Science Teachers Perceptions of Technological Pedagogical Content Knowledge (TPACK) in Urban Area

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ABSTRACT

The ability of teachers' TPCK is an important factor that determines the success of improving the quality of education in urban area. The purpose of this study was to find out the perception TPCK of science teachers in Lhokseumawe City using TPACK survey instrument that consist of 7 components, namely Technological Knowledge (TK), Content Knowledge (CK), Pedagogical Knowledge (PK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK) and TPACK in Likert scale. The data of TPACK perceptions were analysed using descriptive statistics. Based on the results, it shows that TPACK perception of that the. Teachers in Lhokseumawe City have a good category. High school science teachers have started to integrate technology into science learning, using digital platforms recommended in the independent learning curriculum.

Keywords: TPACK, Science Teachers, Perception

1.   INTRODUCTION

Era 4.0 han an impact on human life, as well as in the field of education, where education must be integrated with technology. (Pérez and Montoya, 2022) explained that Education 4.0 is a term used by education experts to describe how to implement technology into learning. the education system must face several challenges related to digitalization. According to (Haderer and Ciolacu, 2022) the main feature of this era is the use of digital platforms to improve the efficiency of the teaching and learning experience of teachers, students, and administration. Besides that (Valtonen *et al.*, 2020) added that teachers are required to have the ability to integrate technology into the learning process, such as using computer applications, the web and other ICT learning.

There are many benefits of using technology in learning, as described by (Hsu and Chen, 2019) are 1) for students to increase attention, concentration, motivation, and independence, 2) for teachers it can reduce the use of time to deliver material, make the student learning experience more enjoyable, design material more interesting, and encourage teachers to improve their knowledge and abilities about computers. The same is also explained by ((Jogezai *et al.*, 2021) Technology has the potential to revolutionize traditional teaching and learning processes, improve teaching pedagogy through synchronous and asynchronous methods, remove barriers to education such as space and time and expand access to lifelong learning. Thus, the use of technology in learning can improve the quality of learning, student satisfaction, income, and service quality.

The teacher's ability to integrate technology into classroom learning is an integral part of the teacher's pedagogical and professional ability indicators known as technological pedagogical content knowledge (TPACK). According to (Aqib, Budiarto and Wijayanti, 2018) effective learning in this era can be seen from 3 factors, namely: technology, content, and pedagogy included in TPACK. Besides that, Teacher TPACK competence is one of the most important elements in professional development (Castéra *et al.*, 2020). This competency is based on a combination of technological knowledge, with broad pedagogical expertise and in-depth knowledge of the content/teaching materials (Rossi and Trevisan, 2018). According to (Rochintaniawati *et al.*, 2019), the development of TPCK begins with the use of simple technology that is easy to use for both teachers and students and gradually develops to become increasingly advanced. TPCK of teachers is very important to improve the quality of education and achieve national education goals, especially in urban area.

Lhokseumawe city as one of the urban areas in Aceh must have a good quality in education, because there are so many facilities to support the use of technology in learning, so that teachers in urban areas should have to improve their knowledge in ICT learning. The perceptions of TPCK science teachers are very important to know how the

teacher's integrated technology in their learning. The results of this study are expected to provide information about TPCK science teachers and can be used as a reference to develop pedagogical and professional competence of science teachers in urban areas.

2. METHOD

The type of research used is descriptive with a quantitatif approach which aimed to find out the perception of TPACK science teachers at public high schools in the city of Lhokseumawe. The number of samples in this tudy were 20 teachers with an age range of 27-40 years who were selected by purposive sampling. The selection of the sample was based on the length of experience teaching science and those who were representative of science teachers spread across public high schools in Lhokseumawe City. Data obtained through surveys and observation of teacher learning based on the TPACK component consisting of 39 questions (Schmidt et al., 2009). Data analysis procedures resulted from research instruments that use a likert scale according to table 1:

Table 1. Category Likert Scale

Range		Criteria
$3.25 < Score < 4,00$		Very High
$2.50 < Score < 3,25$		High
$1,75 < Score < 2.50$		Very Low
$1,00 < Score < 1,75$		Low

3.

4. RESULTS AND DISCUSSION

4.1. Technological Knowledge (TK)

Technological knowledge is knowledge of technology and have this knowledge useful to use and study available technologies. Based on data analysis, the perceptions of technological knowledge (TK) science teachers in lhokseumawe city contained in table 2.

Table 2. Perception of TK science teachers

No	Item of qustions	SD	Mean	Category
1	I know how to solve my own technical problems.	0,6	3,4	Very High
2	I can learn technology easily	0,6	3,6	Very High
3	I keep up with important new technologies.	0,5	3,6	Very High
4	I frequently play around with the technology	0,4	3,7	Very High
5	I am proficient in using Microsoft Word	0,8	3,5	Very High
6	I am proficient in using the Microsoft Excel program	0,7	3,5	Very High
7	I am proficient in using power point	0,6	3,4	Very High
8	I am proficient in using printer, scanner, projector, and camera	0,6	3,3	Very High
9	I Save my data using drive or online program	0,6	3,5	Very High
10	I use internet to communications	0,5	3,1	High
11	I know various platform digital like Canva, quizizi, and others	0,8	3,2	High
	Total	0,3	3,4	Very High

The average score of the TK high school science teacher in the city of Lhokseumawe is at a very good. This shows that the teacher's ability to use teacher technology is very good. This shows that schools in urban areas are already

utilizing technology in school administration activities (Mouza, 2014). So that the use of technology is not something foreign to teachers, so teachers easily adapt to technology.

4.2.   Content Knowledge (CK)

Content knowledge is knowledge about concepts, theories, ideas, frameworks, knowledge about evidence, as well as practices and approaches to develop that knowledge (Shulman, 1986). Based on data analysis, the CK perceptions of state high school science teachers in Lhokseumawe City were presented in Table 3.

Table 3. Perception of CK science teachers

No	Item of questions	SD	Mean	Category
1	I have sufficient knowledge about science.	0,7	3,4	Very High
2	I can use a scientific way of thinking	0,5	3,4	Very High
3	I have various ways and strategies of developing my understanding of science.	0,7	3,5	Very High
	Total	0,8	3,2	Very High

The average CK score of the Lhokseumawe city senior high school teachers is in very good criteria (Table 3). This means that the teacher has confidence in good scientific knowledge. According to (Danday, Lyn and Monterola, 2019) teachers must master teaching materials broadly and quite deeply about the material in their field.

4.3.   Pedagogical Knowledge (PK)

Pedagogical knowledge is the teacher's knowledge of various implementations, strategies, and methods to support student learning (Sahin, 2011). Government Regulation of the Republic of Indonesia No. 19 of 2005 explains that pedagogic competence is the teacher's ability to manage learning which consists of understanding students, planning, implementing learning, evaluating learning outcomes and actualizing all potential students. Based on the data analysis, the perception PK of the science teachers was obtained in table 4.

Table 4. Perception of PK science teachers

No	Item of qustions	SD	Mean	Category
1	I know how to assess student performance in a classroom	0,5	3,6	Very High
2	I can adapt my teaching based upon what students currently understand or do not understand	0,7	3,4	Very High
3	I can adapt my teaching style to different leaners	0,6	3,5	Very High
4	I can assess student learning in multiple ways.	0,7	3,4	Very High
5	I am familiar with common student understandings and misconceptions	0,7	2,9	High
6	I know how to organize and maintain classroom management	0,6	3,7	Very High
	Total	0,3	3,3	Very High

The average PK score of the science teacher at the Lhokseumawe State High School is in very good criteria (Table 4). These teachers already have good pedagogical knowledge and have been able to apply it in the science lessons that are carried out. Mastery of learning strategies is an important part for teachers, especially mastery of learning strategies that emphasize students actively seeking knowledge independently by considering the uniqueness and prior knowledge of students.

4.4.   *Pedagogical Content Knowledge (PCK)*

PCK is pedagogic knowledge that applies to the teaching of specific content. This knowledge includes knowing what teaching approaches are appropriate to the content and knowing how content elements can be arranged for better teaching (Mishra and Koehler, 2006). Based on data analysis, the PCK profiles of public high school science teachers in Lhokseumawe City were obtained which are presented in Table 5.

Table 5. Perception of PCK science teachers

No	Item of qustions	SD	Mean	Category
1	I can select effective teaching approaches to guide student thinking and learning in science.	0,8	3,4	Very High
2	I can make a lesson plan understand or do not understand	0,7	3,4	Very High
3	I can make difficult science material easy for students to understand	0,7	3,3	Very High
4	I can make my own questions to measure students' understanding of the material being taught	0,6	3,4	Very High
	Total	0,6	3,4	Very High

The PCK perception of sicence teachers is in very good criteria. This shows that the teacher has applied PCK very well, especially in preparing their own lesson plans and in choosing learning approaches and strategies that are appropriate to science material.

4.5.   *Technological Pedagogical Knowledge (TPK)*

TPK is knowledge about how various technologies can be used in teaching and the use of this technology is able to change the way teachers teach (Schmidt et al., 2009). Based on data analysis, the perception TPK of public high school teachers in Lhokseumawe City were obtained which are presented in Table 6.

Table 6. Perception of TPK science teachers

No	Item of qustions	SD	Mean	Category
1	I can choose technologies that enhance the teaching approaches for a lesson.	1,0	3,2	High
2	My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom	0,8	3,0	High
3	I am thinking critically about how to use technology in my classroom	0,9	3,0	High
4	I can adapt the use of the technologies that I am learning about to different teaching activitie	0,8	3,1	High
	Total	0,6	3,2	High

The average TPK score for high school teachers in Lhokseumawe City is in good criteria (Table 6). The lowest average is found in statement items using internet facilities to communicate with students. According to (Masrifah *et al.*, 2018) , the use of communication media such as the internet has built a new interaction model in learning at this time.

4.6.   *Technological Content Knowledge (TCK)*

TCK is knowledge about the interrelationships between technology and content (Koehler et al., 2014). This knowledge invites teachers to understand the use of certain technologies can change how to understand the concept of a particular content (Schmidt et al., 2009). Based on data analysis, the TCK perceptions of public high school science teachers in Lhokseumawe City were obtained which are presented in Table 7.

Table 7. Perception of TCK science teachers

No	Item of qustions	SD	Mean	Category
1	I can use digital/technology platforms to assist students in understanding concepts of science	0,7	2,8	High
2	I know the applications or digital platforms related to the material I teach	0,7	2,8	High
3	I can develop student activities and projects involving the use of digital technology/platforms	0,7	2,74	High
	Total	0,7	2,8	High

The average TCK score of high school science teacher in Lhokseumawe City is in good criteria. However, the lowest average is in the statement item knowing about computer applications related to science. This shows the teacher's limited knowledge of computer applications related to science.

4.7.   *Technological Pedagogical Content Knowledge (TPACK)*

TPCK is the knowledge needed by teachers to integrate technology into teaching certain material, into a complete package. The teacher must have an intuitive understanding to the complex interaction between the 3 basic components of knowledge, namely PK, CK and TK, in a way teach certain materials using appropriate pedagogic methods and technologies (Schmidt *et al.*, 2009). the perception TPCK of high school science teacher in Lhokseumawe City in Table 8.

Table 8. Perception of TPCK science teachers

No	Item of qustions	SD	Mean	Category
1	I can teach lessons that appropriately combine science, technologies, and teaching approaches.	0,8	2,7	High
2	I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn	0,7	2,7	High
3	I can use strategies that combine content, technologies, and teaching approaches that I learned about in my coursework in my classroom.	0,6	3,0	High
4	I can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches at my school	0,6	2,8	High
5	I can choose technologies that enhance the content for a lesson	0,7	2,6	High
	Total	0,3	2,5	High

The average TPCK score of Lhokseumawe State Senior High School teachers is in good criteria (Table 8). Teachers have been able to apply their TPCK well. It can be seen in the statement items choosing learning strategies and technology that are in accordance with the science material that will be conveyed in class learning activities.
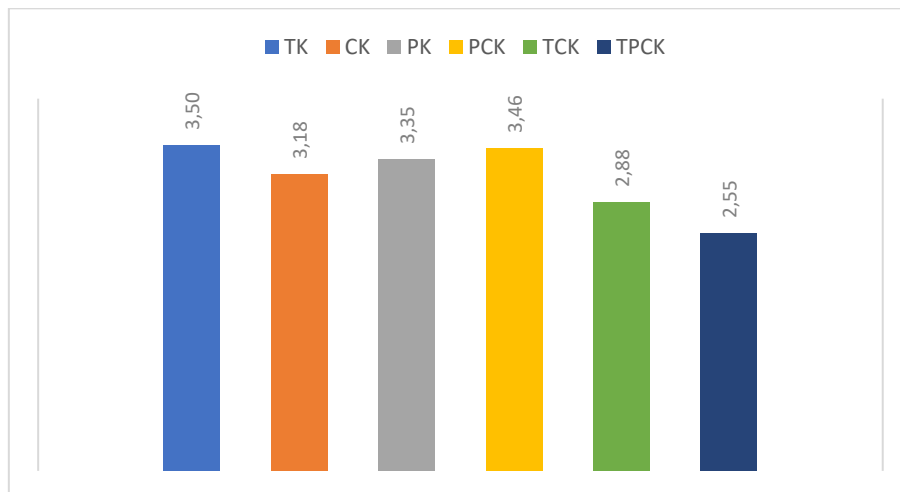

Figure 1. the TPCK's components Average Score of High School Science Teachers in Lhokseumawe City

In general, the ability of public high school science teachers in Lhokseumawe City to apply TPCK is in good criteria. In terms of technology knowledge, most of the state high school science teachers in Lhokseumawe City know how to use technology but still need more practice how to implementation it in science learning. according on independent learning curriculum, each subject teacher is required to integrate ICT in each lesson. In addition, (Suryawati, L.N and Hernandez, 2014; Baris, 2015; Bergoglio and Karabuz, 2017; Hsu and Chen, 2019) argue that the TPCK framework is also in line with the demands of 21st century learning where mastery of ICT is a prerequisite for teachers.

5. CONCLUSION

The description of the ability of the Lhokseumawe City High School science teacher in applying TPACK is in good criteria. Thus, the Lhokseumawe City Public High School Science teacher has been able to organize science learning based on information and communication technology (ICT).

6. ACKNOWLEDGMENT

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