



## Exploring the Perspective of Indonesian In-service Elementary Teachers toward Pedagogical Content Knowledge (PCK) on Teaching Mathematics

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**Abstract:** Mathematical proficiency as a goal of learning mathematics and other skills developed by teachers in schools through a didactic and pedagogical activity. The quality of teaching mathematics in elementary education is largely determined by the teacher's perspective on Pedagogical Content Knowledge (PCK) in mathematics learning itself. This study aims to see the perspectives of elementary school teachers who are experienced in teaching mathematics regarding several things that are needed in learning mathematics in elementary schools. The study used a survey method which was conducted on elementary school teachers who have experience in teaching mathematics with various educational backgrounds and different schools (n = 65) through random sampling. The study is focused on investigating the pedagogical perspective, the perspective of mathematics learning objectives, and the perspective of mathematics content taught in elementary schools. These perspectives are arranged in a research instrument in the form of a questionnaire containing multiple answer questions and open-ended answers. Data collection was carried out with the help of google forms. The data analysis used is quantitative and qualitative approaches. The results showed that various innovative learning models were known by the teacher, although not all teachers were sure that they had implemented the learning model according to the syntax of the learning model. Also, teachers are still optimistic that innovative learning models have flexibility so that they can be applied in pandemic conditions.

**Keywords:** Pedagogical Content Knowledge (PCK). Mathematics, Teacher Perspective, Elementary School.

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### INTRODUCTION

Improving the quality of learning is one thing that cannot be separated from the responsibility of educators. Educators today certainly have a very big challenge where education has shifted in the digital era and the progress of scientific knowledge is very rapid (Fisher & Kusumah, 2018). Moreover, since the COVID-19 pandemic situation, all educators including elementary school education are required to be able to adapt to challenging things, namely carrying out digital transformation in teaching and learning through distance learning (Berry & Kitchen, 2020; Rospigliosi, 2020).

Pedagogical content knowledge (PCK) is a fundamental component as a knowledge base for carrying out learning activities. PCK was first pioneered by Shulman which is seen as the ability to transform disciplinary content into a form that is accessible and

achievable by students (Shulman, 1986). In more detail, PCK is described as a combination of specialized content knowledge (SCK) and knowledge of content and students (KCS) which becomes an understanding of how a topic or problem is taught according to the needs of students (Loewenberg Ball et al., 2008; Moru et al., 2014).

PCK has four domains including student knowledge, curriculum knowledge, knowledge of strategies or learning models, and knowledge of assessment (Hanuscin et al., 2018). The thing which needs to be highlighted is that in this study, what is examined is not only knowledge but tries to emphasize investigating the perspectives or beliefs of teachers of mathematics learning. Belief is one of the factors besides the knowledge that significantly influences how teachers interpret and implement the



curriculum within the classroom (Moru et al., 2014; Thompson, 1992).

The involvement of students in mathematics learning activities is closely related to how the teacher views the essence of mathematics learning itself (Moru et al., 2014). This confirms that the perspective of mathematics learning objectives which is understood by the teacher is key in the learning activities carried out by students. Thus, this study was conducted to investigate the perspective of elementary school mathematics teachers in improving mathematics learning. The improvement referred to is contained in pedagogical content knowledge (PCK) which is based on three foundations, namely pedagogic knowledge, knowledge of learning targets, and knowledge of learning content. Indirectly, the things that become concentrated are perspectives regarding students' thinking, class management, student abilities, barriers to gaining knowledge, and ways of presenting learning material that can be understood by students (Moru et al., 2014).

The research entitled "Exploring the perspective of Indonesian in-service elementary teachers toward pedagogical content knowledge (PCK) on teaching mathematics" was conducted to investigate the perspective of elementary school

teachers on PCK in mathematics learning including pedagogical aspects, learning goals, and content mathematics. Through this research, we expect the development of the quality of learning as a follow-up in overcoming solutions to the findings obtained. Systematization of good learning and optimal teacher performance in planning and implementing learning activities have a very positive influence on elementary mathematics learning (Nugraha et al., 2020).

## METHOD

This study is non-experimental research which was conducted using a survey method. The survey was conducted to find out information about the perspective as well as pedagogical content knowledge (PCK) of elementary school teachers of mathematics learning in elementary schools.

## Research Subject

The study involved 65 participants who were elementary school teachers and had experience in teaching mathematics. Sampling was done randomly with the population, namely elementary school teachers in West Java, Indonesia. More clearly, participant data can be seen in Table 1 below.

**Table 1.** Participant Data

Research Participant		Percentage	Research Participant		Percentage
Gender	Male	33,8 %	Educational Background	Bachelor of education	84,7 %
	Female	66,2 %		Non-educational bachelor	3 %
Classroom Mathematics	1 <sup>st</sup> grade	26,2 %	Teaching Experience	Professional teacher education	6,2 %
	2 <sup>nd</sup> grade	35,4 %		Master of education	6,1 %
Teaching Experience	3 <sup>rd</sup> grade	38,5 %	< 2 years	30,8 %	
	4 <sup>th</sup> grade	47,7 %	2-5 years	40 %	
	5 <sup>th</sup> grade	40 %	5-10 years	10,8 %	
	6 <sup>th</sup> grade	35,4 %	> 10 years	18,5 %	

## Data Collecting and Analysis

The data was collected through a questionnaire as a research instrument. The questionnaire is used to collect survey information with structured data collection which is effective and relatively easy to manage and analyze (Cohen et al., 2007; Wilkinson & Birmingham, 2003). The

questionnaire is divided into 4 parts, namely 1) participant identity sheet, 2) pedagogic knowledge, 3) learning goals knowledge, 4) mathematics content knowledge. The questions in the questionnaire were made in various ways by involving answer choices as well as open-ended answers that led participants to give responses according to their PCK perspective. Explanations and



agreements were included both at the beginning and the end of the questionnaire. This is done to minimize and secure a high enough response rate so that the data that has been obtained has data credibility and reliability (Cohen et al., 2007; Creswell, 2012).

The data collected was then analyzed both quantitatively and qualitatively. Quantitative data are presented automatically on Google

Forms, while qualitative data is a description of the results of the perspective analysis and teacher PCK in mathematics learning. The analysis involves explaining the relationship of several variables (e.g. educational background, learning experience, etc.) to the responses given in the survey (Al-Daami & Stanley, 1998). More clearly, some samples of the questions in this research questionnaire can be seen in Table 2.

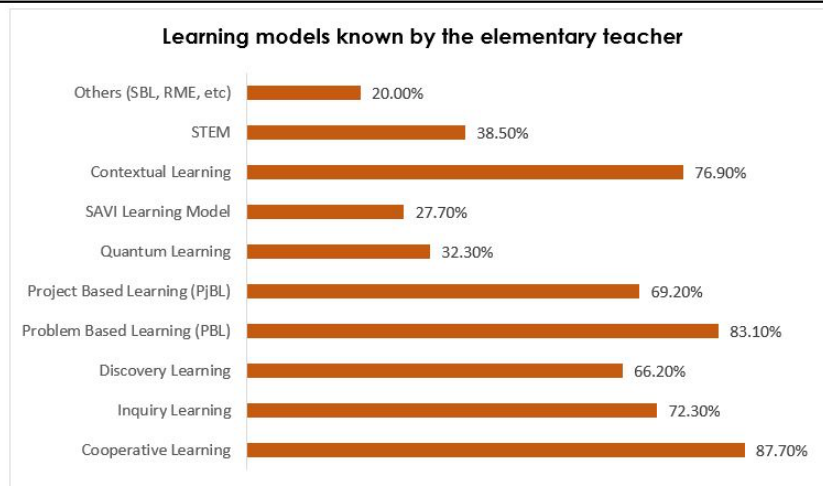
**Table 2.** Examples of questions in research instruments

No.	The example of the questions in the questionnaire
A1	What learning models did you know?
A3	How confident are you that you have implemented the learning model in your class according to the syntax/steps of the model?
A5	Describe a learning model that you know complete with the steps! If you wish, you can add an example of how you can implement it.
A6	Looking at the situation during this pandemic, is it possible to implement this learning model through distance learning? Why?
B1	What mathematics learning goals did you know?
B2	In your opinion, what are the most important learning goals to be taught in mathematics learning in elementary schools?
B4	In your opinion, which learning model is suitable for enhancing these learning goals?
B5	Why did you choose this learning model to enhance the intended learning goals? Try to explain your reasons!
C1	Based on your experience, what math topics are difficult for children to teach and/or understand?
C2	Why did the child find the topic difficult to teach and or understand?

## RESULTS AND DISCUSSION

This basic idea was initiated by previous research conducted by Fuadi & Sopandi (2020) which highlighted how elementary school teachers' perceptions of learning models related to creative thinking and engineering skills. Through this research, we examine a different topic which deeper focus on the pedagogical content knowledge (PCK) perspective that leads to how teachers

provide quality education in the field of elementary education mathematics. Mastery and understanding of the diversity of innovative learning models are closely related to the ability to choose learning models that are by the lesson content and learning goals that will be obtained by students. This survey found that most of the teachers already knew about innovative learning models which could be represented in Figure 1.



**Figure 1.** Results of Elementary Teachers' Pedagogical Perspective

Figure 1 illustrates that the majority of teachers already know about innovative learning models, even though some learning models are still not familiar. The findings in this study confirm that teachers' knowledge of the learning model can be determined by various factors, including educational background and teaching experience. Teachers with a professional teacher education background and a master of education have more extensive knowledge about learning models (Fuadi & Sopandi, 2020; Long et al., 2020). Besides that, teachers who have longer teaching experience also have broader and varied knowledge (Faulkner & Cook, 2006; Gagnon & Maccini, 2007) such as on the learning model knowledge.

### Interest Findings of Pedagogical Perspective

An interesting finding in this study is the majority of elementary teachers are still not sure that they have implemented a learning model according to its syntax. This implementation confidence data shows that 22.7% of teachers are confident, 44.6% of teachers are not sure, 18.5% of teachers choose to doubt and 9.2% of teachers admit that they are implementing the model not according to the syntax. The data on the frequency of time the teacher implements the learning model according to the syntax confirms that 3.1% of teachers implement it very often, 58.5% of teachers implement it frequently, 15.4% rarely, 21.5% not often,

and 1.5% very infrequently. Given that belief is an important factor in the implementation of learning (Moru et al., 2014; Thompson, 1992), then this needs to be a concern and requires follow-up improvement.

Another finding is that 57.8% of teachers are optimistic that the learning models they know can be implemented when it is a distance learning condition. Even so, the teacher agrees that it is necessary to give more effort and supporting infrastructure so that the model is implemented according to the syntax during a pandemic. This confirms that the COVID 19 pandemic has made education an emergency problem that relies on educational technology as a frontline emergency service (Williamson et al., 2020), and maybe in the future schools including elementary schools will have no choice but to continue to carry out online instruction (Verma et al., 2020).

### The perspective of Mathematics Learning Goals

Along with the growing trend of literacy and numeracy as priority skills in education around the world (Ní Chróinín et al., 2016), mathematics learning has undergone various developments to aim at developing mathematical power which includes reasoning, problem-solving, mathematical connections, and mathematical communication (Kilpatrick et al., 2001). Thus, the goal of learning mathematics is not only mastery of the material for completing



exams but needs to pay attention to the objectives of the thinking process.

Elementary school teacher mathematics knowledge is one of the most widely recognized in the international community (Bowie et al., 2019). Educators need to understand mathematics as a combination of both the way of understanding and the way of thinking needed by students so that reasoning occurs (Harel, 2008). Based on this foundation, through our study, we present several mathematical abilities in the questionnaire to confirm whether the teacher already knows about the learning objectives.

Effective mathematics teaching starts from a shared understanding between teachers, one of which is about the broader and more targeted objectives of mathematics (NCTM, 2014). We discover more about the important learning objectives corresponding

teacher's perspective. The findings show that the majority of teachers already know mathematics learning goals. Through an assessment of the perspective on the importance of learning goals for students, we found that the teacher's rudeness in prioritizing problem-solving as the goal of learning mathematics was very high where a percentage was 58.46%.

The second skill prioritized by the teacher is a conceptual understanding of 29.20%. This indicates that conceptual understanding is a very important goal where conceptual understanding is placed as the first goal in mathematical proficiency (Kilpatrick et al., 2001). Conceptual understanding is the foundation and necessary for the development of procedural fluency (NCTM, 2014). More clearly, the findings regarding the teacher's perspective on the objectives of learning mathematics can be represented in Figure 2.

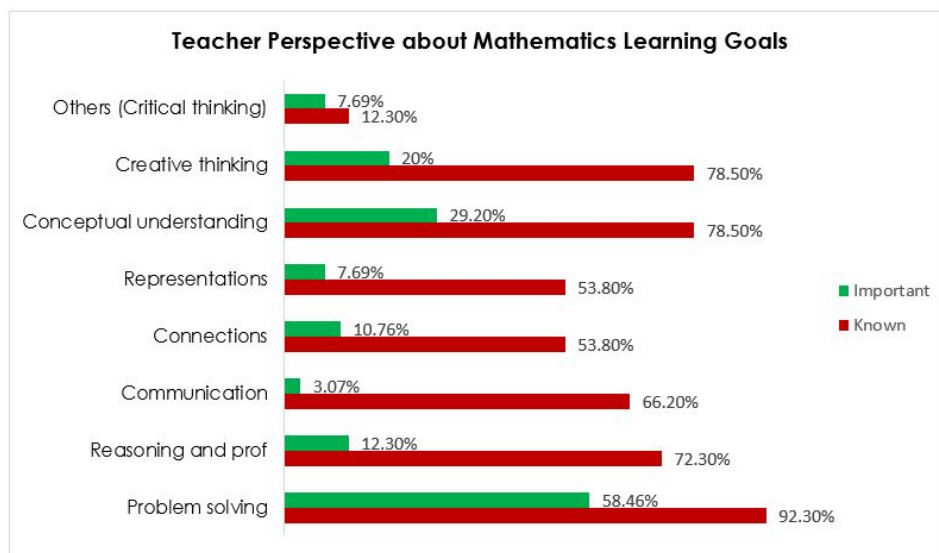


Figure 2. Elementary Teachers' Perspective on Mathematics Learning Goals

### The perspective of Content Mathematics

Knowledge of learning content (CK) is a component of pedagogical content knowledge (PCK). Within this scope, our focus is to investigate mathematics topics that are difficult to teach based on five content standards that are common throughout the class (Martin, 2000; Reys et al., 2009; Van de Walle, 1998) addition by some specific topics in the 2013 curriculum.

We found that three topics that were difficult to teach were fractions (52.30%), geometry (46.80%), and ratio and proportion (33.80%). The reason for the difficulty is that some mathematics topics are not very close to the context of student life. In this case, the majority of teachers have tried to bring math content closer to a certain context but this is still not successful. A representation from the perspective of content mathematics is presented in Figure 3.



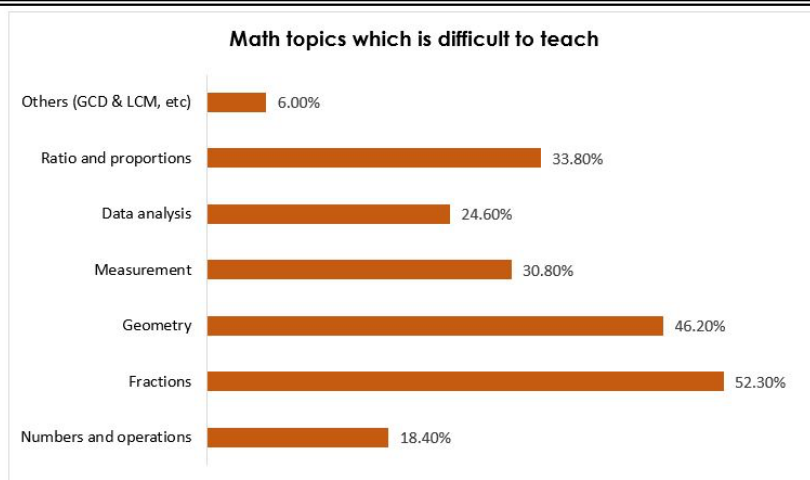


Figure 3. Elementary Teachers' Perspective on Mathematics Content

## CONCLUSION

Based on the PCK perspective, the expertise of elementary school math teachers has room for optimization of certain math topics. Almost all teachers already know innovative learning models that can be developed in mathematics learning. However, in this study, we underline the importance of PCK for teachers not only in terms of knowledge but also beliefs or perspectives. Two factors influence the PCK of teachers, namely educational background and learning experience. The exploration of teachers' beliefs in implementing innovative learning models to PCK knowledge carried out in this study is expected to be a capital for other researchers to investigate further how to increase teachers' beliefs in teaching mathematics. This is because belief is an essential factor besides the knowledge that can affect the quality of curriculum implementation within the classroom scope. It is also hoped that the emergence of instructional design ideas can help teachers facilitate the learning process within the classroom scope. The difficulty of the teacher in approaching mathematics topics when learning needs to be a concern that may be overcome in future studies.

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