Pedagonal : Jurnal Ilmiah Pendidikan
Vol. 06, No. 02, October 2022, pp. 228~237
ISSN: 2550-0406, DOI: 10.55215/pedagonal.v6i2.5756

The Benefits of Teacher Professional Development (TPD) Program Based on Partnership, Technology, and Ethnoscience Approach to Improving the TPACK of Science Teachers

Yohanes Freadyanus Kasi[a]*, Ari Widodo[a], Achmad Samsudin[a], Riandi[a]
[a] Universitas Pendidikan Indonesia, Bandung, Indonesia
yohaneskasi@gmail.com*; widodo@upi.edu; achmadsamsudin@upi.edu; rian@upi.edu
*Corresponding author

Article Info

Article history:

Received Jul 18, 2022
Revised Oct 20, 2022
Accepted Oct 21, 2022

Keywords:

Teacher Professional Development;
Partnership;
Technology;
Ethnoscience;
TPACK of Science Teachers

ABSTRACT

This study aims to determine the benefits of the Teacher Professional Development (TPD) program based on the partnership, technology, and ethnoscience approach to improving the TPACK of science teachers. It was conducted for 3 months from September to November 2021. The subjects consisted of 28 science teachers in Nagekeo Regency spread over 6 districts. This study was conducted using 2 methods, online and offline. In the online method, teachers met via Zoom to analyze the concept of science in Nagekeo cultural activities, adjust the concept to basic competencies, and evaluate the results of learning implementation in the classroom. In the offline method, teachers met directly to, in group, design a culture-based science lesson plan, and 4 teachers mutually agreed to carry out direct learning in class using the designed lesson plan. The results of the pretest and posttest of science teacher knowledge on indicators in the TPACK components were analyzed. The results demonstrated a significant difference between the pretest and posttest results of the TPACK components. The pretest results showed an average value of 39.89 in the low category while the posttest results showed an average value of 88.24 in the high category. These results indicate that the TPD program based on the partnership, technology, and ethnoscience approach is useful in improving the TPACK of science teachers..

Introduction

The Teacher Professional Development (TPD) program is a program that provides changes in teachers' attitudes, knowledge, and skills in improving their learning practices to improve student learning outcomes (Sgouros & Stavrou, 2019). The material in the TPD program is related to teacher teaching practices and their development that leads to student learning (Darling-Hammond et al., 2017). In science, a quality TPD program can provide guidance that enables teachers to develop and support students' science learning (Jensvoll & Lekang, 2017). Research by Jensvoll & Lekang, (2017) focusing on TPD in science through the 5E model shows that this model helps teachers to design teaching, create new experiences, and allow teachers to reflect with their colleagues. The TPD program model

usually includes an in-service training program or pre-service training, (e.g., Weitzel & Blank, 2019; Bravo & Cofré, 2016; Lund, 2018), collaborative work in professional learning communities (Admiraal et al., 2019; Schaap et al., 2018), lesson study (Rochintaniawati et al., 2019; Coenders & Verhoef, 2018), and mentoring programs (Schatz-Oppenheimer, 2016).

Research in the last three decades to reveal the role of the TPD program has yielded a possibility for improving teacher teaching practices and student learning outcomes (Yang et al., 2018). Teachers are expected to be able to perform according to the new curriculum standards and reform their knowledge through activities such as workshops, lesson study, peer teaching, and demonstrations in class. Future improvements to the TPD program need to focus on processes that enable teachers to implement the educational reforms needed for their teaching. Educational reform in this century leads a teacher to have a positive attitude toward the importance of integrating technology in their teaching and learning activities (Yulisman et al., 2019). Currently, the government through the Ministry of Education and Culture has carried out many programs to improve teacher professionalism at all levels and types of education. However, in the case study of the frontier, outermost, and disadvantaged regions (3T), based on Presidential Regulation Number 131 of 2015 concerning the Determination of Disadvantaged Regions in 2015–2019, The TPD program East Nusa Tenggara (NTT) has not run optimally. The Ministry of Education and Culture recommends that there be still many training institutions/services in the regions that have not implemented the subject teacher forum program (MGMP) to the fullest (Kemendikbud, 2018). Kasi et al., 2020) recommend that, in Indonesia, the TPD program needs to be initiated using a partnership, technology, and ethnoscience approach to increase its role in improving science learning in the classroom. Furthermore, research conducted by the Directorate of Teachers and Education Personnel of Secondary Education and Special Education, Directorate General of Teachers and Education Personnel, and the Ministry of Education and Culture of the Republic of Indonesia produced a Policy Brief to support 3T Teachers during the COVID-19 pandemic, explaining that they still need basic digital skills training for the learning process. It means that teachers in the NTT area still need training in the use of technology for the classroom learning process. This is because science teachers in the current era of technological development must know Technological Pedagogical Content Knowledge (TPACK) to carry out meaningful learning practices for their students.

TPACK is teacher knowledge in integrating technology so that it is relevant to the chosen pedagogy and the material being taught. The TPACK concept originated from the Pedagogical Content Knowledge (PCK) concept expressed by Shulman, (1987) as a special combination of relevant content by teaching it so that it can be understood by others. Referring to the PCK idea which explains that skilled teachers have an integration of content knowledge and pedagogical knowledge and their research, Mishra & Koehler, (2006) propose a new component in PCK, namely knowledge of technology (TPACK). According to them, a teacher who effectively integrates technology will be able to utilize extensive content knowledge and pedagogical knowledge in combination with technology knowledge. In the current era of technological development, in addition to knowledge about how to integrate pedagogy and content (PCK), the importance of adding technology knowledge (TPACK) is compulsory for teachers (Mishra & Koehler, 2006).

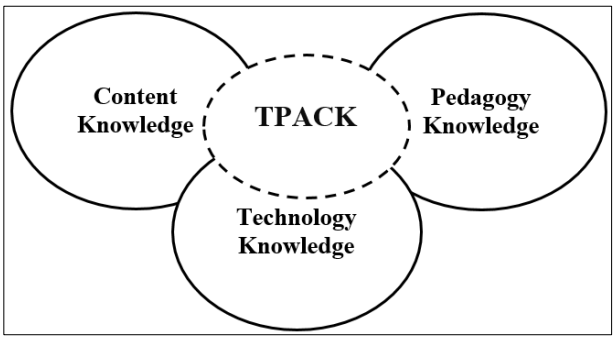

Figure 1. TPACK Model by (Mishra & Koehler, 2006)

Teacher TPACK affects teaching success because it can motivate student learning (Rochintaniawati et al., 2019). According to Riandi et al., (2018), the TPACK of 21st-century teachers still needs to be improved in terms of mastery of content, pedagogy, and technology. Based on the background, the researchers conducted this study to find out the benefits of the TPD program for science teachers in NTT to improve their TPACK using a partnership approach among teachers in which the technology and materials are integrated with local culture (ethnoscience).

Method

This study was conducted in Nagekeo Regency, NTT, for 3 months, from September to November 2021. This study uses mixed-method research with an exploratory type of design. The subjects were 28 junior high school science teachers from over 6 districts in Nagekeo Regency, in which each sub-district is represented by 3-5 teachers. The study was carried out using two methods, online and offline. For the online method, teachers met via Zoom to analyze science concepts in Nagekeo cultural activities, adapted these concepts to the existing basic competencies, and evaluated the results of the learning implementation in class. In the offline method, they met directly to design a culture-based science lesson plan in groups, and 4 of them were selected to carry out direct learning in class using the designed lesson plan. The research stage begins with the science teacher receiving introductory material related to the importance of integrating technology and the use of local science by university lecturers, participants taking the TPACK ability test and submitting the lesson plans that they have made so far. Participants then study the module, analyze the concept of science in culture and adapt it to basic competencies, and develop a technology and culture-based science lesson plan. In the final stage, four teachers were selected to carry out class instructions for four consecutive weeks using the lesson plans that had been developed before. After the teachers completed the lesson for each week, an evaluation related to the learning is carried out. Next, the researcher conducted TPACK test as a final test after the TPD program, along with teacher interviews and questionnaires.

Four training modules developed by researchers are used as a guide. The first module focuses on explaining the nature of science instruction and because the direction of science material is related to the Nagekeo culture, there is also an explanation regarding its relationship. The second module focuses on technology in science instruction which explains the development of technology in education, technology as content in science instruction, and technology as a medium in science instruction. The third module focuses on science instructional models. The last module is related to the development of technology and culture-based learning activities along with examples of lesson plans.

Data collection was carried out using TPACK test questions (33 item) for teachers before (pretest) and after (posttest) the implementation of the TPD program. Data analysis was carried out by looking at the average test results of all teachers during the pretest and posttest to be used as data in answering research questions related to the benefits of the TPD program. Descriptive statistics were measured for the results of teachers' TPACK tests before and after the program. The results are presented in tabular form showing the increase in teachers' TPACK.

Results and Discussion

The results of the statistical test of improving TPACK for science teachers before (pretest) and after (posttest) following the TPD program based on the partnership, technology, and ethnoscience approach are presented in Table 1 below.

Table 1. The results of the statistical test for improving the TPACK of science teachers

Data	TPACK Test Result	
	Pretest	Posttest
Number of Teachers (N)	28	28
Standard Deviation	2.74	8.87
Normality Test	0.200 (Normal)	0.200 (Normal)
Homogeneity Test	0.000 (Not Homogeneous)	
Paired Sample T-Test	0.001 (Significantly Different)	

Based on the results in Table 1, the normality test obtains Sig (2-tailed) > 0.05, and the homogeneity test obtains Sig (2-tailed) < 0.05, so it can be concluded that the data are not homogeneous. Furthermore, the TPACK test data are normally distributed and not homogeneous, so, to find out the benefits of the TPD program based on the partnership, technology, and ethnoscience approach to improving the TPACK of science teachers, a Paired Sample T-Test was carried out which is part of parametric statistical analysis using SPSS version 22.0. Furthermore, Table 1 also shows the results of significance test of the TPACK test results for science teachers on Sig. (2-tailed) < 0.05, so it can be concluded that there is a significant difference between the average test results of pretest and posttest, which means that the TPD program based on the partnership, technology, and ethnoscience approach is beneficial to improving the TPACK of science teachers. The average TPACK test results for science teachers before (pretest) and after (posttest) following the TPD program can be seen in Figure 2 below.

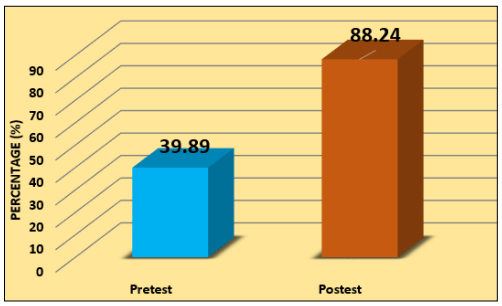

Figure 2. Average TPACK test results of science teachers

Based on Figure 2, the average result is low (39.89%) for the TPACK test before science teachers join the training program. This result indicates that at the beginning before participating in the training, the participants did not have integrated TPACK knowledge as science teachers, so they were included in the low category. This result is the same as research that shows that teachers have not been able to integrate technology, pedagogy, and

regional/local content into learning practices (Riandi et al., 2019). This result is also because TPACK is new knowledge for the participants, namely science teachers in Nagekeo Regency, so, naturally, they find difficulties in providing answers tailored to their learning practices. The length of the teacher's teaching experience is not directly proportional to his TPACK abilities (Suyamto et al., 2020). Furthermore, according to Suyamto et al. (2020), schools and teachers in Indonesia still have problems, including teacher standards, mastery of materials, and low media and technology literacy, even though 21st-century teachers are required to have knowledge as well as skills in using various technological devices both to facilitate learning and improve learning outcomes (Rahmadi, 2019).

Figure 2 also explains that, after science teachers participated in the training program, the average TPACK test results increased to (88.24%), meaning that the TPD program is based on the partnership, technology, and ethnoscience approach to improving the TPACK of science teachers gave positive results in which participants were able to integrate technology knowledge with pedagogical and content knowledge. This indicates that the TPD program based on the partnership, technology, and ethnoscience approach could improve TPACK knowledge of science teachers in designing, implementing, and evaluating learning. These results are consistent with what was conveyed by Sgouros & Stavrou, (2019) that the TPD program provides a learning process for teachers throughout their careers because it is considered effective in improving the quality of teachers and students. Furthermore, the results of this study explain that there is a significant difference in the average TPACK test results of pretest and posttest, which means that there is a benefit of the TPD program based on the partnership, technology, and ethnoscience approach to improving the TPACK of science teachers. These results are under what was revealed that, in the future, it is necessary to use a combination of several models/approaches in a professional development program so that it can improve the knowledge and skills of teachers (Kasi et al., 2020).

The partnership approach in this study is that the participants (science teachers) with their colleagues were given the opportunity online and offline to get material about TPACK from experts, use the training module to analyze science concepts in the culture of Nagekeo Regency, design a culture-based lesson plan by utilizing technology, conduct classroom learning, evaluate learning outcomes, redesign the lesson plan evaluation results, and return to learning with students in the class (pedagogical knowledge). The partnership approach allows the participants to gain many practical ideas that can be applied to their teaching and, most importantly, when they get information from their peers and teacher trainers when observing teaching that they cannot do on their own (Lund, 2018). The partnership approach provides new information for participants in learning practices including knowledge of pedagogy, content, technology, and changes in teachers' attitudes and perspectives about learning practices (Jin et al., 2019). The collaborative process in the TPD program allows teachers to gain additional specialized knowledge in terms of general pedagogy, content, PCK, and technology as well as share values as they reflect together with other researchers and colleagues (Bravo & Cofré, 2016; Förtsch et al., 2016). Based on the results of interviews with science teachers participating in the program, a teacher said,

> *"Other science teachers and I study the analysis of science concepts in the Nagekeo culture, develop lesson plans, conduct learning, and evaluate learning outcomes together online and offline. I got new information and ideas when joining the program. At first, I did not know that cultural activities in Nagekeo could be related to science learning, how to design lesson plans for culture-based learning, and how to use technology for science learning."*

The technology approach in this TPD program is that participants (science teachers) together with researchers and other science teachers use the Zoom Cloud Meetings online application to analyze science concepts in Nagekeo culture, analyze the suitability of basic competencies, design lesson plans for evaluating learning outcomes in class, and refer to the training module. Teachers design learning by utilizing technology (technology knowledge). Hasanah et al., (2021) revealed that online TPD could be a good alternative to implementing teacher training programs. Involving technology in the TPD program can increase teachers' technology knowledge over time and pedagogical beliefs about scientific inquiry, and teachers show high interest in the TPD program (Lee et al., 2017). According to Xue et al., (2019), teachers express positive perceptions in terms of teaching practice when participating in the Online Community of Practice program. They also reflect on how to start using technology in the classroom and think about their student's involvement in the use of technology in learning (Dalal et al., 2017). Chen & Jang, (2018) also explained that, in the TPD program, it is necessary to incorporate technology knowledge into teacher self-regulation so that they can sustainably improve their professionalism. Some science teachers revealed that the technology approach provided new knowledge for them, especially in designing learning by utilizing technology such as science teachers who had started to think about using laptops and LCDs in finding information related to learning materials and creating YouTube content associated with the learning material.

The ethnoscience approach in this study is to utilize local science or cultural activities in Nagekeo Regency to be associated with science subject matter in class. The participants were allowed to analyze scientific concepts (physics, chemistry, and biology) that exist in local science as well as any customary rituals that contradict scientific concepts. The results of this analysis were then linked by the participants to the science material in the basic competencies to further design a lesson plan for science learning in culture-based classes. Program participants were motivated in carrying out the analysis process to design the lesson plans. A participant stated,

> *"It turns out that cultural activities in Nagekeo can be implemented in the learning process. I have never known that culture can be linked to science learning. I am very motivated and, because of that, the students in my class are enthusiastic about receiving lessons because there is something new, namely the relationship between material and culture, which they also practice."*

According to Dwianto et al., (2017), in addition to maintaining the culture in an area to be preserved, the program has an ethnoscience approach where cultural knowledge associated with scientific concepts can enrich learning material (content knowledge). Teachers will have more interest when analyzing and designing culture-based science learning because the learning becomes meaningful according to their lives so it is believed to be able to improve student achievement. The cultural approach equips teachers with knowledge about the nature of science learning and culture-based science learning, which is beneficial for (1) giving insight and knowledge to the teachers about cultural values that can be integrated into learning activities, (2) equipping teachers with principles and knowledge in developing culture-based learning activities, and (3) providing an understanding of the importance of the role of culture as students' prior experience and knowledge in teaching and learning activities (Soko, Setiawan & Widodo, 2019).

The TPD program based on the partnership, technology, and ethnoscience approach can increase the TPACK of science teachers because they can collaborate in reflecting on and designing learning including determining models, methods, media, learning resources, and evaluation (pedagogy), utilizing technology as a medium of collaboration and classroom

learning (technology), and science content/materials are associated with Nagekeo cultural activities so that they make it more meaningful because it is in accordance with their daily context (ethnoscience). The three approaches in the TPD program are designed to be carried out in an integrated manner to increase the TPACK of science teachers. The good TPACK of science teachers will affect their students' learning outcomes because the results of the study show that the student learning environment can be influenced by the professionalism of the teachers, namely TPACK ability (Yulisman et al., 2019; Yanti et al., 2020). Thus, according to Chai et al., (2017), policymakers in Indonesia should give time and effort to facilitate the TPD program directed at integrating technology so that it is relevant to pedagogy and content.

Conclusion

Based on the results of data analysis, the TPD program based on the partnership, technology, and ethnoscience approach is useful in improving the TPACK of science teachers. The TPACK knowledge of science teachers in Nagekeo Regency before joining the TPD program was in a low category (39.89). Furthermore, after participating in the TPD program, the TPACK knowledge of science teachers improved to the high category (88.24). The three approaches in the TPD program are designed to be carried out in an integrated manner to increase the TPACK of science teachers. The good TPACK of science teachers will affect their students' learning outcomes because the results of the study show that the student learning environment can be influenced by the professionalism of the teachers. It is recommended that, in designing and implementing the TPD program in the future, the designer must pay attention to the setting of the teacher and use technology in the process.

Acknowledgment

I sincerely thank Lembaga Pengelola Dana Pendidikan (LPDP), Departemen Keuangan Indonesia, for providing me with the financial support during my study at Universitas Pendidikan Indonesia, Bandung.

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