Integration of Technological Pedagogical and Content Knowledge in 21st Century Learning

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Abstract: This study aims to describe the implementation of technological pedagogical and content knowledge (TPACK) in learning in senior high schools. The research approach used is qualitative with descriptive type. Data was collected by conducting in-depth interviews and data analysis using analysis using the Miles and Huberman model with the stages of data reduction, data presentation, and drawing conclusions. The results of this study indicate that the implementation of TPACK in SMA has not been implemented optimally. This is because there are several obstacles encountered such as the unavailability of facilities that support optimally in several schools. The facilities in question include internet networks and learning tools in the form of computers and LCDs. In addition, the increase in the ability of teachers to implement TPACK-based learning is still uneven. This is a challenge in applying TPACK to learning optimally. The alternative chosen in learning is to use conventional learning by utilizing the facilities available at school.

Keywords: Technological; TPACK; 21st -Century Learning

Introduction

One of the goals of education is to humanize humans. In this process, various types of efforts are needed to be able to form human beings who have abilities in the form of both hard skills and soft skills. Formation of students' abilities through learning can be done with a variety of strategies and learning models (Darling-Hammond et al., 2020). The development of technology and information is a driving force for increasing teacher abilities in forming competent students. The learning process is also required to be carried out by utilizing technology and information according to the times. This is none other than to help educators communicate the material to students. The role of technology in learning is very important to provide direct experience to students so that students' absorption of what is conveyed by the teacher becomes better (Geng et al., 2019).

Teachers are expected to integrate digital technology into teaching practice (Budiman et al., 2018). The need for teaching with technology, especially in

virtual learning environments, has become even more critical in 2020, when the entire world has shifted to online teaching due to the COVID-19 pandemic. However, many teachers have difficulty using technology in their classrooms, both in physical and virtual environments (Utami et al., 2021). On average, less than half of teachers feel adequately prepared to use technology in their classrooms. Studies show that many in-service graduates feel unprepared to use technology effectively in their classrooms on their first day of teaching.

Teacher education programs need to prepare pre-service teachers to release, rethink, and reframe learning and teaching by leveraging communication, collaboration, and inquiry technologies for 21st-century teaching. Indonesia needs teachers who are able to integrate technology in learning (Tampubolon et al., 2021), because teachers who can integrate technology in learning will be able to support learning well so that students can easily master competencies in the 21st -century (Haleem et al., 2022). But in reality, teachers in Indonesia are still faced with various problems

including problems with teacher standards, mastery of material and low mastery of media and literacy media and technology (Defit et al., 2022). This can be seen in the results of the teacher competency test in Indonesia in 2019 which are still below the standard which is 54.05 while the value set by the government as a graduation standard is 90.00.

This is of course a challenge for teachers in Indonesia, therefore the pattern of developing teacher competence is in the form of the TPACK framework which is a solution to ensure the implementation of learning in accordance with the demands and changes in 21st century learning. TPACK is a form of knowledge that includes three main components namely technology, content, and technology. Pedagogical content technology knowledge is the understanding that emerges from the interaction between content, pedagogy and knowledge technology. TPACK is a truly meaningful and highly skilled teaching base with technology (Dewi et al., 2022).

TPACK is the foundation of effective teaching with technology, requiring an understanding of the representation of concepts using technology (Ismail et al., 2022); pedagogical techniques that use technology in a constructive way to teach content/materials; and how technology can facilitate the problems faced by students in learning. In addition, TPACK is knowledge and skills in integrating technology into learning (Iskandar, 2022). TPACK is the knowledge needed so that a teacher can use the right technology, which is based on an analysis of the character of the material and an analysis of pedagogical aspects (Makawawa et al., 2021). TPACK requires unique multi-interactions and synergies between materials, pedagogy and technology (Malik et al., 2019). Therefore, according to (Ismail et al., 2022) TPACK consists of six components of knowledge, such as Technology Knowledge (TK), Content Knowledge (CK), Pedagogical Knowledge (PK), Pedagogical Content Knowledge (PCK), Technology Pedagogical Knowledge (TPK), and Technology Content Knowledge (TCK). TPACK owned by a teacher can influence the way the teacher teaches a material (Darling-Hammond et al., 2020).

TPACK is defined as a form of knowledge which is a synthesis of three content/material knowledge, pedagogical knowledge, and technological knowledge. This concept was further developed into TPACK because of the added technology element. Through the proper application of TPACK, teachers will be able to motivate students to be involved and motivate students to explore learning content to a greater level. According to (Santos & Castro, 2021) the TPACK model shows that technology-integrated content knowledge and pedagogical skills are important conditions in creating effective and innovative classroom teaching using technology (Septiyanti et al., 2020). Therefore, teachers must be able to integrate technology into learning. This requires the availability of technology and teacher skills in applying it to the learning process. As the results of initial observations made in the city of Mataram, the average teacher still has difficulty implementing TPACK-based learning. Current developments in technology and information demand changes to be made in the educational process. The use of technology in learning is urgent to achieve high absorption in students' understanding. This study aims to describe the implementation of TPACK in high school learning.

Method

The method used in this study uses a qualitative approach with a descriptive type. Research with a descriptive type is research that describes or describes a real event in the field with the support of data and good grammar and easy for readers to understand. The data collection technique used was in-depth interview and documentation techniques which were then analyzed through the stages of data reduction, data presentation, and drawing conclusions.

Result and Discussion

The application of TPACK in learning has been widely carried out, especially at the senior high school education level. One form is the integration of technology and information in the learning process, such as in the delivery of material. Based on the results of interviews and data collection conducted, it was found that the application of TPACK-based learning was as follows:

Implementation of Content Knowledge (CK)

Based on the results of focus group discussions regarding content knowledge (CK), it shows that 100% of teachers have implemented content knowledge (CK). This shows that the teacher already understands various ways of developing understanding to link learning content. The teacher links subsequent learning with explaining the material, and provides questions that relate previous knowledge to the material presented will be studied. Furthermore, the teacher also gives assignments to link the previous learning material with subsequent learning (Dong et al., 2020). Not only that, the teacher also provides motivation for student learning Näsström et al. (2021), by providing motivation by telling positive, and inspiring stories so that students don't get bored while learning.

Implementation of Pedagogical Knowledge (PK)

Based on the results of the analysis regarding the application of PK in the learning process, it shows that 80% of teachers carry out the application of learning

with various methods including group learning. Through group activities teachers can encourage and appreciate students to ask questions and express opinions. Teachers try to apply different teaching methods and strategies to organize teaching activities in class so that students' knowledge construction is conducive (Yusuf & Pattisahusiwa, 2020).

The way the teacher plans group activities for students in learning is by forming study groups that have been determined by the class teacher, then the teacher also gives LKPD as a reference in learning activities. Learning in groups can attract students to discuss with each other so that learning becomes active (Forslund Frykedal & Hammar Chiriac, 2018). However, there are still teachers who have not implemented various learning models and methods and only apply conventional methods which make students bored in learning activities.

Implementation of Technological Knowledge (TK)

Based on the research results obtained by researchers, it can be said that the application of technological knowledge in the learning process only 50% of teachers use learning methods that utilize technology as learning media. Technology is used by teachers to find references, learning resources, and learning media (Pulungan, 2021). Examples of technology used include ICT Hardware and Software (Computers, Laptops, Projectors, Ms-Office). During the Covid-19 pandemic, teachers used mobile phones to study online.

Implementation of Pedagogical Content Knowledge (PCK)

The results of the analysis of the teacher's PCK show that the two teachers have implemented PCK 100% in accordance with the provisions. This shows that the teacher has made a learning design by conveying the objectives and learning activities. Learning plans are designed in the form of syllabus and learning implementation plans that refer to content standards. Furthermore, the design of learning can be done by the teacher by conveying goals and activity learning. The way the teacher makes lesson plans that utilize learning technology is by knowing what material will be studied first Iqbal et al. (2021), looking for material references, then adjusting between the media and learning materials, example using picturer and videos as learning media (Hew et al., 2020).

Implementation of Technological Content Knowledge (TCK)

The results of the analysis regarding the aplication of learning process show that 50% of teachers can use technology in learning. the way teachers carry out the learning process by integrating and using technological media such as projectors, laptops, and mobile phones. Not only that, the technology used by teachers as learning media includes using ICT Hardware and Software (Internet, Video, Pictures, Laptops, Projectors, Mobile Phones). However, most teachers have not been able to use technology in learning (Johnson et al., 2016). These teachers only use books as learning resources and have not used information technology (internet) and its supporting tools.

Implementation of Technological Pedagogical Knowledge (TPK)

The results of the study show that only 50% of teachers use technology in the learning process as a learning medium that is adapted to the material and characteristics of students in class. The teacher prepares how to use technology in class, by designing the implementation of learning in the form of a Learning Implementation Plan. Furthermore, the teacher adjusts the use of learning technology for teaching activities. Teachers use learning technology that is adapted to learning objectives, learning materials and student characteristics. Using technology in the learning process as a learning medium that is adapted to the subjects and characteristics of students in class (Singh et al., 2021).

TPACK implementation

Based on the results of the checklist analysis regarding the application of TPACK in the teacher learning process, it shows that the two teachers are 50% able to integrate learning technology. The application of learning technology is carried out using strategies that combine material, technology and learning strategies. The teacher carries out the learning process by integrating technology, lesson content, and learning strategies. In terms of learning technology media such as using the internet to find images that are appropriate to learning materials and learning strategies (Abdulrahaman et al., 2020). Another example of the use of learning technology is showing videos related to objectives, and learning materials using laptops and projectors, as well as Learning Implementation Plans used to design activities and learning guidelines (Suwandayani et al., 2021). Furthermore, the teacher also integrates learning technology for different learning activities. Based on the results of the FGD it was found that one of the obstacles in implementing TPACK-based learning was the availability of facilities in schools. From the identification results, 80% of schools already have facilities in the form of textbooks, 100% of schools have laboratory rooms and libraries, as many as 65% of schools have internet and computer networks. Based on the identified data, TPACK-based learning should have been implemented, however, as explained by the respondent, it was true that these facilities already existed at his school, but there were some that were still limited in operation, especially internet and computer networks and learning media. For example, the internet

network exists at school, but can only be accessed around the teacher's room, so it doesn't reach the classrooms. In addition, the availability of computers or LCDs is also limited in schools. For example, in one school there are only 4 LCDs. When learning is going to be carried out, you have to fight over it with other teachers.

Conclusion

The results showed that the implementation of TPACK in learning based on the majority of respondents reported having a moderate average level. Based on the results of research on the application of TPACK to learning carried out by teachers, it is not maximal in integrating technology in learning activities. Learning technology has not been optimally used by teachers as a reference, learning resource, and learning media. The application of TPACK is also designed before carrying out learning activities, the teacher tries to integrate learning technology by paying attention to the use of strategies that combine material, technology and learning strategies. To carry out effective TPACK-based learning, it requires the support of facilities from schools such as internet networks, computers, LCD and the ability of the teacher himself. This is an obstacle in the implementation of TPACK-based learning. In addition, it is necessary to conduct training or workshops in order to increase the ability of teachers to utilize technology in learning.

References

Abdulrahaman, M. D., Faruk, N., Oloyede, A. A., Surajudeen-Bakinde, N. T., Olawoyin, L. A., Mejabi, O. V., Imam-Fulani, Y. O., Fahm, A. O., & Azeez, A. L. (2020). Multimedia tools in the teaching and learning processes: A systematic review. *Heliyon*, *6*(11), e05312. https://doi.org/10.1016/j.heliyon.2020.e05312

Budiman, A. B., Rahmawati, R., & Ulfa, R. A. (2018). Efl Teacher's Belief and Practice on Integrating Ict In The Classroom: A Case Study On The Implementation Of Samr Model In Teaching Reading Descriptive Text At Ma Assalam, Sukoharjo. *Jurnal Penelitian Humaniora*, *19*(2), 39–51. https://doi.org/10.23917/humaniora.v19i2.6809

Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2020). Implications for educational practice of the science of learning and development. *Applied Developmental Science*, *24*(2), 97–140. https://doi.org/10.1080/10888691.2018.1537791

Defit, S., Achmad, N., Novia Dewi, Y., Srinovita, Y., & Zefriyenni. (2022). Elementary School Teacher Quality Improvement Model Based on Literacy and Technology. *International Conference on Research and Development (ICORAD)*, *1*(1), 210–217. https://doi.org/10.47841/icorad.v1i1.27

Dewi, N. R., Rusilowati, A., Saptono, S., & Haryani, S. (2022). Project-Based Scaffolding TPACK Model to Improve Learning Design Ability and TPACK of Pre-Service Science Teacher. *Jurnal Pendidikan IPA Indonesia*, *11*(3), 420–432. https://doi.org/10.15294/jpii.v11i3.38566

Dong, A., Jong, M. S.-Y., & King, R. B. (2020). How Does Prior Knowledge Influence Learning Engagement? The Mediating Roles of Cognitive Load and Help-Seeking. *Frontiers in Psychology*, *11*, 591203. https://doi.org/10.3389/fpsyg.2020.591203

Forslund Frykedal, K., & Hammar Chiriac, E. (2018). Student Collaboration in Group Work: Inclusion as Participation. *International Journal of Disability, Development and Education*, *65*(2), 183–198. https://doi.org/10.1080/1034912X.2017.1363381

Geng, S., Law, K. M. Y., & Niu, B. (2019). Investigating self-directed learning and technology readiness in blending learning environment. *International Journal of Educational Technology in Higher Education*, *16*(1), 17. https://doi.org/10.1186/s41239-019-0147-0

Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers*, *3*, 275–285. https://doi.org/10.1016/j.susoc.2022.05.004

Hew, K. F., Jia, C., Gonda, D. E., & Bai, S. (2020). Transitioning to the "new normal" of learning in unpredictable times: Pedagogical practices and learning performance in fully online flipped classrooms. *International Journal of Educational Technology in Higher Education*, *17*(1), 1-22. https://doi.org/10.1186/s41239-020-00234-x

Iqbal, Md. H., Siddiqie, S. A., & Mazid, Md. A. (2021). Rethinking theories of lesson plan for effective teaching and learning. *Social Sciences & Humanities*

Open, 4(1), 100172. https://doi.org/10.1016/j.ssaho.2021.100172

Iskandar, D. (2022). Integration of Technological Pedagogical Content Knowledge (TPACK) Learning Methods in The Learning Management System as An Effort to Improve Educator Competence. *JTP - Jurnal Teknologi Pendidikan*, 24(3), 389–399. https://doi.org/10.21009/jtp.v24i3.31773

Ismail, I., Muhammad, M., & Bahtiar, B. (2022). Profile of Technological Pedagogical and Content Knowledge (TPACK) Middle School Teachers in Sekarbela District, Mataram City. *Jurnal Pendidikan Fisika Dan Teknologi*, 8(1), 56–61. https://doi.org/10.29303/jpft.v8i1.3594

Johnson, A. M., Jacovina, M. E., Russell, D. G., & Soto, C. M. (2016). Challenges and Solutions when Using Technologies in the Classroom. In *Adaptive Educational Technologies for Literacy Instruction*, 13-30. https://doi.org/10.4324/9781315647500-2

Makawawa, J. C., Mustadi, A., Septriwanto, J. V., Sampouw, F., & Najoan, R. A. O. (2021). Primary school teacher perception of technological pedagogical content knowledge in online learning due to Covid 19. *Jurnal Prima Edukasia, 9*(1), 86–96. https://doi.org/10.21831/jpe.v9i1.35245

Malik, S., Rohendi, D., & Widiaty, I. (2019). Technological Pedagogical Content Knowledge (TPACK) with Information and Communication Technology (ICT) Integration: A Literature Review. *Proceedings of the 5th UPI International Conference on Technical and Vocational Education and Training (ICTVET 2018)*, 498-503. https://doi.org/10.2991/ictvet-18.2019.114

Näsström, G., Andersson, C., Granberg, C., Palm, T., & Palmberg, B. (2021). Changes in Student Motivation and Teacher Decision Making When Implementing a Formative Assessment Practice. *Frontiers in Education*, 6, 616216. https://doi.org/10.3389/feduc.2021.616216

Pulungan, A. H. (2021). The Use of Interactive Learning Media for Teachers in Rural Areas. *Budapest International Research and Critics in Linguistics and Education (BirLE) Journal*, 4(1), 524–532. https://doi.org/10.33258/birle.v4i1.1705

Septiyanti, M., Inderawati, R., & Vianty, M. (2020). Technological Pedagogical and Content Knowledge (Tpack) Perception of English Education Students. *English Review: Journal of English Education*, 8(2), 165-174. https://doi.org/10.25134/erjee.v8i2.2114

Singh, J., Steele, K., & Singh, L. (2021). Combining the Best of Online and Face-to-Face Learning: Hybrid and Blended Learning Approach for COVID-19, Post Vaccine, & Post-Pandemic World. *Journal of Educational Technology Systems*, 50(2), 140–171. https://doi.org/10.1177/00472395211047865

Suwandayani, B. I., Ekowati, D. W., Darmawan, S., & Haryono, A. D. (2021). Analysis Of Planning, Implementation, Assessment of Learning from Home Strategies During the Covid-19 Pandemic in Private Elementary Schools. *Al-Bidayah: Jurnal Pendidikan Dasar Islam*, 13(1), 107–124. https://doi.org/10.14421/al-bidayah.v13i1.623

Tampubolon, S., Susanty, L., Khasanah, K., Wisman, W., & Riyanto, A. (2021). Understanding why teachers entrust technology in innovating the learning outcomes. *Jurnal Konseling Dan Pendidikan*, 9(4). https://doi.org/10.29210/169000

Utami, L. P. R. A., Suwastini, N. K. A., Dantes, G. R., Suprihatin, C. T., & Adnyani, K. E. K. (2021). Virtual Reality for Supporting Authentic Learning In 21st Century Language Classroom. *Jurnal Pendidikan Teknologi Dan Kejuruan*, 18(1), 132-141. https://doi.org/10.23887/jptk-undiksha.v18i1.32376

Yusuf, A., & Pattisahusiwa, E. (2020). Teacher's Strategies to Create a Conducive Learning Environment in The Ron Clark Story Movie. *Prosodi*, 14(2), 87–98. https://doi.org/10.21107/prosodi.v14i2.8760