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EXECUTIVE SUMMARIES OF TEACHER'S ABILITY ON TPACK IN NORTH SUMATERA: PRELIMINARY RESEARCH ON THE DEVELOPMENT OF SCIENCE LITERACY-BASED LEARNING MODELS

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Abstract

To be able to teach scientific literacy to students, teachers need scientific literacy competencies and are in line with TPACK (Technological Pedagogical Content Knowledge) competencies. This research was initial research in the development of learning models which aims to determine the extent of the TPACK abilities of science teachers in North Sumatra. The method used in this study was a qualitative descriptive method by describing data in the form of numbers and direct interviews. The instrument used was TPACK multiple choice questions that had been previously developed and proven valid to be able to measure the TPACK ability of science teachers which consisted of 40 questions. The research sample was determined by purposive sampling method. From the sampling results, 20 science teachers were selected from 10 junior high schools in North Sumatra.

Keywords: TPACK Ability, Scientific Literacy, Learning Model, Science's Teachers

Introduction

Scientific literacy is the ability to understand scientific concepts and processes and use science to solve problems in everyday life. According to The Program for International Student Assessment (PISA) scientific literacy is the ability to use scientific knowledge, identify questions, and draw conclusions based on scientific evidence in order to understand and make decisions regarding nature and its changes due to human activities (Chi, et al. , 2018; Diana, 2016; Winata, et al., 2016; OECD, 2016). Scientific literacy is the main goal of science education (Wenning, 2006). Scientific literacy is multidimensional, not just an understanding of scientific knowledge, but more than that. Through scientific literacy, students can ask, find, and determine decisions that are developed from their curiosity related to their daily life experiences so that they can be interpreted. Understanding and interpreting the characteristics of science is a characteristic of someone who is scientifically literate. This understanding and meaning includes scientific inquiry, awareness of science and technology that shape the material, intellectual and cultural environment, and a desire to be involved in issues related to science.To achieve this, of course, teachers must also have the ability and competence to prepare students to have scientific literacy competencies. The abilities that teachers must have include technological, pedagogic, content, and knowledge abilities or what we often hear with the term TPACK.

The development of the era marked by technological developments throughout the world lately can no longer be stopped. Recent developments have been marked by the emergence of the term industrial revolution 4.0 starting in 2011. The development of the industrial revolution 4.0 has also reached its end point so that now there is also the issue of the development of the industrial revolution 5.0 or society 5.0 which is centered on technological developments (Harun, S., 2021). The industrial revolution 5.0 is centered on the development of all aspects of life that are integrated with advanced technology such as artificial intelligence (AI), Internet of things (IoT), and other robotic technologies that aim to achieve effective, efficient and flexible results in everyday life. The development of the industrial revolution 5.0 certainly also touches the field of education in everyday life. In practice education at this time cannot be separated from technological developments. All activists in the education sector, especially teachers, must participate in developing themselves so that they are able to adapt to this development. Teachers cannot be replaced by technology, but teachers who do not master technology will definitely be replaced. Therefore, in order to achieve national education goals, the government always makes efforts, one of which can be seen from the development of the curriculum used in Indonesia. The 2013 curriculum and the independent curriculum are the latest curricula used in Indonesia. This curriculum requires students to be able to apply the knowledge and competencies they acquire at school to solve problems in everyday life. In addition, students are also given the freedom to acquire the knowledge and competencies they need to be used in everyday life. This is in line with the term scientific literacy, namely the ability students have to be able to apply the knowledge and competencies they have to solve their problems in everyday life.

Talking about preparing teachers who are able to integrate technology in learning, is always associated with the development of the technological pedagogical content knowledge (TPACK) framework (Lyublinskaya, I., 2022). The TPACK framework includes several teacher knowledge domains consisting of: the technological knowledge or technological knowledge (TK); the content knowledge or content knowledge (CK); the pedagogical knowledge (PK); the technological content knowledge (TCK); the pedagogical content knowledge (PCK); and the technological pedagogical knowledge (TPK). In the last decade or so, the TPACK framework has rapidly become a widely used conceptual framework in the field of teacher education, especially since teacher education programs have begun to redesign their curricula to provide a systematic and meaningful way of

preparing literate teachers to integrate technology and education. (Lyublinskaya, I., 2015, Voogt, J., et al. 2017, and Niess, M. L., 2021).

Therefore this study aims to look deeply at the technological, pedagogical, and content capabilities of a teacher in teaching students so that the results of this study can be used as data or information in developing scientific literacy-based learning models.

Research Method

The population in this study are all science teachers in North Sumatra. to be able to represent the entire population, the sample in this study was determined by random sampling. From the results of selecting a random sample, 20 science teachers were selected from 20 schools in North Sumatra.

This research method used was a descriptive quantitative method which aims to reveal the problem and the actual situation regarding the initial TPACK abilities of science teachers in North Sumatra (Sugiyono, 2016). This descriptive study only tries to describe clearly and sequentially to the research questions that have been determined before the researcher enters the field and there is no special treatment or hypothesis as a guide to the direction of the research. The quantitative approach in this study was to describe in full and in depth the TPACK abilities of science teachers in North Sumatra. In addition, data in the form of interviews using an interview guide were also developed to find out social, economic, and educational background aspects of science teachers and their influence on the TPACK abilities of science teachers.

Result and Discussion

Proportion of TPACK Capability of Science Teachers at Middle Schools in North Sumatra

Data collection has been carried out on the Technology, Pedagogic, and Content capabilities of Science Teachers throughout North Sumatra, the results of which can be seen in Figure 1 below. The data was obtained using the Technological Pedagogical Content Knowledge (TPACK) instrument which was expected to be able to explore aspects of teacher knowledge consisting of; knowledge of Technology (K); content knowledge (CK); pedagogical knowledge (PK); pedagogical content knowledge (PCK); technology of pedagogical knowledge (TPK); technology of content knowledge (TCK) and technological pedagogic content knowledge (TPACK). Based on the data in Figure 1, it can be seen that in general the average percentage of TPACK ability in each aspect is 52.9%. Each aspect shows a percentage value of 30.6% for technological knowledge, 58.7% for content ability, 40.4% for pedagogic knowledge, 48.4% for content pedagogic knowledge, 62.4% for pedagogic technology ability, 37% for content technology knowledge, and 52.4% for TPACK knowledge.

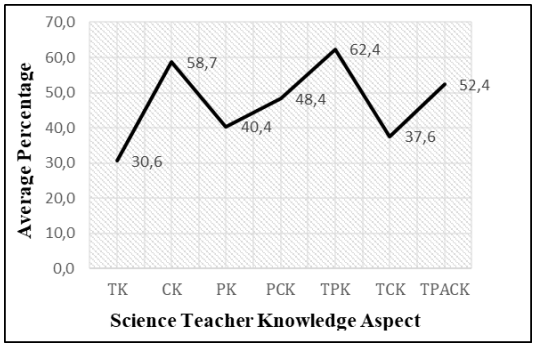

Figure 1. Percentage of Science Teacher TPACK Knowledge

Comparison of Educational Background to Science Teacher's TPACK Knowledge

In the process of mapping and analyzing the needs of this research, one of them was viewed from the teacher's educational background. From the data obtained, the educational background of the teachers who taught in the sample schools in this study had backgrounds in Biology, Biology, Physics Education, and Physics Education. From these data it can be seen that there were no science teachers who have graduated from the Science Education study program.

From Figure 2 below it can be seen that teachers with a background in Biology

Education have a higher percentage of TPACK scores with a value of 58.08%. However, in general, the average percentage of the TPACK scores of teachers with backgrounds in Biology, Biology, Physics Education, and Physics Education is below 60%. This is of course something that cannot be left alone, and a solution or solution must be found immediately.

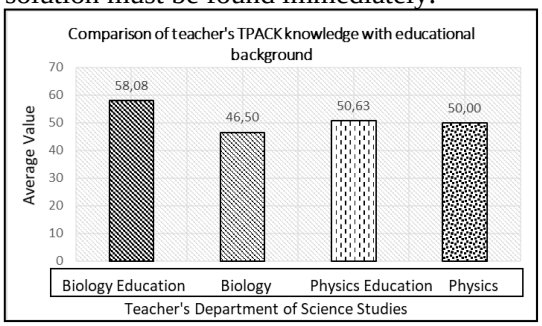

Figure 2. Comparison of teachers' TPACK knowledge with educational background

Comparison of TPACK Ability with Certificate Professionalism

Based on the distribution of data obtained from this research, there were several categories of teachers based on educational background and the presence or absence of a certificate of professionalism or often referred to as teacher certification with categories including: 1) Certification Biology Education, 2) Non-Certification Biology Education, 3) Certification Biology, 4) Non-Certification Biology, 5) Certification Physics Education, 6) Non-Certification Physics Education, 7) Certification Physics. From Figure 3 below it can be seen that there was a difference in the percentage of TPACK scores of certified and non-certified teachers. The TPACK percentage scores of teachers who are certified with both biology and physics education backgrounds are higher than the TPACK percentage scores of teachers who have not obtained professionalism certificates with percentage values of 60% and 58.75%. However, for teachers with an educational background in pure biology who are not certified, there is no significant difference from teachers who have been certified.

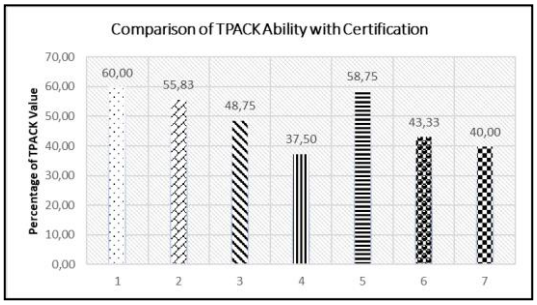

Figure 3. Comparison of TPACK Ability with Competency Certificates

Comparison of Teaching Period with TPACK Ability

The mapping of the science teacher's profile was also carried out with the category of the teacher's length of teaching or the work experience of the science teacher. The data obtained can be seen in Figure 4. Based on the picture, it can be seen that the highest TPACK percentage for science teachers was found in teachers with 6-10 years of experience and 11-15 years with TPACK percentage values of 55% and 57.92%. Whereas teachers with higher work experience, namely 16-20 and 20-25, obtained lower TPACK percentage scores with scores of 48.44% and 47.50%.

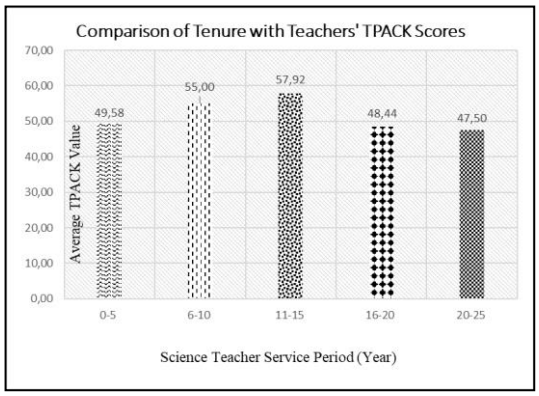

Figure 4. Comparison of Service Life with TPACK Ability

Technological Pedagogical Content Knowledge (TPACK) is a terminology that is currently being hotly discussed among educators. TPACK is knowledge that must be mastered by teachers or educators in integrating technology with learning (Koehler & Mishra, 2009). From the data obtained, it can be seen that the ability or technological knowledge of science teachers

was still very low, marked by the results of the Technology Knowledge (TK) and Technology Content Knowledge (CK) tests which are still low. This is in line with the results of Regita's research (2022) in his article which states that teachers' technological abilities are still low and the government needs encouragement to overcome this. Apart from that, to overcome this, it is also necessary to have the self-awareness of the teacher concerned to continue to improve his abilities and competencies, especially in the field of technology. This is also in line with the research found by Hardinata, A. (2020) that teachers had difficulty using technology in learning during the Covid-19 pandemic.

The ability or professional competence of a teacher is certainly influenced by the educational background of teachers who teach in schools. From the research data it can be seen that teachers who teach in junior high schools, science subjects have backgrounds in Biology Education, Physics Education, and there were also teachers with non-educational backgrounds, namely Biology and Physics. This certainly affects the teacher's pedagogic competence in his professionalism. However, in Indonesia, teachers with non-educational backgrounds have previously been provided with pedagogical competence, as indicated by obtaining an "Akta IV" certificate. But in fact, that alone is not enough to be marked based on the data obtained with the percentage of teachers' pedagogical knowledge still below average. Apart from that, this was also due to the fact that previously there were no campuses in North Sumatra, especially those that provided science education study programs. The new Science Education study program was held at Universitas Negeri Medan in 2017. So, it is hoped that later graduates from the Science Education study program can become competent teachers in the field of Science Education in schools in Indonesia, especially in North Sumatra.

Teachers in Indonesia for a certain period were given the opportunity to measure their professional abilities by taking a certification exam. It is hoped that this certification will support teacher performance in their professional duties. Based on the data obtained in this study, it is true that teachers who have passed the competency test (certification) have higher scores than teachers who have not been certified. This is of course not a surprising result, because these certified teachers have previously been prepared with TPACK competencies such as technology, pedagogy, and adequate content.

Likewise with the work period that has been obtained by the teacher. Based on the data obtained, the teacher's tenure was not a factor that affected the level of science teachers' TPACK knowledge. Science teachers who have worked for 6-15 years show a higher percentage than teachers with more than 20 years of experience. This of course can be influenced by several factors such as weak physical conditions, as well as individual weaknesses that do not want to upgrade or update their knowledge.

Conclusion

Based on the results of the research above, it can be concluded that the percentage of TPACK knowledge of science teachers in North Sumatra is still low. Science teacher's TPACK knowledge is still below average. The low knowledge of TPACK is influenced by many factors. One of the influencing factors is the learning model used by teachers in schools and lack on using technology in daily life specially on the class.

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