Reflective Practice of Pre-Service Mathematics Teacher on Online Learning

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Abstract. One important part of the teaching and learning process is reflection. The deeper a teacher's reflection, the better it is for the improvement of subsequent learning. This study aims to determine the depth of reflective thinking of pre-service mathematics teachers on their teaching practices. This type of research is descriptive research with a qualitative approach. The learning was conducted online for two months by ten students of pre-service mathematics teacher at five different schools. There are four types of reflection depth used, namely general type, description type, argumentation type, and contribution type. The method used was observation and in-depth interviews which were also conducted online. The instruments used were observation sheets, interview sheets, questionnaire sheets and portfolios. The results showed that the depth of reflective thinking of pre-service mathematics teacher increases from argumentation type to contribution type. This has a positive impact on improving the quality of learning.

1. Introduction
The teacher is a very important element in the teaching-learning process and its responsible for future generations [1]. In regards with the importance of teachers' existence, the education of pre-service teachers is also very important to note. This is a key element in societal change and requires a large investment [2]. Prospective teachers are encouraged to be continuously critical of their teaching practice [3] whatever the case. The conditions of the Covid-19 Pandemic make online learning mandatory. Pre-service teachers are required to have sufficient skills for online learning to be effective.

There are two main things that support mathematics teaching skills [4], namely mathematical competence and professional competence. Mathematical competence consists of two aspects, namely knowledge; related to basic concepts and in-depth knowledge; related to the ability to experiment with mathematical content and to carry out activities that link mathematics with other fields. Professional competence also consists of two aspects, namely knowledge, related to the contribution of mathematics education in learning, especially methodological aspects and in-depth knowledge, related to the ability to apply knowledge for teaching to make it better, including implementing learning plans and reflecting on one's own actions so that the design of learning activities becomes more creative.

Reflection on learning refers to the tendency of a teacher to engage in conscious identification of problems in their teaching practice and seek valuable alternative solutions for the quality of student learning [5]. In essence, reflection aims to increase new understanding [6]. Reflection is a process of
continuous development. The ability to reflect on learning for a teacher usually grows step by step during the teacher's career. To deepen and broaden the reflection of prospective teachers, the reflection process must focus not only on lesson but also on a broader and more diverse context. Therefore, it is necessary to make tools to help that the reflection works well [7].

It is realized that a teacher's reflection does not necessarily improve the quality of the teacher. However, reflection is very important, especially for pre-service teachers who are starting to learn how to teach. Although this reflection is often carried out on the education of pre-service teachers, it is often not connected with the training process or teaching practice. Therefore, it is important to understand the process of reflection broadly and deeply for pre-service teachers. Reflection helps broaden the view of learning [8], and as a basis for making decisions for learning improvement [9]. The importance of teacher reflection is it can help understand the complexity of teaching [10]. Written reflection can help increase knowledge about what is happening in the classroom. There is relationship between the teaching and learning process and pre-service teacher reflections and the depth of that reflection [11].

On other hand, there are several ways that can be used to reflect on learning [12], namely by using diaries, notebooks and teacher journals. With a different portfolio, the results of the reflection are also different [13]. The technique of asking yourself like “what it is?”, “so what?”, “now what?” is also very helpful in the reflection process. The existence of reflection will make changes in cognition and teaching practice. It is an effective way to organize learning so that students remain active until the end of the lesson. As a result, teachers will teach in different ways if they apply reflection to their teaching practice. Reflection is inherently part of the teacher learning process, and helps teachers to identify their strengths and weaknesses.

One popular way of reflecting is to use a portfolio. This method is one of many approaches that can stimulate teachers to reflect on learning themes according to their context [14]. Portfolio assessment is a mechanism to capture the extent of reflection by teachers to improve the quality of their learning [15]. In fact, it’s recommended that the use of portfolios is not only when becoming a pre-service teacher but extended until someone has become a teacher for professional development [16]. The concept of a portfolio is defined as the collection, selection, and organization over time of teacher work that shows evidence of reflection and learning [4]. Although portfolios are important, what is more important is the nature and quality of the reflections that arise in the use of these portfolios. Regarding portfolios, there are 4 types of reflective writing, namely D1 (pure descriptive), D2 (descriptive and evaluative), R1 (low level reflection), and R2 (high level reflection) [17].

In-depth reflection needs to be carried out by a teacher. There are 3 stages in the deep reflection process [18], namely descriptive, comparative and critical reflection. At the descriptive stage, the problem setting stage occurs, where the teacher determines what aspects (class or teaching practice) are the centres of attention when reflecting. At the comparative stage, the teacher begins to think by understanding the point of view of others, resulting in a more comprehensive understanding of the teaching and the complexities that occur in it. In the critical reflection stage, the teacher evaluates options for integrating new information obtained with the knowledge he/she knows. At this stage, it will determine an alternative way of teaching the teacher.

Another opinion about deep reflection was raised [19]. He divides into 3 distinct stages during deep reflection. The first, the technical stage. This stage is related to the technical arrangement of the classroom in teaching practice. This stage is limited to analysing the impact of the classroom setting on the learning strategies used. The second, the practical stage. This stage involves reflecting on the consequences of applying strategies to teaching practice. Here the teacher assesses the implications of the actions taken. The third, the critical stage. At this stage, it involves questioning the moral and ethical dimensions of the decision to implement the strategy taken, either directly or indirectly to the classroom situation. Another idea says that there are 4 models of reflection, namely experimental events, idea suspension, idea formation, and action testing with observation [20].

The purpose of this study is to determine the depth of reflection and uses the depth of reflection according to [1] which consists of (1) general type, namely when the teacher does not reflect even
though he acknowledges it (2) description type, namely when the teacher is able to explain aspects related to the teaching and learning process (3) argumentation type, namely when the teacher is able to draw conclusions in the teaching and learning process, and tries to understand the activities undertaken (4) contribution type, namely when the teacher contributes to improving the teaching and learning process and is involved in the development and improvement of activities. The aspects that are reflected are as in figure 1 below.

![Figure 1. Aspects that are reflected by pre-service mathematics teachers on the online learning process.](image)

2. Method
This type of research is descriptive qualitative research. The method used in this research was observation and in-depth interviews which were conducted online. Observation was performed by entering the virtual classroom where the pre-service mathematics teacher was teaching. Interviews were conducted by teleconference and chat. In observing and interviewing, instruments such as observation sheets and interview guidelines were used. In-depth interviews were conducted in a semi-structured manner. There may be an adjustment of the existing interview guidelines according to conditions in the field. Teaching practice is carried out for two months in Educational Interaction activities involving 10 pre-service teachers in five schools, those are two high schools and three junior high schools. Interviews were conducted at the end of the first month and the end of the second month.

Aspects reflected by pre-service teachers are teaching and learning aspects. In the teaching aspect, the content of the subject matter and the teaching methodology are the focus. In this aspect of teaching, the researcher conducted a study of the material presented on the learning platform and the teaching methods of the teacher during online learning, including aspects related to organizing teaching in the online classroom. Whereas in the learning aspect, pre-service teachers reflect on aspects (1) content (what is taught) and (2) methodology (how the content is taught) as well as (3) knowledge acquisition (mastery) and (4) knowledge application.
In the aspect of mastery of knowledge, the aspects that are reflected are (1) knowledge obtained before teaching practice or personal experience (2) knowledge obtained during teaching practice. It is attempted for pre-service teachers to reflect more deeply on what was done during their teaching practice. Other things related to knowledge acquisition that were reflected in were (a) appreciation (b) findings in class (c) difficulties faced and (d) attitudes during teaching practice. Meanwhile, the application of knowledge is related to the use of the material being taught.

3. Result and Discussion
Learning processes are carried out online due to the Covid-19 Pandemic situation. This process includes the teaching process and the learning process. Learning uses the Google Classroom platform for the asynchronous model and teleconference (Zoom, Google Meet, and WA Groups) for the synchronous model.

In the teaching aspect, the subject matter and the learning methodology are observed. From the results of observation in the google classroom, it was found that 90% of pre-service teachers have prepared material according to the curriculum and 70% of pre-service teachers have presented material in an ordered and systematic manner, while the remaining 30% of material presentation has not been sorted, some are confused and some material is not written down.

There is one pre-service mathematics teacher who presents material not in accordance with the curriculum. This is because the school decided that there were several math topics that were not taught at grade 7. The materials were combined to be taught at grade 8. The main reason was that time was limited because at that time the school was still adapting to the online learning model. In general, the material presented is in accordance with the curriculum. This is good to ensure the standardization of material presented at the formal school level [6].

Another interesting thing is that there are 3 pre-service mathematics teachers who are confused about the order of the material presented. This shows that the person concerned does not yet know which parts are important and which parts are prerequisites for the next material. There are also some parts of the material that are not included. This shows that the material being mastered is not that deep. The next impact is that the students' mastery of the material is also less.

The learning methodology part is observed when learning using the Zoom or Google Meeting platform. There are eight teaching skills observed during online learning, namely (1) skills to open and close lessons (2) skills to ask questions (3) skills to provide reinforcement (4) skills to give variation (5) skills to explain material (6) skills to manage virtual classes (7) skills to guide small group discussions, and (8) skills to teach small groups/individuals. In small group discussion sessions consisting of 4-5 students, prospective teachers use a breakout room on the Zoom platform. In general, the grouping is carried out by a random Zoom system without paying attention to the abilities of students. In the next session it is possible that a different group has members.

From the observations of synchronous learning using the observation sheet, it was found that not all teaching skills appeared during the learning session. The three main skills that often appear are opening and closing lessons (95%), explanation skills (80%), and questioning skills (60%). The strengthening skills appeared the least (15%). It occurs because pre-service teachers do not know which parts are really important and need reinforcement. The second is that pre-service teachers do not have the right choice of words to provide reinforcement at the time of explaining the material. Skills hold variations and manage virtual classes 30% and 45% respectively. Virtual classroom management related to time management, attendance checks, interaction with students. Pre-service teachers partially pay less attention to students when explaining material, for example students who permit to go to the toilet and are late returning to the virtual classroom, do not reprimand when students mute sounds or turn off videos. This skill of guiding small groups (30%) appeared during discussions in the WhatsApp (WA) group, although the responses of students and pre-service teachers were not instantaneous. Small group teaching skills (20%) also occurred during discussions in the WA group. This is because students consider the discussion in the WA group unimportant and informal. Virtual face-to-face meetings via zoom only are considered official meetings.
The aspect that the pre-service teacher reflects on is the learning aspect. These aspects include (1) the content being taught, (2) the method of teaching content, (3) knowledge acquisition and (4) knowledge application. Reflection data on this aspect of learning is obtained from the results of interviews and questionnaires filled in by pre-service teachers, and portfolios of pre-service teachers on the learning platform and chat history in the WA group. The questionnaire was filled in after each learning session and in-depth interviews were conducted after four meetings. In the material section, there are six questions to help reflect:

- In your opinion, is the presentation of your material in accordance with the curriculum?
- In your opinion, are the stages of presenting the material coherent?
- Have you prepared the material or problem in stages starting from the easy to the difficult one?
- In your opinion, is there anything that needs improvement?
- Which parts need repair?
- In your opinion, how is the improvement?

In the learning aspect of the presentation of this material, all pre-service teachers (100%) can explain what they write on the learning platform. This means they are already at the type of description. After the reflection process, there were six pre-service teachers who could draw conclusions about what needed to be improved, but had not yet arrived at an alternative solution for the improvement. This means that 60% of pre-service teachers are in the argumentative type. In the second reflection process, namely after the eighth lesson, there was an increase, namely 80% of pre-service teachers were in the argumentative type. This shows that the results of reflection can improve the quality of learning. There have not been many alternative improvements because these prospective mathematics teachers still need a lot of flying hours to practice teaching. Previous teaching experiences also influenced the reflection process [13]. The intensity of interacting with various students affects many alternatives to improve the way the material is delivered and increase students' absorption of teaching material.

The several parts that are improved according to the pre-service mathematics teachers are (1) sentence structure, so that students can easily understand it (2) the use of standard words/terms (3) the use of symbols that must be consistent, and (4) clear illustration of pictures or graphic components complete. Pre-service teachers can find parts that need to be improved. Thus, this is in line with the opinion of [5] which states that reflection is a conscious activity to identify problems in learning. If reflection is done frequently, the more inhibiting problems can be found. The opportunity to improve the learning process is also getting bigger. This is in accordance with the type of reflection for people who are pursuing higher education [21]. However, reflection must focus on the main idea, namely improving the process [22].

For the learning aspects in the learning method section, data was obtained those pre-service teachers used the following methods: lectures (25%), lectures and discussions (15%), lectures and questions answers (45%), lectures and quizzes (10%), lectures and group discussions (5%). This data is obtained by observing pre-service teachers in the synchronous learning with the Zoom or Google Meet platform. Reflections are carried out on eight aspects of teaching skills that are practiced. Recordings of learning and material presentation on the Google Classroom platform as a portfolio really help pre-service teachers in the reflection process. This is in line with the opinion of Wade and Yarbrough [15] which states that portfolios are one of the mechanisms by which reflection is carried out.

The eight aspects of teaching skills are reflected at the end of each learning session. Reflection data is obtained from a questionnaire filled out by pre-service teachers. Pre-service teachers are asked to write down which aspects they think need improvement, then proceed with the question of how to fix it. With the help of in-depth interviews in the reflection process, data shows that the teaching skills of pre-service teachers of mathematics have increased, especially in the aspects of skills in opening and closing lessons as well as skills in explaining the material. The next aspect that has also improved is
the skill of asking questions. All aspects of teaching skills do not appear because the teaching process is so complex. This is in accordance with the opinion of Davis [10] which states that reflection can help understand the complexity of teaching.

It can be seen in table 1 that there are two pre-service teachers who have a significant increase from the descriptive type to the contribution type. There is one pre-service mathematics teacher whose reflective thinking type remains at the descriptive level, while the rest go up one level from the argumentative type to the contribution type. This is in line with the opinion of [3] that novice teachers, including prospective mathematics teachers have a large capacity to reflect in the first year, but the critical power to reflect is still lacking. Reflective dialogue after learning becomes meaningful for implementing learning strategies [23], including giving feedback [24]. Therefore, a companion teacher or supervisor is needed to reflect by deliberate analysis, so that pre-service mathematics teachers have many views [25].

Table 1. The development of pre-service teacher reflective types in learning aspects of the presentation of learning content and methodology.

| Subject | Reflection Type |
|---------|----------------|
|         | Reflection I   | Reflection II |
| 1       | argumentation  | contribution  |
| 2       | argumentation  | contribution  |
| 3       | argumentation  | contribution  |
| 4       | description    | contribution  |
| 5       | description    | description   |
| 6       | argumentation  | contribution  |
| 7       | argumentation  | contribution  |
| 8       | argumentation  | contribution  |
| 9       | argumentation  | contribution  |
| 10      | description    | contribution  |

The next part is the learning aspect of the knowledge section. It consists of knowledge acquisition and application knowledge. Both are not directly related to learning but are related to the reflection process that can improve the knowledge of pre-service teachers, so that it can have an impact on improving their learning. Knowledge acquisition relates to the knowledge that pre-service teachers acquire before or during the learning process. Meanwhile, application knowledge relates to the application of knowledge possessed by pre-service teachers in their learning class.

In knowledge acquisition, information is extracted about what knowledge the pre-service teacher will acquire during the learning process. This knowledge comes from the interaction of pre-service teachers with students in their online learning classes. With the help of portfolios in the form of learning recordings, material on the platform, and chat history with students, pre-service teachers reflect on the knowledge gained. Information is collected and analysed based on in-depth interviews. This interview was also conducted online (telephone and Google Meet). There are three key questions in this section: (1) To what extent do you know the students? (2) Do you give appreciation to students when the learning takes place? What form? (3) In your opinion, what did you get during the lesson?

90% of pre-service teachers do not know their students well, because they are new to the teaching practice class. This has an impact on the learning methods used. Proximity to students makes pre-service teachers awkward in interacting and communicating [26]. This is also caused by cultural differences [2]. In addition, 30% pre-service teachers rarely give appreciation to students who have succeeded in answering questions either directly or in writing. When asked further, pre-service
teachers said that they were not used to giving appreciation and lacked choice of words to express appreciation for students. Changes in pedagogy, from face-to-face to online and ethics in virtual forums are also influential [27].

When pre-service teachers are given the opportunity to convey what knowledge was obtained during the learning process, most pre-service teachers find it difficult to express it clearly. Most only said that pre-service teachers were satisfied with the material being taught. But they do not know the absorbency of the students. When interviewed regarding the attitudes of students, most of the pre-service teachers said that the students’ attitudes were normal, such as during face-to-face learning in real classes. This shows that prospective teachers have not been able to reflect deeply on their teaching practices and are less able to see that the learning process is part of the reflection. The result is that it is less able to stimulate students to think critically [28].

In phase II reflection on the acquisition knowledge aspect has increased. Pre-service teachers are getting to know the characteristics of students and getting used to giving appreciation. They are aware that by giving awards in the form of words of appreciation, it motivates students to stay focused on learning. Pre-service teachers have also begun to find in-depth knowledge related to the pedagogical process, especially the fact that in order for the material presented to be properly accepted by students, it needs to be delivered in stages and it is necessary to be patient for it. Providing scaffolding during small discussions in the WA Group chat was also felt to increase absorption. At this stage it shows that reflection can increase new understanding and make more confidence in teaching [8].

In the learning aspect of the application knowledge section, information was obtained that 60% of pre-service teachers could apply previously acquired knowledge in the lecture class. Knowledge of content of school mathematics material, learning methodologies and developmental psychology of students can be felt beneficial when this teaching practice takes place in different portions. Knowledge data that is useful during this teaching practice is obtained based on a questionnaire filled out by pre-service teachers, as shown in figure 2. As many as 40% of pre-service teachers find it difficult to apply previously acquired knowledge in their pursuit of practical classes, especially in the psychological aspects of student development. This shows that reflection can come from learning experiences and teaching practices [29] in accordance with the purpose of reflection itself, namely to develop learning outcomes and develop teaching practices. Mathematical knowledge is a strong driver for reflection [8].

In the learning aspect, the knowledge section of this application is also reflected twice. In the first phase of reflection, pre-service teachers have not been able to mention in detail what knowledge was obtained in lectures that were useful during teaching practice. In the second phase of reflection, 7 pre-service teachers have begun to be able to explain useful lecture material while teaching, as well as provide examples of the form of its application. However, peacock has not been able to provide a clear
alternative about what knowledge is needed so that the quality of learning is better. In general, for the learning aspects of the knowledge section, the type of reflection of pre-service teachers increases from description type to argumentation type. The student response questionnaire showed that 78% of students said that the material presented and the teaching methods of pre-service teachers had increased from half the time to the end of teaching time.

Previous research has been able to show what aspects are reflected by pre-service mathematics teacher in their teaching practices. Meanwhile, this study complements the previous research, namely what knowledge is needed by pre-service mathematics teacher to improve the quality of their online learning. This research has had a significant impact on the teaching practice of pre-service mathematics teacher. A list of reflection questions helps student teacher candidates to increase the depth of their reflection. The contribution reflection type will make online classroom learning better.

4. Conclusion
The results showed that the type of reflection of pre-service teachers has increased, from the argumentation type to the contribution type. In the first stage of reflection, pre-service mathematics teacher was able to describe their learning and teaching processes. As well as being able to determine which things need improvement. In the second phase of reflection, pre-service teacher was able to provide alternatives for process improvement in the next period. The portfolio in online teaching for pre-service mathematics teachers was able to help increase the depth of their reflective thinking. This portfolio is related to learning aspects for the presentation of material and teaching methods. The portfolio stimulates to reflect on learning in accordance with the context and can be evidence of reflection time to time. This result is in line with the opinion of [14] and [4]. Knowledge of school mathematics material, teaching methods and student psychology can increase the depth of reflective thinking. In general, the visible impact is that the quality of the learning is getting better.

5. References
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