredness corresponds to learner-focus (Susanti et al., 2020).

Much research has examined the epistemological beliefs of teachers and prospective teachers. In Cephe & Yalcin (2015) research studying the relationship between teachers' epistemological beliefs and students' epistemological beliefs in foreign language learning, (Sahin-Yilmaz & Naclerio, 2011) studied teacher candidates' epistemological beliefs and teaching concepts, and Sheehy et al., (2019)studied the influence of teachers' epistemological beliefs and pedagogical concepts on learning instruction. In Indonesia, research on epistemological beliefs has not been carried out extensively (Yoppu Wahyu Purnomo et al., 2016). Nevertheless, epistemological beliefs and teaching and learning beliefs in mathematics have begun to receive attention from researchers in Indonesia (Kohar et al., 2019; Y. Purnomo, 2017; Y. W. Purnomo et al., 2018; Siswono et al., 2016; Yoppu Wahyu Purnomo et al., 2016). Research reports that teachers' belief in knowledge has a strong relationship with their belief in problem-solving (Siswono et al., 2016, 2017). However, several other studies reveal teachers' beliefs about learning practices (Siswono et al., 2016; Yoppu Wahyu Purnomo et al., 2016).

Epistemological beliefs in prospective mathematics teachers have also been carried out, in this study more specifically on prospective elementary school mathematics teachers (Yoppu Wahyu Purnomo et al., 2016). Purnomo's research shows that learning practices do not necessarily reflect the beliefs held. On the other hand, beliefs about the nature of mathematics have a more dominant effect than other beliefs on learning practices. This research is qualitative and most research in the world also tends to be qualitative (McGrath et al., 2019; Stohlmann et al., 2014).

Many learning models are carried out in the classroom, one of which is the eliciting activities model. Eliciting Activities Model (MEAs) is learning that focuses on student activities to obtain or obtain solutions to real problems given through the process of applying mathematical procedures to form a mathematical model. Realistic problems are the hallmark of MEAs. In MEAs learning, students are faced with problems that are meaningful and relevant to their daily lives. With this reality principle, MEAs learning trains students' ability to analyze and construct situations critically and creatively so that they can solve the problems they face (Akhmad & Dr. Masriyah, 2014).

According to Istianah, learning mathematics with the MEAs approach is an alternative approach that seeks to make students actively involved in the process of learning mathematics in the classroom (Istianah, 2013). By actively involving students in the learning process, it is hoped that students' creative thinking skills in mathematics will continue to increase and be well trained. According to Yildirim through MEAs, students repeatedly reveal, test, and refine or revise their way of thinking to produce a structured model and the most effective and efficient way to solve a given problem (Yildirim et al., 2010).

Chamberlin & Moon (2005) state that MEA is implemented in several steps, namely: 1) the teacher reads a problem sheet that develops the student context; 2) students are ready to respond to questions based on the problem sheet; 3) the teacher reads the problem with the students and ensures that each group understands what is being asked; 4) students try to solve the problem, and 5) students prepare their mathematical models after discussing and reviewing solutions. The syntax of the MEA learning model is: 1) presenting material with a heuristic-based problem-solving approach; 2) elaborate, into simpler sub-problems; 3) identify problems that have been cut into several parts, 4) arrange sub-problems so that connectivity occurs and aims to develop problem-solving skills in learning mathematics, and 5) choose the right solution to solve problems (Pane et al., 2017; Rusliah et al., 2021).

This study aims to determine the epistemological beliefs of mathematics, the application of eliciting activities models in mathematics learning, and the relationship between the two on prospective mathematics teachers. Thus, in detail, this study will investigate and analyze three things, namely (1) the epistemological beliefs of prospective mathematics teachers; (2) the application of eliciting activities model; (3) the relationship between the two.

Method

This research method is quantitative research using a survey. The subjects of this study were 52 prospective mathematics education teachers (15 males and 37 females). The data collected in this study is quantitative data regarding the epistemological beliefs of prospective teachers in teaching mathematics. Data collection is done by using a questionnaire.

This study uses a questionnaire from TEDS-M that investigates the beliefs of prospective mathematics teachers about teaching mathematics (Döhrmann et al., 2014; Tatto, 2020). Data analysis will be carried out quantitatively, both descriptively and by correlation. Descriptive data analysis was calculated by calculating the mean and standard deviation (Döhrmann et al., 2014; Tatto, 2020; Yang et al., 2020). This analysis was carried out by calculating the mean and standard deviation for each dimension of epistemological belief in teaching mathematics. Descriptive analysis was carried out by calculating the mean and standard deviation for the knowledge and constructivist dimensions.

Dimensions that have a higher mean value than other dimensions indicate that prospective mathematics teachers tend to believe in these dimensions. Correlation analysis using Pearson Moment Product between dimensions. Regression analysis was also used to test the regression strength of the relationships between these dimensions.

Result and Discussion

Results of the study will be presented by describing the epistemological beliefs of mathematics and teaching models of eliciting activities of prospective mathematics teachers. The results of descriptive data analysis regarding the epistemological beliefs of mathematics and the teaching of eliciting activities model for prospective mathematics teachers are shown in the following table:

Tabel 1. Data on Epistemological Belief Results and Application of Eliciting Activities Model for Prospective Mathematics Teachers

Description	Min	Max	Mean	Std. Deviasi
Static Beliefs (SB)	3.45	6.03	5.33	0.53
Dynamic Beliefs (DB)	3.23	4.89	4.29	0.68
Reality Principle (RP)	2.51	4.92	3.41	0.66
Constructive Principle (CP)	3.37	5.34	4.62	0.61

In terms of epistemological beliefs, the average score of static beliefs is higher than dynamic beliefs. This shows that prospective mathematics teachers are more likely to believe that mathematics is static knowledge. The average score of both static and dynamic beliefs also shows that prospective teachers also have high static and dynamic beliefs. This shows that prospective mathematics teachers tend to have mixed epistemological beliefs.

The teaching of the eliciting activities model of prospective mathematics teachers has a lower mean value on the relativity principle than on the constructivist principle. This means that prospective mathematics teachers more often use the reality principle in teaching eliciting activities models. However, similar to the epistemological beliefs of mathematics, prospective mathematics teachers also tend to apply constructive principles as indicated by a mean value of more than 3. The results of the correlation analysis are presented in the following table:

Tabel 2 The results of the correlation analysis

Description	SB	DB	RP	CP
Static Beliefs (SB)	1	0.445	0.145	0.345
Dynamic Beliefs (DB)		1		0.334
Reality Principle (RP)			1	0.321
Constructive Principle (CP)				1

Table 2 shows that there is a positive and significant correlation between static epistemological beliefs and dynamic beliefs in prospective mathematics teachers. This shows that prospective mathematics teachers tend to hold both these beliefs. This is following the previous descriptive analysis, that although the mean of static beliefs is higher than dynamic beliefs, the mean of dynamic beliefs is greater than 4. In terms of its relationship with teaching eliciting activities, it shows that static epistemological beliefs in mathematics are positively correlated with teaching eliciting models. constructive and realistic principles. That is, prospective mathematics teachers who have dynamic beliefs tend to have mixed beliefs about teaching eliciting activities models, both realistic and constructive principles.

Based on the above results, prospective mathematics teachers tend to hold static epistemological beliefs about mathematics. The case study studies of Yoppu Wahyu Purnomo et al., (2016) and Tamba & Cendana (2021) on a prospective elementary school mathematics teacher show that static beliefs about the nature of mathematics tend to be held. Even so, prospective mathematics teachers also tend to agree with dynamic epistemological beliefs. This is because based on the mean value on dynamic confidence is more than. These findings indicate that the beliefs of prospective mathematics teachers have mixed beliefs of both static and dynamic. This finding is consistent with previous research which found that prospective teachers tend to have mixed beliefs (Beswick, 2012; Felbrich et al., 2012; Noordyana, 2018; Wang & Hsieh, 2014; Yang et al., 2020). In addition, research from Xenofontos (2018) reveals that teachers with beliefs that are explicitly fallibilist (dynamic) can also maintain Platonic beliefs (static). Therefore, the author concludes that prospective elementary school mathematics teachers tend to have mixed beliefs. That is, the belief of prospective teachers does not necessarily only have one belief. So for a teacher to hold beliefs that are inappropriate or inconsistent (Op't Eynde et al., 2002; Xenofontos, 2018).

In teaching the eliciting activities model, prospective mathematics teachers are more likely to apply constructive principles. This is indicated by the mean value of the constructivism principle which is higher than the reality principle. Similar to epistemological beliefs, prospective mathematics teachers also have a pen. This finding is consistent with previous research which explained that prospective teachers and teachers tend to be inconsistent or hold two beliefs at the same time (Y. Purnomo, 2017; Xenofontos, 2018; Yang et al., 2020). Another finding is that there is a positive and significant relationship between epistemological beliefs (static and dynamic) with constructivist beliefs and between dynamic epistemological beliefs and traditional beliefs. This finding shows that there is a correlation between epistemological beliefs about mathematics and beliefs about teaching and learning mathematics. This is consistent with findings in previous studies (Beswick, 2012; Xenofontos, 2018; Yang et al., 2020; Yoppu Wahyu Purnomo et al., 2016). However, what is interesting is that there is no relationship between dynamic epistemological beliefs and traditional teaching and learning beliefs. This shows that there is a complex relationship between mathematical epistemological beliefs and mathematics teaching and learning beliefs (Y. Purnomo, 2017; Xenofontos, 2018; Yang et al., 2020).

In the research of Purnomo et al. (2016), the study provides a broader picture by involving more participants and expanding methodologically. and contributes that the epistemological beliefs of mathematics and the beliefs of mathematics teaching and learning held by prospective mathematics teachers are not always explicit in one particular belief. The findings above have limitations, namely, the instrument used has not been developed. So there is the possibility of a special context or indicator that cannot be disclosed or has not been measured in this study. Subsequent research needs to consider making instruments that have been developed according to students' conditions. This is possible because there are many forms of instruments used in different contexts (Beswick, 2012; Felbrich et al.,

2012; Kohar et al., 2019; Y. Purnomo, 2017; Tatto, 2020; Ünlü & Aktaş, 2013; Xenofontos, 2018).

Conclusion

Based on the description above, the findings of this study indicate that prospective mathematics teachers tend to hold static beliefs about mathematical epistemology. However, prospective mathematics teachers also have faith in dynamic mathematical epistemology. Therefore, it can be said that prospective mathematics teachers have mixed beliefs, namely static and dynamic, but rather static beliefs about the dominant mathematical epistemology. Thus, in the application of eliciting activities model learning, prospective mathematics teachers have mixed beliefs, namely conventional and constructive, but more on the dominant constructivist belief. The findings of this study also show that there is a relationship between mathematical epistemological beliefs and eliciting activities model learning. Prospective teachers who have a dynamic belief in the epistemology of mathematics correlate with both beliefs in the application of model eliciting activities. Meanwhile, static belief in mathematical epistemology correlates with belief in the application of constructivist eliciting activities models. The findings of this study provide practical implications for prospective mathematics teachers and imply that the application of the learning model must begin by testing or understanding the beliefs of prospective mathematics teachers regarding the epistemology of mathematics.

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