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Digibook and Novice Teachers' Mathematical Belief

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Abstrak

Belief matematis yang dipahami sebagai keyakinan terhadap mata pelajaran matematika, kenyataannya sangat berpengaruh dalam proses pembelajaran matematika, khususnya terhadap hasil belajar peserta didik. Tujuan penelitian ini adalah menganalisis belief matematis guru pemula dalam mengajar dan belajar matematika, ditinjau dari media *Digibook* yang telah dikembangkan. Sebanyak 9 guru pemula dengan belief matematis pada aspek belajar matematika yang berbeda menjadi subjek dalam penelitian ini. Penelitian ini termasuk pada deskriptif kualitatif dengan pengambilan data berupa media *Digibook* yang dikembangkan oleh subjek, angket belief matematis yang sebelumnya telah divalidasi dan wawancara semi terstruktur. Hasil penelitian ini menunjukkan bahwa guru pemula dengan keyakinan belajar level platonis meyakini bahwa dalam belajar matematika, pemahaman akan konsep merupakan inti dari belajar. Hal ini berdampak pada cara mereka mengajar, meyakinkan siswa bahwa matematika bukan hanya prosedur. Bagi guru pemula dengan keyakinan belajar *problem solving*, belajar merupakan proses mengeksplorasi pengetahuan dan media pembelajaran berperan sebagai alat bantu, alat komunikasi dan alat pengembangan berfikir matematis. Hasil penelitian ini mengimplikasi bahwa guru pemula dengan semangat belajar dan mengajarnya serta keinginan dalam mengembangkan media pembelajaran mampu menghasilkan media *Digibook* yang sesuai dengan karakteristik dan kebutuhan siswanya.
Kata Kunci: belief matematis; guru pemula; media *Digibook.*

Abstract

Mathematical beliefs, which are understood as beliefs about mathematics subjects, are in fact very influential in the process of learning mathematics, especially on student learning outcomes. The purpose of this study was to analyze the mathematical beliefs of novice teachers in teaching and learning mathematics, in terms of the Digibook media that has been developed. A total of 9 (nine) novice teachers with mathematical beliefs in different aspects of learning mathematics were taken as the participants of this study. This study was a descriptive qualitative using Digibook media developed by the participants and a mathematical belief questionnaire that has been previously validated and semi-structured interviews as data collections. The results of this study showed that novice teachers with platonic level learning beliefs believed that in learning mathematics, understanding concepts was the core of learning. This affected the way they teach, convincing students that math was not just a procedure. For novice teachers with problem solving learning beliefs, learning was a process of exploring knowledge and learning media acts as a tool, a communication tool and a mathematical thinking development tool. The results of this study implied that novice teachers with their passion for learning and teaching and the desire to develop learning media were able to produce Digibook media in accordance with the characteristics and needs of their students.
Keywords: mathematical belief; novice teacher; Digibook media.

I. PENDAHULUAN

The government's efforts, especially the ministry of education and culture, to make various breakthroughs and also launch various programs, including the Merdeka Belajar policy, have become a moment to reexamine the relevance of teacher competence and performance. Educators should do reflection, evaluate and even develop their performance to answer challenges in the present and also the future (Sari & Afriansyah, 2022). It is emphasized that educators must think independently, not only limited to educational administration, but also concerned with the paradigm of independent learning to respect change and change in education units (Siregar, Kairuddin, Mansyur, & Yusoff, 2023).

Responding to the Merdeka Belajar program, educators are required to abandon their comfort zone immediately to generate a more creative concept of thinking. Today's educators must be able to develop their skills in order to become creative, innovative, and adaptive learners towards the various changes faced (Oktaviyanthi & Sholahudin, 2023). Educators must be able to adapt to various changes in education policies, including the use of digital technology in learning or better known as the cyber system, which is able to facilitate learning without space and time limits. Technology in education is a system used to support learning to achieve the desired results (Rahmaniah, 2022). The implementation of technology in education in Indonesia is that technology could be utilized as learning media, administrative tools, and learning resources (Lestari, 2018; Hasanudin & Maryati, 2023). The utilization of technology essentially aims to facilitate human work in everyday life, including in teaching and learning activities. Some studies (Setiawan, Putria & Suryani, 2019; Herawati, Hidayati, & Iffah, 2023) showed that the development of digital media in education also had a significant influence on the interaction patterns of teachers and students.

Teachers are actually the frontliner who play an important role in the success of the education system. Although they are not the only factor to determine the suces, the learning process cannot be separated from the role of the teacher. In order to create a quality learning process, teachers are required to continue to learn and hone their skills. For novice teachers, namely teachers with less than 5 (five) years of teaching experience (Kim & Roth, 2011), the efforts to improve the learning experience are still highly demanded. Among novice teachers, the desire to keep up with technological developments is relatively high because it is generally supported by the ability and skill in adapting to existing technology. In addition, according to (Rahayu, Muhtadi, Ridwan, 2022) to teach mathematics, it was necessary to have basic knowledge and teaching skills that can accommodate the characteristics of mathematics itself. It

was expected that a math teacher could organize the learning process well and interestingly to foster students' willingness to learn. However, challenges for novice teachers often emerged regarding working conditions and formal assistance or guidance. This spurs the emergence of a teaching style character influenced by the beliefs of the novice teacher.

Mathematical beliefs, which are commonly understood as beliefs regarding mathematics, are in fact very influential in the process of learning mathematics, especially on student learning outcomes (Robbani & Sumartini, 2023). This conclusion is based on a review of several studies on mathematical beliefs towards students (Beliefs in students towards mathematics, self-ability, and beliefs in the role of teachers in teaching are things that need to be applied in the mindset of students) (Elyana, Astutiningtyas, & Susanto, 2023). Motivation formed from mathematics beliefs reassures students and reduces doubts in the learning process such as in solving problems, in discussing, and working on problems (Defi, Parta & Permadi, 2021; Rahayu, Liddini, & Maarif, 2022). Livianandа & Ekawati (2019) revealed that there was a significant relationship among students' beliefs towards mathematics, the learning process and students' mathematical abilities. Thus, the mathematical beliefs among students are the result of the mathematics learning process.

Nurmi, Hanula, Maijala & Pehkonen (2003) stated that mathematical beliefs and learning mathematics were interrelated to form a circular process. How mathematics was taught in class would eventually affect students' beliefs on mathematics. Vice versa, beliefs could affect how students "welcome" math lessons. To be able to shape this, mathematics teachers must also have good mathematical beliefs (Tamba, 2021). Mapping the mathematical beliefs of novice teachers needs to be done because it can be an overview of the character of novice teachers in teaching and providing understanding of mathematics to students. The results of this mapping can be used as a theory that underlies the practice of teacher professional development in the future. This encourages mathematical belief to be one of the appropriate variables to investigate further.

Related to mathematical beliefs and the demands of the stakeholders that teachers must be able to produce learning media involving technology, it is necessary to conduct an in-depth analysis of how mathematical beliefs can be measured, including through media produced by teachers (Aprilia & Diana, 2023). Marbán and Mulenga (2019), concluded that teaching style had the ability to predict ICT integration in mathematics classes. Thus, teaching styles influenced by mathematical beliefs will also affect the media developed by teachers. Media is

one of the tools to convey messages or information carried out by educators to students in the learning process. And the learning process will run optimally if the supporting media is available. Unfortunately, many media that are developing today are not appropriate with the desired learning objectives. Thus, it is necessary for teachers to develop media based on the learning objectives and characters of their students.

One of the media to be developed by teachers is Digibook (digital book). Lestari, Ratnaningsih, and Dewi (2022), Digibook was developed with an emphasis on interactivity and a combination of media content. Digibook development continued to be carried out to increase students' potential and motivation in learning various subjects, especially mathematics. Mathematics lessons through Digibooks are expected to optimize student learning. Some applications to create Digibooks are Flash Flip Book, 3D PageFlip, Kvisoft Flipbook Maker, Flip HTML5, and Flip PDF. Among all these applications, Flip PDF has several advantages, namely its ease of use for beginners as they do not need to master any programming language. Digibook math is also able to optimize students' mathematical abilities (Khoerunnisa, Ratnaningsih, Lestari, 2021) and (Fauzi, Ratnaningsih, Lestari, 2022).

Developing Digibook media based on the learning objectives is a challenge in itself. The resulting Digibook will show how novice teachers' mathematical beliefs. The result of this analysis would be a new theory regarding novice teachers' mathematical beliefs in developing a learning media.

II. METHOD

The study used a descriptive qualitative method. The study involved 9 novice teachers, namely teachers with teaching experience between 0-5 years who are currently pursuing a master's degree in mathematics education at Siliwangi University, Tasikmalaya, West Java, Indonesia. These novice teachers were first taught how to create Digibooks using professional flip pdf software. In developing this Digibook, the participants were asked to use the media development model.

The initial stages in the model began from analyzing the needs of students and learning materials based on the school curriculum. After the participants completed all stages of developing learning media, they collected the Digibook and filled in the mathematical belief questionnaire that had previously been validated. The last stage was a semi-structured interview with the participants. Thus, the instruments of this study were Digibook media, mathematical belief questionnaire and the researcher himself.

Furthermore, the data were analyzed by triangulation by first categorizing the novice teachers based on 3 (three) aspects of mathematical beliefs, namely teachers' beliefs about mathematics and learning

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media, teachers' beliefs about learning mathematics and the role of learning media in learning, teachers' beliefs towards teaching mathematics and the role of learning media in teaching. The results of the participants' belief categories were analyzed with the Digibook media developed. And the last stage was an interview with the participants to explore their mathematical beliefs.

III. RESULTS AND DISCUSSION

Mathematical beliefs in this study referred to 3 (three) aspects, namely teachers' beliefs regarding mathematics and learning media, teachers' beliefs regarding learning mathematics and the role of learning media in learning, teachers' beliefs regarding teaching mathematics and the role of learning media in teaching. There were 3 (three) levels of beliefs from each aspect, namely instrumentalist, platonic, and problem-solving. Mathematical belief questionnaire scores of ordinal data were calculated statistically by analyzing the size of the data distribution. The results of the calculation were used to classify the participants based on the level of belief as expressed by Thompson in Ernest in 1989. The purpose of this calculation was to obtain descriptive data of the belief level of novice teachers as the participants.

Table 1.
The participants' belief level

Participant	Aspect 1	Aspect 2	Aspect 3
S1	problem solving	platonic	problem solving
S2	problem solving	problem solving	problem solving
S3	problem solving	platonic	problem solving
S4	problem solving	platonic	problem solving
S5	problem solving	problem solving	problem solving
S6	problem solving	problem solving	problem solving
S7	problem solving	problem solving	problem solving
S8	problem solving	problem solving	problem solving
S9	problem solving	problem solving	problem solving

Regarding aspect 1, all participants were already at the problem-solving level. It was the highest level of mathematical belief. The characteristics at this level considered mathematics as dynamic ideas and an expanding field of creation and discovery. According to (Novikasari, 2016), problem-solving or constructivist beliefs demonstrated an ideal belief type compared to the other two belief types, namely platonic and instrumental. It involved the development of knowledge and experience to get to this level of belief. Regarding learning media, at this level learning media was believed to be a tool in exploring students' mathematical abilities. One participant (S1) revealed that the learning media made was learning

media that facilitated responses from students.

In aspect 1, participant-2 was developing Digibook media for scale and comparison materials. Material selection was based on the analysis of students' needs. The results of the needs analysis found that the students were struggling to understand scale and comparison material and through Digibook, the learning process will be much easier because there were quite a lot of learning videos for this material. From the media point of view, the Digibook media display was quite attractive with the selection of colors that were commensurate, supporting music and video links that were appropriate. From material presentation, it was in accordance with the learning objectives and the presentation of the material also referred to the problem-solving belief in aspect 1, namely mathematics was the result of creation and discovery. This conclusion was supported by the presentation of material that challenged students to find the initial concept of comparison themselves, before finally being explained by the teacher (shown in Figure 2).

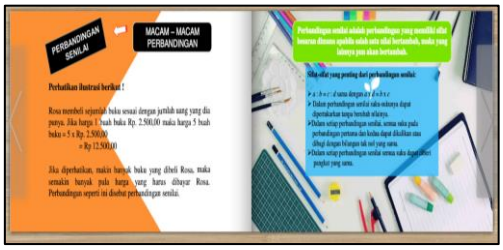

Figure 1. The comparison of material presentation of participant 2

The belief that mathematics was the result of creation and discovery was illustrated in the Digibook math developed by participant-5. The materials developed were Arithmetic and Geometric Rows & Sequences. The selection of this material was based on the results of the needs analysis. The presentation of the material on the Digibook began with the introduction of the concept of arithmetic sequence without a formula and then with a formula (see Figure 2). The results of participant-5's interviews regarding the presentation of material revealed that it was necessary to present the material gradually to build a comprehensive understanding of the concept of rows. Thus, the teacher believed that mathematical concepts were the result of discovery and learning media was a tool to strengthen the delivery of a mathematical concept.

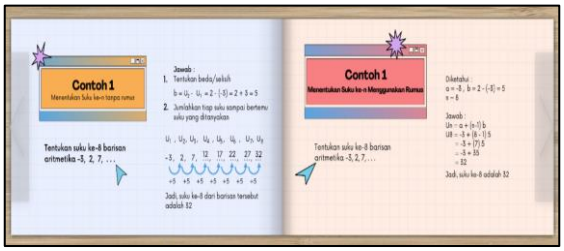

Figure 2. Concept of Arithmetic Rows Without Formulas and With Formulas

For aspect 2, participants were divided into two levels of beliefs, namely platonic and problem-solving. S1, S3 and S4 participants belonging to the platonic level considered that learning mathematics was a process of constructing knowledge and

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learning media functioned as a tool in constructing knowledge. For the problem-solving level, the belief towards learning mathematics was a process of exploring knowledge independently and learning media acted as a tool, communication tool and mathematical thinking development tool. The difference in the level of belief of these two types was dealing with "exploring independently" and "constructing" knowledge. According to the KBBI (Indonesian Dictionary), the term exploration meant exploring the field to obtain more knowledge while constructing, which as one of the mental activities to build students' knowledge through two processes, namely assimilation and accommodation through the equilibration process as an adjustment (Setiawan & Rahman, 2013). Teachers understood that in constructing knowledge, there was a process involving assimilation and accommodation as expressed in Jean Piaget's theory that assimilation occurred when a child incorporated new knowledge into existing knowledge, i.e. the child assimilated the environment into a scheme. Accommodation occurred when a child adapted to new information, i.e., the child adapted their schema to their environment.

Participant-3 with platonic level developed Digibook of the square root material. The material selection was based on the results of the needs analysis. From the media point of view, the selection of colors, music, buttons, etc. was well fulfilled. In terms of material presentation related to the "learning math" aspect, the material was straightly presented. KI and KD were provided and the material was presented briefly accompanied by sample problems, and the presentation of exercise questions guided students to do independent questions. The presentation of the material referred to the platonic belief that learning mathematics was a process of constructing knowledge (see Figure 3).

Figure 3. The platonic aspect of learning mathematics

Unlike the other participants, the participant-9 at the Problem-Solving chose Specialization Mathematics material, namely Polynomials. In the Digibook, the teacher paid attention to the students' needs by providing a choice of music to accompany the learning process using the Digibook. The presentation of the material was in accordance with the learning objectives, starting with the definition of polynomials, determining the value of polynomials and continuing with the concept understanding test. Some video links were provided to clarify the concept of operations in polynomials. At this level,

the teacher was developing learning media as tools, communication tools and mathematical thinking development tools.

In aspect 3, namely teachers' beliefs regarding teaching mathematics and the role of learning media in teaching, all participants were categorized into the problem-solving level. At this level, participants believed that the teaching process was not just a transfer of knowledge. Mulyana (2000) reiterated that there was a strong relationship between the knowledge of novice teachers and their learning, such as the results of Steinberg's study in 1985. A novice teacher's teaching system was conceptually oriented, emphasizing "why" questions on the mathematical procedures and providing problems for the students to solve in their own way. He strongly agreed that students derived their own algorithms. This statement was also in line with the results of the interview with participant S9.

Researcher: How do you think a teacher should teach math to their students?

S9: In my opinion, various teaching strategies are necessary. From my experience teaching math specialization and only discussing trigonometry material would be very boring for students if the method I used was lectures and practice problems. Considering many formulas that students must understand in the trigonometry chapter. Usually at the beginning as an opening, I make a video explaining why students should learn trigonometry. Then when introducing the material, I made learning discussion groups and provided stimulus material for students to develop. Students did peer tutoring and the teacher as a facilitator. If there are difficulties in student discussions, I clarify the misunderstanding of concepts that students encounter. There are also times when I provide material in LKPD (learner worksheets) to be done independently by students. At the end of the semester, I give a project to students to present the results of their group discussions with the happy performance method, which is freeing students in presenting the results of their discussions, it can be in singing, or just exposure, or making their own terms. The point is that students will memorize and this method has proven successful, especially in remembering the formulas in trigonometry.

From the results of the interviews, the participants at the problem-solving level believed that communicating mathematical ideas and information was very important for teachers to clarify the students' understanding. In addition, the main thing that must be done before teaching was to set the right mathematics learning objectives for students. There was always a positive relationship between beliefs and knowledge of teaching practices (Muhtarom, Juniati, Siswono, 2022). Beliefs and pedagogical content knowledge (PCK) were two factors that influence teaching practices in the classroom (Muhtarom, Juniati, Siswono, 2019). The compliance of the relationship between the level of confidence of novice

teachers and the media developed, namely Digibook, supports the theory that teacher confidence affects the integration of favored the learning process (Kim, et al., 2013). Belief was highly correlated with mastery of mathematics content and teaching expertise (Muhtarom, Juniati, Siswono, 2018). The developed Digibook could also show how the level of novice teachers' belief was demonstrated.

IV. CONCLUSION

This study discussed Digibook media and novice teachers' mathematical beliefs consisting of three aspects, namely teachers' beliefs regarding mathematics and learning media, teachers' beliefs regarding mathematics learning and the role of learning media, and teachers' beliefs regarding mathematics learning and the role of learning media for teaching. The study concluded that the novice teachers were generally at the problem-solving level, especially for aspects 1 and 3. At this level, the novice teachers believed that mathematics contained dynamic ideas. In addition, mathematics was considered to be a vast field generated by creation and discovery. Learning media served as a learning tool that was very helpful to explore students' mathematical abilities. Digibook media development was a strategy to explore these mathematical abilities. Belief in teaching was also adjusted to the ability of students, and learning media was integrated into the teaching process to support the achievement of the learning objectives. Novice teachers with platonic level learning beliefs considered that in learning mathematics, understanding concepts was the core of learning. It affected their teaching strategies by convincing students that math was not just a procedure. The results of this study implied that novice teachers with their learning and teaching enthusiasm and desire to develop learning media were able to produce Digibook that was appropriate with the characteristics and their students' needs.

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