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Analysis of Productive Pedagogies of Pre-Service Teacher of Mathematics Education Study Program in Teaching Mathematics at School

Abstract. *This research aims to analyze the productive pedagogies of the pre-service teacher. Productive pedagogies are measured based on four dimensions, namely intellectual quality, connectedness, supportive classroom environment, and recognition of difference for pre-service teacher students who carry out teaching practices in the even semester of the 2020/2021 academic year. This research is a case study. The assessment of productive pedagogies was measured using a 5-point Likert scale questionnaire. Based on the overall dimensions measured through the questionnaire, the lowest average was found on the intellectual quality dimension of 79.68 (high category). The highest dimension of connectedness was 84.7, with a very high category. While supportive classroom environment dimension is in the high category at about 79.96. The average recognition score of recognition of differences is 82.2, meaning they are in the very high category. The results also showed that productive pedagogies of prospective teacher students were in the very high category.*

Keywords*: Analysis, Pre-Service Teacher, Teaching Practice, Productive Pedagogies.*

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Introduction

A teaching practice program (PPL) is an effort to increase the pedagogical competence of pre-service teachers to master good strategies to help students achieve the expected learning achievement. In addition, PPL activities help the pre-service teachers increase their understanding of the material presented in class. PPL students with the teaching knowledge and content in lectures must be sensitive to the school culture built by policies, traditions, power, and personality. This is a special challenge for beginners trying to apply their knowledge (Zeichner & Gore, 1990). The preservice teachers are prepared in the university with knowledge and methods for overcoming problems during the learning process. Although many obstacles may occur when teaching practicing programs, pre-service teachers will implement various strategies to deepen their teaching skills (~~Tri~~ Yuli, 2021).

If mathematics learning is only obsessed with student test scores, it limits the ability to serve the broader needs of students and their communities. The objectives of learning mathematics should include mathematical concepts, everyday contexts, and the world (Nurwati, 2014). Furthermore, students are expected to develop a strong cultural and social identity in the mathematics learning process. This is relevant to the principle of productive pedagogies, which provides a different view of teacher teaching practice. It views teacher choices about content and strategy as fundamental and their main responsibility. It provides a context for prospective teachers to prioritize pedagogy as they start their careers.

One of the frameworks developed in Queensland in Australia, known as productive pedagogy, is an attempt to integrate the research findings of effective teaching from various research fields in education and classroom training. In particular, productive pedagogy is the product of a longitudinal study of school reform carried out in Queensland, Australia (Lingard, 2001). The basic objective of this framework is to improve the quality of classroom teaching. The ongoing investigation effort focuses on strong and important ideas and concepts connected to students' experiences and their world

(Atweh, 2014; Zyngier, 2005). Productive pedagogy is concerned with how to help students learn and how to improve their academic and social outcomes during classroom teaching. Developers of the productive pedagogies framework (Lingard, 2001) postulate four dimensions that describe and mark what is called the quality of teaching (Atweh, 2014). These four dimensions are Intellectual Quality, Connectedness, Enabling Classroom Environment, and Recognition of Differences. Productive pedagogies can describe and examine how the learning process occurs. The study results can be useful for creating optimal learning by applying pedagogic skills considered appropriate through exploring productive pedagogies.

Rousseau (1889) defines pedagogy as an art, practice, or profession as teaching, systematic science, or teaching related to teaching principles and methods. Meanwhile, productive pedagogies are a normative framework consisting of four dimensions for improving classroom teaching: Intellectual Quality, Connectedness, Supportive Classroom Environment, and Recognition of differences (recognition of differences). Each dimension is further elaborated by some elements that make up it (Lingard, 2001), as in Figure 1 below:

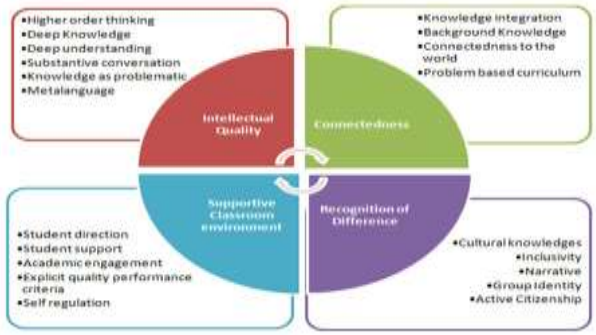

Figure 1. *The framework of Productive Pedagogies*

Productive pedagogies in this study illustrate the pros and cons of learning strategies used in the classroom environment. Productive pedagogies are described through the values obtained based on questionnaires, observation sheets in the learning process, lesson plan indicators, and learning implementation. According to Lingard (2001), teachers can consider the learning strategies and present material to students through the productive pedagogies framework. Values in the range 1-29 indicate productive pedagogies that are not good, 30-39 (very low), 40-55 (low), 56-65 (moderate), 66-79 (high), and 80-100 (very good).

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As an effort to integrate research findings into effective teaching, productive pedagogies allow teachers to reflect critically on their work. As identified by Gore (2001), various benefits can be obtained, among others, to make the teacher or involve the teacher in personal reflection and substantive conversation about students.

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Research Method

This research is a case study involving an intensive descriptive analysis of participants that focuses on the in-depth learning experiences of 3 students of the PPL course. (They were selected

because they practiced in the same State Junior High schools), namely teacher H, teacher N, and teacher Hd. (Pseudonyms have been used to protect the identity of the pre-service teachers).

This research took place at the school where the PPL was implemented, which consisted of 3 different classes according to levels by involving the three PPL students for the even Semester of the 2020/2021 school year as participants.

Data collection was carried out using a questionnaire from the productive pedagogies dimension and semi-structured interviews (Lingard, 2001) to measure the productive pedagogies (intellectual quality, relevance, relevance, and management of the classroom environment) for teachers during the learning activities. There are 17 questions in the questionnaire, and each question item will represent every indicator of the four dimensions of productive pedagogies. The questions were taken from the Department of Education (2002) about indicators of productive pedagogies. The indicators of the four dimensions of productive pedagogies will be seen whether or not they appear through the data obtained from questionnaires and interviews.

The results of the questionnaire answers regarding the productive pedagogies of teachers were analyzed using a Likert scale. The overall score obtained is assessed by:

$$Score = \frac{\text{Total score}}{\text{Max score}}\ x\ 100$$

The scores obtained are interpreted as shown in Table 1:

Table 1. Interpretation of Questionnaire Answer Scores

Score	Interpretation
30-39	*Very Low*
40-55	*Low*
56-65	*Average*
66-79	*High*
80-100	*Very High*

(Arikunto, 2012)

Results and Discussion

Productive pedagogies measured include intellectual quality, connectedness or relevance in presenting material, and the supportive classroom environment. Productive pedagogies were conducted on student-teacher candidates who attended lectures of PPL via questionnaire productive pedagogies.

1. *Intellectual Quality*

The intellectual quality dimension relates to students' understanding of the mathematics material taught by the teacher. This includes a basic understanding of learning and a further understanding of issues that require high-level analysis and deep thinking (HOTS).

The lowest average was found on the intellectual quality dimension of 79.68. The following table shows the overview of productive pedagogies in this dimension.

Table 2. Value of Students' Productive Pedagogies on Intellectual Quality Dimensions

No	Intellectual Quality	Statement	Average

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International reader didn't know about PPL, how long this course, what is the goal of this course , ? What mathematics course they hav took as pre requsite of PPL corse?

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Please include data from observation of they video recording of their teaching

How many meeting they teach?
What topic they teach during PPL? What grade?
How long?

When did researchers ask preservice teachers answer the questionnaire, after 2 months or when?

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Please give more information to support the explaination, such as preservice teachers' documents during teaching

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			H	N	Hd
1	Deep knowledge	The teacher develops mathematics lesson that covers operational fields in any depth, detail, or level of specificity	80	88	82
2	Higher-order thinking	Teacher gives students opportunities to use higher-order thinking operations within a critical framework~~?~~	80	81	80
3	Deep understanding	The teacher uses the mathematics work and responses of the students to demonstrate a deep understanding of concepts or ideas	75	80	79
4	Substantive conversation	The teacher keeps sustained conversational dialogue between students, between teacher and students, to create or negotiate an understanding of the mathematics topic	85	80	80
5	Knowledge problematic	The teacher gives students chances to critically examine texts, ideas, and knowledge	65	70	71
6	Metalanguage	Teacher prominently gives aspects of mathematics knowledge, symbol, and concept	90	85	83
		Mean	79.2	80.67	79.17

Based on the research results, the teacher has provided an understanding of learning to students. The average teacher score prominently gives aspects of mathematics knowledge, symbol, and concept around 86. According to the participants, students have also done the assignments well. However, teachers have difficulty applying higher-order thinking to the indicators, inserting problems requiring high-level analysis in learning mathematics. According to Kristiyono (2018), learning with high-level analysis is directed at creating independent students, thinking critically, and answering all problems and problems in the surrounding environment. This is very important for students to adapt and compete in a global society. There are supporting research results in increasing student achievement using HOTS learning and assessment. HOTS learning can make students think systematically, learn to analyze a problem from various aspects, educate students to be confident, and improve critical and creative thinking skills.

Kristiyono (2018) found that using the HOTS-based Student Worksheet (LKS) positively and significantly affected the science learning motivation of 7th-grade students in junior high school. There are five things that cause HOTS-based worksheets to increase student motivation, namely: (1) stimulating students' willingness to learn because the worksheet offered raises curiosity, (2) encouraging pleasure because it displays concepts that cannot be observed directly with other media, (3) helps students find mathematics concepts so that this media becomes a liaison between students' prior knowledge, (4) stimulates students' willingness to learn because the worksheet offered is not an answer from the object of observation but only implementation instructions so that students experience the process of finding themselves, (5) encouraging independence students because each student is allowed to do reinforcement in the form of critical thinking skills. These things show that the learning must not only provide a basic understanding of the learning objectives to be achieved. Mathematics learning also needs to include high-level analytical problems.

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Why authors didn't start from aspec 1, 2, ... 8 respectively?

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2. *Connectedness*

In general, the connectedness dimension has a mean value of 84.7, which is in the very high category.

Table 3. Value of Students' Productive Pedagogies on Connectedness Dimensions

No	Connectedness	Statement	Average		
			H	N	Hd
1	Knowledge integration	The teacher integrates the lesson in a range of subject areas	80	80	81
2	Background knowledge	The teacher explicitly creates the lesson links with students' background knowledge.	93.4	80	80
3	Connectedness to the world	The teacher applies activity or task connected to competencies or concerns beyond the classroom.	86.6	87	85
4	Problem-based curriculum	The teacher creates lessons focused on identifying and solving intellectual and/or real-world problems.	93.4	85	85
Mean			88.35	83	82.75

Teachers score high on the relatedness dimension among the four dimensions of productive pedagogies. On indicators relating students' background knowledge to the material being taught in learning, the three teachers strongly agreed and applied these indicators in learning. Teachers H and Hd teach probability material and remind students of fraction simplification material. Teacher N who leads the presentation of data in a pie chart also relates it to the diagramming lesson that students have learned in elementary school. Suherman et al. (2003:55) suggest that "school mathematics as mathematics taught at the primary and secondary education levels is chosen based on or oriented towards educational interests and the development of science and technology." Some of the material taught is basic and closely related to other material taught at higher education levels. This causes teachers to need to remind students about learning materials that are required or have a relationship with the material to be studied.

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Other indicators of the relatedness dimension, namely the existence of similarities or connections with the real world, have also been carried out in the teacher's learning. According to Van den Heuvel-Panhuizen & Paul Drijvers (2014), relating the material taught to real life in ongoing learning is necessary. With a connection to real life, students feel the urgency or importance of learning. This can be a reason for students to learn the material being taught. Likewise, in learning mathematics, it is necessary to connect the material being taught with students' real life.

Teachers H and Hd also connected mathematics topics with real-life teaching and learning. The teacher takes examples of problems and questions related to real life. Especially in the probability material, students are expected to estimate which decisions should be taken based on the value of existing opportunities from the problems they face in the real world. Meanwhile, in learning mathematics conducted by Teacher N, there is a clear connection with real-life students. Students can find and see the presentation of data in diagrams in real life, such as in newspapers and electronic media such as television. In solving real-world problems, students require literacy ability to solve them, including mathematical connection abilities by using links between concepts, procedures, and facts as the role of mathematical connections in mathematical problem-solving activities (Didik, 2020).

3. *Supportive Classroom Environment*

The mean value of productive pedagogies among PPL students in the supportive classroom environment dimension is in the high category, about 79.96, as shown in Table 4 below.

Table 4. Value of Students' Productive Pedagogies in Supportive Classroom Environment

No	Supportive Classroom Environment	Statement	Average		
			H	N	Hd
1	Student control	The teacher gives students chances to determine specific activities or outcomes of the lesson	80	75	70
2	Academic engagement	The teacher engages students and gives them on-task during the lesson	80	85	83
3	Self-regulation	The teacher explicitly develops criteria for judging the range of students' performance.	86.6	80	80
Mean			82.2	80	77.67

Based on the study results, the indicators of this dimension have been carried out by teachers in teaching and learning mathematics. The teacher gives students the freedom to ask questions and provide opinions during mathematics learning. In addition, the teacher also provides problems that require students to be active in solving them so that students can build understanding in learning.

To maximize the learning process, students need a positive environment that supports student learning. If students feel they are cared for and allowed to participate actively and responsibly, they think the school climate is positive and supportive and helps students feel they belong at school (Vera, 2021). Classroom management strategies are required to create a positive environment and make children want to work together. According to Atweh (2012), productive pedagogies can be a reference or framework for creating a supportive or conducive classroom environment. Learning is done by maximizing students' participation and freedom in determining the learning steps. This can be seen from the indicators on the dimensions of a supportive classroom environment. Various indicators such as students having a voice in determining the direction and outcomes of learning, students participating actively in learning, and explicit assessments have emerged in mathematics learning by teachers, even though the average score is only about 75.

4. *Recognition of Difference*

In general, the productive pedagogies of student participants in the dimension of recognition of differences is 82.2, which means that they are in the very high category.

Table 5. Value of Student Productive Pedagogies on Recognition of Difference

No	Recognition of Difference	Statement	Average		
			H	N	Hd
1	Cultural knowledge	Teacher values non-dominant cultures	86.6	85	85
2	Inclusivity	Teacher attempts to encourage active student citizenship within the classroom	80	80	80
3	Group identity	The teacher builds a sense of community and identity	80	82	81
Mean			82.2	82.33	82

From the dimension of recognition of differences, the participants ensure that students know and appreciate cultural diversity, create positive relationships between students, respect individuals, and help develop a sense of community. This applies cultural knowledge, inclusiveness, expository, group identity, and an active citizen role. The indicator involves diverse expertise and

culture in the teaching and learning process. The insertion of moral messages related to culture can influence students directly or indirectly always to behave well. Inserting general knowledge into learning or given assignments can add insight to students in social life (Sadulloh, 2010). Thus, inserting cultural and moral messages into learning is a good thing to do. In addition, giving moral messages related to cultural values to students can also attract their attention if it is done at the beginning of learning and can motivate them to study hard.

Teachers must pay attention to time allocation when inserting messages related to culture. So this does not affect the learning material to be taught. Especially in learning materials that are difficult to understand and require a lot of time allocation in teaching. Because the main priority in learning is to make students understand the topics and achieve the objectives of learning mathematics (Komalasari, 2013).

Conclusion

Based on the results of research and discussion, it can be concluded that: Productive pedagogies of mathematics education students in teaching practice in schools (PPL) are in the very high category. Mathematics education students can apply productive pedagogies in their learning activities. Overall, participants in carrying out learning practices argue that they have used the dimensions of intellectual quality. The data shows that the average value of productive pedagogies for the dimensions of intellectual quality is in the high category. In general, the dimensions of connectedness are in the very high category. Meanwhile, the mean value of productive pedagogies among PPL students in the class environment dimension is high. Likewise, the average productive pedagogies of participants in the dimension of recognition of differences are in the very high category. Please write limitation and recommendation of the findings.....

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1. The topic of this research is interesting however didn't support enough information.
2. The demography of participants is not enough
3. There are 3 preservice teachers involved in this research. Researchers asked them to answer the questionnaire by them self, how to make sure they answer correctly? Reader need the credible data. Please support the other instruments or information
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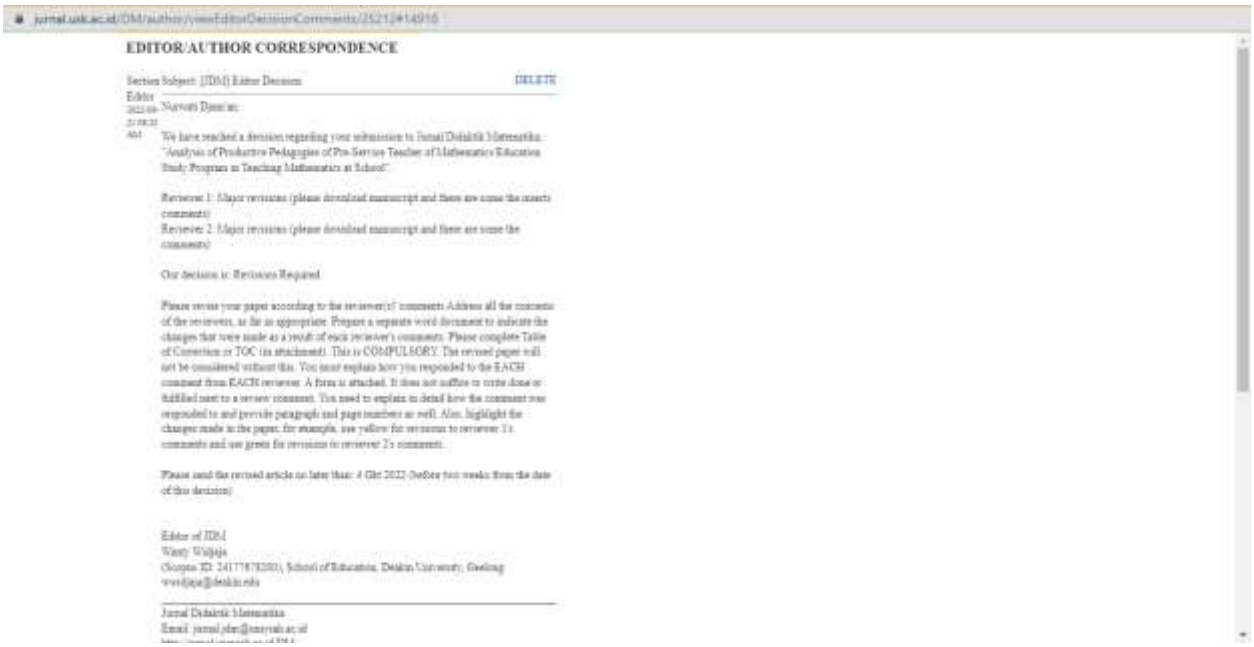

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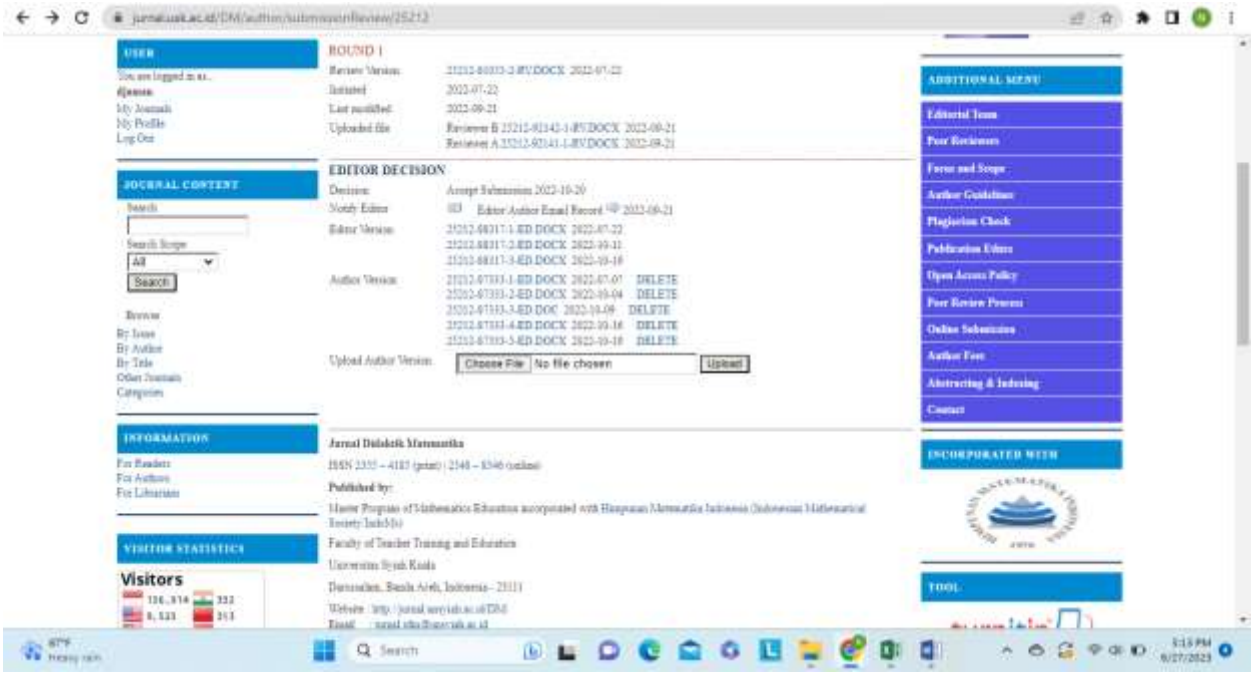

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