



Assessing Science Teachers' Pedagogical Content Knowledge (PCK) in the Context of Understanding about Instructional Strategies

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Abstract: This study aimed to investigate the gap between teachers' perception and practice of implementing the learning models by biology teachers. This article applied descriptive quantitative research design, with the Learning Models Questionnaire (LMQ) used to collect the data. The research subjects were 78 teachers who are members of Science Subject Teachers' Meeting (SSTM) and the object of research was the understanding and application of learning models. The results showed that there were three gaps related to the understanding and implementation of the biology learning model. First, there was around 70% of biology teachers stated that they understood learning models, however just only 25% of teachers understood the need for rational selection of models, building reaction systems, providing learning tools, and managing time. Second, teachers have good knowledge of learning models, but less than 35% of teachers implement them in class. Third, teachers have perceptions about the characteristics of the learning model, namely syntax, objectives, and learning tools, but in practice some teachers still do not understand syntax, do not know the purpose of the model being applied, and do not prepare learning tools that support the implementation of the learning model. There are a number of gaps between the understanding and practice of learning models by biology teachers, it is important to follow up as an indication of the teacher's pedagogical competence is still weak in understanding and applying learning models. These insights will impact the development of teachers' understanding of the learning models.

Keywords: Instructional strategies; Pedagogical content knowledge (PCK); Science teachers'.

Introduction

Pedagogical Content Knowledge (PCK) is essential for science teachers to teach their subjects effectively and create meaningful learning experiences for their students (Loughran et al., 2004; Wiens et al., 2020; Zohar & Schwartz, 2012). Furthermore, according to Magnusson, et al. (1999), the representation of PCK involves a greater understanding of this knowledge and its influence on teachers' practices including; orientations towards science teaching, knowledge of curriculum, knowledge of assessment, knowledge of students' understanding of science, and knowledge of instructional strategies. In terms of the knowledge of instructional strategies, using a quality learning model is

one of ways to create an effective science learning (Bentley, 2012; Leu & Price-Rom, 2006).

The learning model is the student learning environment and teacher behavior in the learning process. The use of learning models includes lesson planning, curriculum, learning materials and tools used. The learning model is also interpreted as a conceptual framework that describes the learning procedure (Joyce & Weil, 2003; Wilson & Peterson, 2006). In addition, teacher behavior will be positively correlated with student achievement if it is able to allocate and use time in learning appropriately. The selection of the right learning model must pay attention to the conditions of the students, the nature of the teaching materials, the available media facilities, and the condition of the

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teacher himself. Teachers must master both material and strategies in learning (Schumacher et al., 2013).

The learning design is said to use a learning model if it fulfills 5 characteristics including; syntax, social system, reaction principle, support system and instructional impact (Joyce & Weil, 2003). Choosing the right learning model can improve student learning outcomes (Obizoba, 2015). Teachers are expected to be able to determine the appropriate learning model when teaching, so as to increase student motivation. In order to determine the appropriate learning model, it is necessary to review the teacher's understanding of the learning model. This aims to find out the model used by the teacher in learning and increase the teacher's understanding of the learning model. A good understanding of the learning model will make the selection of the right learning model when learning at school.

However, based on observations made, most of biology science teachers have not implemented the learning model in the learning process in class, even though these teachers quite often attend training related to the application of learning models in the learning process. Some studies in line with this condition, there are challenges faced by science teachers' when integrate learning models theory on teaching science practice (Darling-Hammond et al., 2020; Karavi, 2016; Wrenn & Wrenn, 2009).

The teacher's understanding of the learning model is part of the pedagogical content knowledge (PCK) which is one of the indicators to become a professional teacher. In this paper, we focus on capturing teachers' pedagogical content knowledge of 78 primary teachers who have had one year of science in their teacher education who are members of the Science Subject Teachers' Meeting (SSTM) in Padang City, West Sumatra, Indonesia. For the reasons above, the study aims at investigating teachers' perceptions of the learning model as well as some challenges they encounter when realizing these learning models in their teaching contexts.

Method

Research Design

The type of research used is descriptive research. the object of research is the teacher's understanding of the learning model. Data was collected by distributing questionnaires to teachers and studies.

Sample and Data Collection

The subjects of this study were 78 primary teachers who had one year of science in their teacher education and who are members of the Science Subject Teachers'

Meeting (SSTM) in Padang City, West Sumatra, Indonesia. Data collection was in the form of the teacher's understanding of the learning model using the Learning Models Questionnaire (LMQ).

Analyzing of Data

The data analysis used is descriptive qualitative, namely analyzing data on the results of the Learning Models Questionnaire (LMQ) instrument which consists of: 1) the teacher's understanding of the model and components of the learning model, 2) the teacher's understanding of the learning model according to the 2013 Curriculum and limitations in practice implementation, 3) perception teachers to learning models. In general, the research procedure can be described as follows.

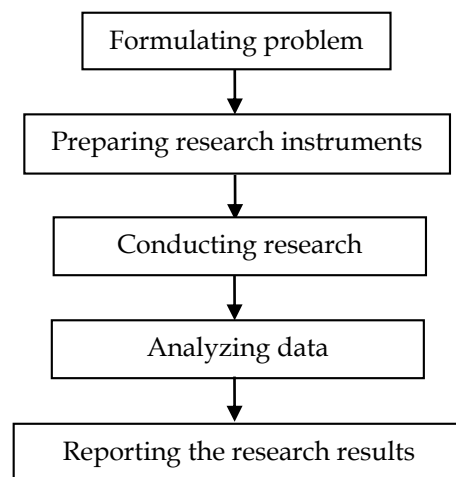


Figure 1. The Research Procedure

Result and Discussion

The results of the research conducted on teacher education who are members of the Science Subject Teachers' Meeting (SSTM) in Padang City, West Sumatra, Indonesia by looking at the understanding of the learning model are as follows.

Teacher's understanding of learning models and components of learning models

The biology teacher's response to the learning model is described in percentages (Figure 2). Most of the teachers, more than 70% have understood the learning model. Further investigation (Figure 3) provides information on the percentage of teachers and learning model components that have been understood. Both information illustrates that there is a gap between the high number of teachers who express understanding of learning models but only a quarter of the population who understand the importance of rational selection of

models, building reaction systems, providing learning tools, and managing time.

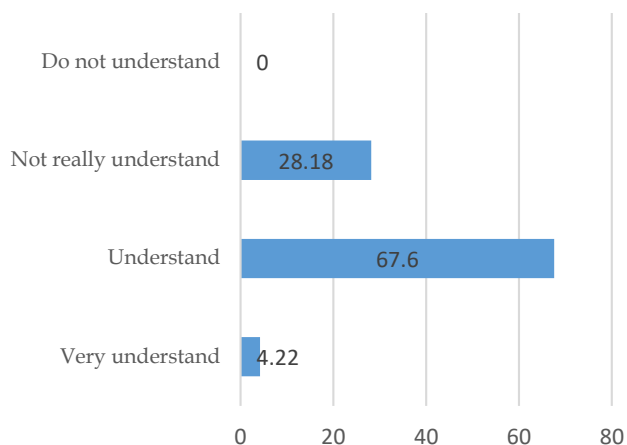


Figure 2. The Percentage of Teachers Understand The Learning Model

The highest component data results in the learning model in the teacher's perception, namely syntax was about 35%. Syntax is known as the stages/phases in the learning process (Joyce & Weil, 2003). This is because the teacher is familiar with syntax in learning, so the teacher has an understanding that the most important component in the learning model is syntax. Teachers' understanding is not evenly distributed, so it is necessary to educate teachers about learning models. This aims to increase the teacher's understanding of the learning model in the classroom.

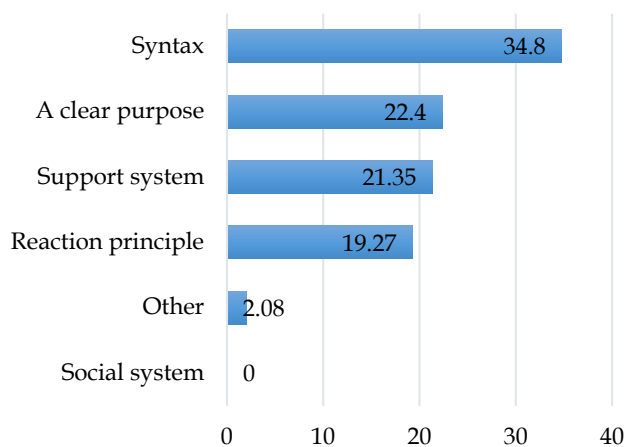


Figure 3. The Percentage of Teachers Understand The Components of The Learning Model

The teacher's understanding of the learning model according to the 2013 curriculum and the limitations in implementing it. Teachers have good knowledge of Biology learning models according to the 2013 Curriculum. These learning models are problem based learning, problem solving, inquiry learning, discovery

learning, and cooperative learning. The learning models best known by biology teachers are problem based learning and discovery learning.

In the 2013 curriculum, namely PBL and discovery learning. This is in accordance with the demands of the 2013 Curriculum, namely the 4C skills that can be applied to students using this model (Hasanah et al., 2018; Zubaidah, 2018). Research that has been conducted proves that the PBL model can be used in an effort to achieve the learning objectives of the 2013 curriculum (Dalila et al., 2022; Lukitasari et al., 2019). This does not rule out the possibility of applying other learning models to learning. In essence, each learning model has its own advantages and disadvantages. Therefore, it is hoped that teachers can be creative in using learning models in each lesson. So that there are variations in learning models in each teaching-learning process in the classroom.

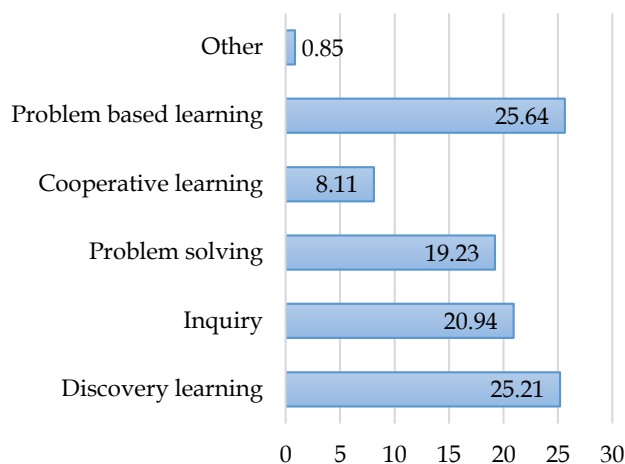


Figure 4. Percentage of Recommended Learning Models

The real gap is clearly visible between the teacher's knowledge of the learning model that should be applied and the practice in the classroom. Most of the Biology teachers choose to apply various other learning methods/methods/models, which are not recommended for learning the 2013 curriculum. From a number of recommendations for learning models that are in accordance with the 2013 curriculum, only 3 learning models can be applied by biology teachers (Figure 5), practiced by about 70 percent of biology teachers. Almost the same number of teachers apply the Problem Based Learning and Cooperative Learning Models, around 30 percent. The least practiced problem solving model. None of the teachers had ever practiced the inquiry and discovery learning models. (most However, the number of teachers who have implemented the learning model recommended by the 2013 curriculum is still low. Less than 35% of teachers implement it in class.

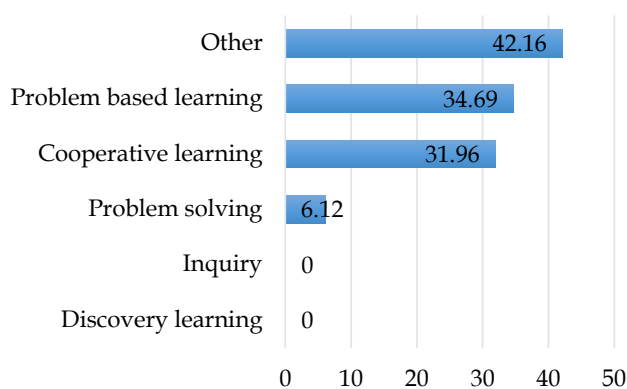


Figure 5. Types of Learning Models Applied by Teachers in The Learning Process

Currently, many teachers use the PBL model in class, this is due to learning demands in the form of problem solving (Amalya et al., 2021; Murdiyah et al., 2020). Therefore, teachers use this learning model more often than other models. Another model often used by teachers is problem solving 23.12%. Along with the demands in the world of education which are not only focused on cognitive skills but also encourage teachers to apply problem solving learning models. The problem solving learning model focuses on teaching and skills in problem solving (Supriyanti et al., 2015).

Teacher Perceptions of Learning Models

Perception is a process of giving meaning to an object. Perception is knowledge that is built based on experience. The perception held by nearly 50% of biology teachers is that the distinguishing feature of the learning model is the existence of syntax. About 20% of biology teachers have the perception that the learning model has components of objectives, reaction principles (pictures of student reactions), and support systems (learning tools).

The teacher's perception is relatively good about the learning model, but in practice in the classroom some teachers with this perception state that they are still unable to apply syntax, are unable to know the purpose of the model being applied, and do not prepare learning tools that support the implementation of the learning model. The results of the percentage of teacher perceptions of the learning model can be seen in Figure 3.

The results of the data regarding the teacher's perception of the learning model amounted to 34.89% put forward as a learning syntax. Teachers are familiar with learning syntax at school, so teachers have a perception of learning models as learning syntax (Agus Martawijaya, 2018). Syntax is an important component in the learning model (Joyce & Weil, 2003). The perception of the learning model as a learning objective

is 22.39% and as Student worksheet is 21.35%. This is because the teacher is used to knowing the learning model as a learning stage that is equipped with Student worksheet and learning objectives. In learning at school, teachers are usually required to achieve learning objectives and make Student worksheet in achieving these learning objectives, so that many of the teachers have a perception of the learning model as Student worksheet and learning objective (Lee, 2014). Group learning is perceived as a learning model by 19.27% and 2.08% for others.

Teacher Difficulties in Implementing Learning Models

The results of the data regarding the teacher's difficulties in implementing the learning model include insufficient time available as much as 30.41%. In the midst of the Covid-19 pandemic, many teachers complained about limited time in learning (Adedoyin & Soykan, 2023; Barrot et al., 2021; Gillett-Swan, 2017) . This also makes it difficult for teachers to apply learning models in class. Another difficulty experienced by teachers is that students are less cooperative in carrying out tasks according to the learning model as much as 23.19%. One of the reasons why learning is not going well is because students are less active in class, so teachers have difficulty implementing learning models (Ardi et al., 2019; Ariany et al., 2018). The teacher's lack of understanding of syntax is 15.46%. This is a serious concern for increasing teacher understanding of the learning model, because learning goes well if the teacher understands the model applied. Other difficulties in implementing the learning model in the classroom that the teacher felt were the unavailability of learning tools that supported 13.91%, the class was too narrow to organize students according to the learning model as much as 9.79%, and they did not know the purpose of the learning model as much as 5.15%.

Table 1. Percentage of Difficulties in the Learning Model

| Type of Problem | Percentage (%) |
|---|----------------|
| The available time is not enough | 30.41 |
| Students are less cooperative in carrying out tasks according to the learning model | 23.19 |
| Teacher's lack of understanding of syntax | 15.46 |
| The unavailability of supporting learning devices | 13.91 |
| Classes are too narrow to organize students according to the learning model | 9.79 |
| Lack of knowledge of the objectives of the learning model as much as | 5.15 |

Conclusion

The results showed that there were three gaps related to the understanding and implementation of the biology learning model. First, there was about 70% of

biology teachers stated that they understood learning models, however just only 25% of teachers understood the need for rational selection of models, building reaction systems, providing learning tools, and managing time. Second, teachers have good knowledge of learning models, but less than 35% of teachers implement them in class. Third, teachers have perceptions about the characteristics of the learning model, namely syntax, objectives, and learning tools, but in practice some teachers still do not understand syntax, do not know the purpose of the model being applied, and do not prepare learning tools that support the implementation of the learning model. There are a number of gaps between the understanding and practice of learning models by biology teachers, it is important to follow up as an indication of the teacher's pedagogical competence is still weak in understanding and applying learning models. These insights will impact the development of teachers' understanding of the learning models.

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Author Contribution

All authors participated in the creation of this entire article.

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Conflicts of interest

All authors declare that there are no conflicts of interest related to the publication of this paper.

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