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Modules Based on Technological Pedagogical Content Knowledge to Improve Elementary Students' Science Domain

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ABSTRAK

Penggunaan modul ajar berbasis technological pedagogical content knowledge belum digunakan dengan maksimal karena guru masih terfokus hanya pada hafalan teori. Tujuan penelitian ini untuk menghasilkan modul ajar berbasis TPACK guna meningkatkan domain sains siswa Sekolah Dasar. Pendekatan penelitian ini adalah campuran (mix method) dengan jenis Research and Development menggunakan model pengembangan ADDIE. Uji kelayakan meliputi tingkat validitas dan kepraktisan. Instrumen pengumpulan data menggunakan angket validitas dan kepraktisan. Data dalam penelitian ini berupa kuantitatif dan kualitatif. Hasil validasi produk menunjukkan tingkat validasi sebesar 94,29% kategori validitas tinggi. Adapun tingkat kevalidan media 96% kategori dengan validitas tinggi, validasi materi 98% dengan validitas tinggi, dan validasi bahasa sebesar 88,89% kategori validitas tinggi. Tingkat kepraktisan sebesar 85,72% dengan kategori sangat praktis, respon guru 82% kategori sangat praktis dan respon siswa sebesar 89,44% kategori sangat praktis. Hasil penelitian menunjukkan bahwa modul ajar berbasis technological pedagogical content knowledge (TPACK) untuk meningkatkan domain sains siswa SD layak digunakan dalam proses pembelajaran.

ABSTRACT

The use of teaching modules based on technological pedagogical content knowledge has not been used to the maximum because teachers are still focused only on the theory. The purpose of this research is to produce a teaching module based on TPACK in order to improve the science domain of elementary school students. This research approach is a mix method with the type of Research and Development using the ADDIE development model. The qualification test covers the level of validity and practicality. Data collection tools use validity and practicality lifts. The data in this study is both quantitative and qualitative. The product validation results showed a validation rate of 94.29% for high validity categories. As for the media validity rate of 96% for High validity Categories, the material validation of 98% for higher validity, and the language validation for 88.89% for the High Validity Category. The practicality rate of 85.72% for the Good Practical Category, the teacher's response to 82% of the category was very Practical and the student's reply to 89.44% of the Category was Very Practice. The results of the research show that the teaching module based on technological pedagogical content knowledge (TPACK) to improve the science domain of elementary school students deserves to be used in the learning process.

1. INTRODUCTION

Quality education can be created by quality teachers, who are professional, have special skills or skills and are dedicated so that they can make reliable and superior human resources in the future. This is because teachers as the spearhead in educational services are considered not to have adequate competence to provide learning services that are in accordance with the demands of the times (Kodrat, 2019; Rahmadi, 2019; Syarifah, Z. A., & Yanuarto, 2023). The competencies that teachers and lecturers must have are personality, professional, pedagogical, and social. One of the standards of teacher competence is that the material they teach must be able to utilize information and communication technology to meet learning needs and professional competence capacity. Technology helps educators and students to understand the material easily with the use of technology (Dewi & Ibrahim, 2019; Galingging, 2020) (Su et al., 2022). The pedagogic competence possessed by teachers will greatly affect the quality learning process for students. Teachers are able to utilize pedagogical knowledge and content effectively to facilitate meaningful and interesting thematic learning for learners (Ambaryanti et al., 2020; Syahfitri et al., 2023). Teachers should have pedagogical skills, including the development of learning tools in the form of teaching modules. This pedagogic competence is part of the competencies that teachers absolutely

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possess as well as competencies that distinguish teachers from other professions. In this context, the teacher has a role as a learning resource, manager, guide, provider and motivator of students in education (Oyanagi, W., & Satake, 2016; Putri, 2023). The tough challenge faced by the world of education in Indonesia in global complexity is the skill of developing a teaching module development plan collaborated with teacher skills in aspects of Technological Pedagogical Content Knowledge. Technology pedagogical content knowledge and pedagogical content knowledge both of which are important for developing the professional skills of a teacher and prospective teachers (Al Shammari, 2021; Syavira, 2021).

Technological pedagogical content knowledge is a complete or comprehensive knowledge and skills in a field and pedagogics connected to technological development (Hasibuan, R., Haerullah, I. S., & Machmudah, 2023). Technological pedagogical content knowledge is a new type of knowledge that must be mastered by teachers to be able to integrate technology well in learning. Technological pedagogical and content knowledge is referred to as a method that can provide guidance for teachers to solve problems related to ICT integration in the classroom learning process (Fajero et al., 2021; Herlina & Saputra, 2022). The principle of technological pedagogical and content knowledge is the combination of technology, pedagogy, content/materials that are applied in one context. In technological pedagogical and content knowledge, teachers' knowledge of how to incorporate technology into learning can lead to effective learning. Technology integration is seen as a pedagogical element related to and contained in pedagogical content knowledge. In order to keep up with technological developments and in accordance with the current independent curriculum, it is necessary to continue to improve teacher through trainings (Akhwani & Rahayu, 2021; Oyanagi, W., & Satake, 2016). The use of technological pedagogical and content knowledge is expected to facilitate the improvement of students' skills, one of which is the science domain.

The learning characteristics of elementary school-age children include concrete, integrative, and hierarchical. Concrete learning in this case can be combined with a learning design that allows from being seen to being tinkered with by children. Learning through visual activities assisted with technology can make it easier for students to build the concept of the material being studied (Cahyadi, 2019; Fauziah et al., 2022). However, the phenomenon that occurs is that visual activities in learning devices or teaching modules, such as reading activities without the use of technology, become a means of learning to memorize concepts. This causes the concept or material that has been learned to be easily forgotten. Material that is easily forgotten can inhibit the knowledge domain, science process domain and attitude domain. This is in accordance with the results of previous research state that the wrong understanding of concepts will have a negative impact on further scientific concepts, so treatment is needed to avoid more misconceptions (Dewi & Ibrahim, 2019).

The 2015 TIMSS international study test results on the ability of fourth grade elementary school students in science subject content, ranked 4th from the bottom with a score of 397 points, far from the scale standard set by TIMSS which is 500 points. In addition, Indonesia received a fairly low percentage of the science domain in the TIMSS study, namely 45% for life science, 35% for physical science, and 20% for earth science (Su et al., 2022). This science domain problem can be solved by learning more than just knowledge, but also process, creativity, attitude, and application and connections in accordance with Bloom's view in the taxonomy of science domain. In its implementation, changes in curricula or educational policies may affect the implementation of TPACK. Teachers may need to adjust their approach to comply with the new rules or adjust the curriculum. In its implementation, many primary schools may not have adequate access to the technology and software necessary to implement TPACK effectively (Alegre & Galado, 2023; Fajero et al., 2021; Wilujeng et al., 2020). Some teachers may not see the benefits of using technology in learning or may feel uninterested in developing their TPACK capabilities. This can hinder the progress of TPACK implementation. Moreover, teachers in primary schools may not have adequate training in using the technology in teaching. They may feel insecure or lack sufficient knowledge to integrate technology well into learning. The use of technology in learning should be consistent with the purposes of the curriculum and should not be felt as an irrelevant addition. Elementary school students may have different levels of access to technology devices at home. It can create inequalities in learning if some students have better access than others (Ambaryanti et al., 2020; Kurnianto, B., & Sarwono, 2023).

In practice, TPACK encourages collaborative and interactive learning. Teachers can use technology to connect students with external resources, conduct joint projects, or facilitate communication and collaboration among students. By integrating technology into learning, TPACK helps students develop the digital skills and literacy they need to succeed in an increasingly technology-related world. Technology allows teachers to provide quick and effective feedback to students, which can help students understand which areas require improvement in their understanding. TPACK can improve student involvement in learning because students are often more interested and motivated when technology is used effectively in the classroom (Rusman, 2014; M. Schmid et al., 2020). In addition, TPACK

can help teachers manage time and resources more efficiently. They can use technology to automate administrative tasks and provide access to online learning resources. TPACK equips students with the skills and knowledge they need to face the challenges of the future, where technology will continue to play an important role in everyday life and work.

One of the efforts that can be made to improve students' science domain is to create a Technological Pedagogical Content Knowledge (TPACK) Based Teaching Module. This module will be a set of lesson plans with ICT integration in the classroom learning process. Combining the excellence of TPACK (Technological Pedagogical Content Knowledge) with teaching modules has many significant benefits in learning. Teaching modules can help teachers organize lessons in a more structured and easily accessible way for students. The combination of TPACK with teaching modules allows teachers to integrate technology properly into the modules, creating a more efficient and effective learning experience. The teaching modules enriched with technology enable students to learn independently (Chaipidech et al., 2022; Sung et al., 2016).

Teachers can provide a module that includes digital resources, videos, simulations, or links to relevant websites. It allows students to explore the subject matter independently, access additional resources, and repeat the matter according to their needs. The teaching modules integrated with technology enable students to learn anytime and anywhere. This can be very useful in situations where students need to learn from a distance, or when they have a tight schedule outside the school. Educational modules that include interactive elements, such as videos, simulations, or online tasks, can enhance student engagement. They are more likely to be involved in learning because technology can make material more interesting and relevant to them. The teaching modules related to TPACK can provide richer resources, such as learning videos, simulations, and interactive materials. It can help students understand concepts that may be difficult to understand through traditional methods. In other words, by combining TPACK with teaching modules, teachers can create a more dynamic, relevant learning experience, and enable students to develop the skills needed in this digital age. Therefore this study aims to produce a teaching module based on TPACK in order to improve the science domain of elementary school students.

2. METHOD

The research's approach is mixed method, research and development. The development model used is ADDIE (Analysis, Design, Development, Implementation, and Evaluation). The ADDIE model is a learning system design model that shows the basic stages of a learning system that is easy to do (Cahyadi, 2019). Research and development in the form of a set of learning or known as a teaching module based on technological pedagogical content knowledge (TPACK) to improve the science domain of elementary school students. The ADDIE development model is used because it is in accordance with the product development process that will be carried out by researchers because in each step the stages are carried out systematically and there is an evaluation at each stage so that it can produce appropriate / relevant and valid products. The subjects of this development research trial were grade I and grade IV students of SDN 131/IV Jambi City. This trial was conducted to see the level of practicality of the teaching module based on technological pedagogical content knowledge (TPACK) to improve the science domain of elementary school students developed. TPACK-based learning devices that have been developed are able to increase student learning activities and can improve students' problem solving abilities (Kurnianto, B., & Sarwono, 2023). At the end of the lesson, students were asked to fill out a questionnaire assessing the entrepreneurship module that had been used.

The types of data in this study are quantitative data and qualitative data. Quantitative data in this study are data from questionnaires of media validators, material validators, language validators, as well as data from the results of teacher and student responses related to the practicality of teaching modules. While the qualitative data in this study are in the form of suggestions, criticisms and responses from teachers and students. Validators, teachers and students who are used as considerations in making improvements. The data sources in this study were validators, teachers and students of class I and class IV.

This research instrument is a questionnaire assessment of validators, teachers and students. In this study, researchers used a closed type questionnaire. This instrument is used to see the feasibility of teaching modules based on technological pedagogical content knowledge (TPACK) developed (validity and practicality). Furthermore, other data collection is in the form of an observation sheet for the use of teaching modules based on technological pedagogical content knowledge (TPACK) to improve the science domain of elementary school students during the trial. The researchers used TPACK instruments that have indicators of Pedagogical Knowledge, Content Knowledge and Technologocal Knowledge. The instruments

have 45 items. The analysis technique in this research is qualitative and quantitative data analysis. Qualitative data analysis was obtained from input and suggestions from validators of linguists, media experts, and material experts. Quantitative data analysis is obtained from questionnaire scores. The results of the validation questionnaire from the validators were then analyzed and the percentage was calculated. The practicality criteria is show in Table 1.

Tabel 1. Practicality Criteria

No	Score	Practicality Level
1	86% - 100%	Good Practical (can be used without revision)
2	70% - 85%	Practical enough (can be used with revision)
3	60% - 69%	Less Practical (cannot be used)
4	0% - 59%	Not very practical (total revision)

3. RESULT AND DISCUSSION

Result

The research produced a teaching module based on Technological Pedagogical Content Knowledge (TPACK) to improve the science domain of elementary school students. The development model used is ADDIE (Analysis, Design, Development, Implementation, and Evaluation). The analysis stage includes analyzing the need for TPACK-based teaching modules in class IV elementary schools. The results of observations show that in the process of learning science in class IV elementary schools, teachers have not been able to make TPACK-based IPAS teaching modules so that students' science skills cannot be improved. The teaching modules used only follow what is available on the Internet. This situation shows the need for teaching modules based on Technological Pedagogical Content Knowledge (TPACK) to improve the science domain of elementary school students. This need is supported by the demands of an independent curriculum that requires teachers to be able to create and develop teaching modules according to student learning needs. Competencies related to the use of technological pedagogical content knowledge are examined so that they can be included in the content or content of teaching modules in IPAS subjects.

In analyzing the characteristics of grade IV students at SDN 131/IV Jambi City, it appears that students like challenging learning activities. This condition shows that learning in elementary schools has differences with the learning process carried out with other levels of education. For example, experimental activities or experiments to construct curiosity that was hampered by the Covid pandemic are a challenge for a teacher. In the learning process, it also appears that children prefer to learn in groups (collaborative) compared to the individual learning process. Student curiosity can be seen from the ability of students to ask questions and the willingness of students to carry out activities in accordance with the work procedures given by the teacher. The observation results also show that students are familiar with the use of technology such as the use of computers and smartphones. From the analysis of these characteristics, researchers determined the IPAS learning media used in the developed teaching modules. The design or design stage is carried out by following the story board that has been made before. The content of the designed product refers to the analysis stage that has been obtained. Cover design and learning outcomes display is show in Figure 1.

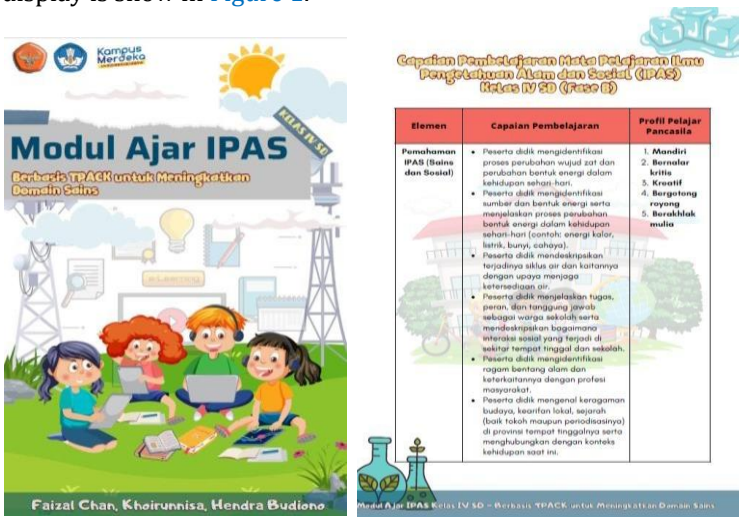

Figure 1. Cover Design and Learning Outcomes Display

The cover is designed to illustrate the content of the teaching module developed. The cover shows the title of the teaching module and pictures of students using various technologies that reflect the learning process by implementing technology. In addition to technology, the cover is also designed with various pictures that can stimulate language development and listening skills for children. The use of media is categorized as unique and interesting by combining images and text in a creative form. In the teaching module, learning outcomes are displayed in accordance with the demands of the current curriculum, namely the independent curriculum. These learning outcomes are the competencies that students must achieve during the learning process. Display of each chapter and display of teaching module is show in Figure 2.

Figure 2. Display of Each Chapter and Display of Teaching Module Contents

The developed teaching module also includes a chapter section for each subject or friend to be studied. From the section of each chapter, teachers and students will know what material will be learned and mastered by students during the learning process. The contents of the teaching module follow the rules in the preparation of teaching modules in the independent curriculum. In this section, it is made starting from general information to the bibliography as a reference to the contents of the teaching module. The product that has been obtained at the design stage in the form of an initial prototype or initial product is then validated in order to produce a valid product. The validation stage includes validation media, material, and language. The validation results on each validator obtained result as show in Table 3.

Tabel 3. Level of Validation of TPACK-Based Teaching Modules

Validation	Average Percentage Score	Level of Validity
Media	96%	High Validity
Material	98%	High Validity
Language	88.89%	High Validity
Average Validation percentage	94.29%	High Validity

Table 3 shows the level of validity of the product in the form of a teaching module based on Technological Pedagogical Content Knowledge (TPACK) to improve the science domain of elementary school students that has been developed. The data shows that the average validation percentage is 94.29% with a high validity category. These results indicate that the products that have been developed can be used in the learning process, especially in IPAS subjects in grade IV SD. An expert validation is needed to assess the feasibility of the media. The validators chosen are experts who are competent and understand in their respective fields.

In media validation, the average percentage obtained was 96%. These results indicate that the products developed meet the criteria for media use, especially the application of TPACK in the learning

process. Furthermore, in the material validation, an average percentage of 98% was obtained in the high validity category. In language validation, 88.89% validation results were obtained with a high validity category. This means that the language in the teaching module developed is in accordance with Indonesian spelling and in accordance with the level of elementary school students. Spelling is used as a standard form in scientific and official writing. The accuracy of using spelling will certainly provide many benefits such as accuracy in conveying meaning. In addition, the use of proper spelling is the basis of good and correct use of Indonesian.

The implementation stage is the stage of using the product in the actual class in the form of trials. After the product is said to be valid, small group and large group trials are carried out. The small group test was conducted to see the readability of the teaching module product that had been validated. The results obtained then it was improved so that the product was ready to be used in the large group test. In the large group test, the practicality of the product was seen from the users, namely students and teachers through a questionnaire given at the end of the lesson. The results of the level of practicality is show in Table 4.

Table 4. Level of Feasibility of TPACK-Based Teaching Modules

Respondents	Average Percentage Score	Level of Practicality
Teacher	82%	Good Practical
Students	89.44%	Good Practical
Average	85.72%	Good Practical

Table 4 shows the average percentage of product feasibility value of 85.72% with a good practical category. This value is obtained from teacher responses and student responses based on the questionnaire that has been given. Teacher responses show an average percentage of feasibility value of 82% in the good practical category, while student responses with an average percentage value of 89.44% in the good practical category. The evaluation stage carried out at each stage shows the results that the teaching module based on technological pedagogical content knowledge to improve the science domain of elementary school students developed is suitable for use in the learning process, especially learning IPAS grade IV elementary school. This is based on the level of validation and practicality that has been obtained.

Discussion

Based on this research, a full or thorough knowledge and abilities in an area and pedagogy related to technology development is referred to as technological pedagogical content knowledge. Technological pedagogical content knowledge is a new form of knowledge that instructors must acquire in order to effectively incorporate technology into learning. It was first conceived and then further developed. Technological pedagogical and content knowledge is defined as a way that may assist instructors in resolving issues linked to ICT integration in the classroom learning process. The integration of technology, pedagogy, and content/materials in one setting is the principle of technological pedagogical and content knowledge. Teachers' understanding on how to employ technology into learning can lead to successful learning in technical pedagogical and subject knowledge (Herlina & Saputra, 2022; Rahmah et al., 2021). Technology integration is viewed as a pedagogical component that is connected to and included inside pedagogical subject knowledge. Wever, it is vital to continue to improve teachers through trainings in order to stay up with technological changes and in compliance with the current independent curriculum. The use of technology pedagogical and subject knowledge is believed to aid in the development of students' skills, particularly in the scientific area.

Elementary school-age children's learning styles include tangible, integrative, and hierarchical. In this scenario, concrete learning may be linked with a learning design that encourages children to tinker with what they observe. Learning through visual activities aided by technology can help students establish a concept of the content being studied (Akhwani & Rahayu, 2021; Augustine, R. B., & Mohamed, 2023). However, visual activities in learning devices or teaching modules, such as reading activities without the use of technology, become a way of learning to recall concepts. As a result, there is no integration of new knowledge with established notions in pupils' cognitive structures. As a result, the notion or content learned is readily forgotten. Material that is readily forgotten can impede the knowledge, scientific process, and attitude domains.

The analytical component of this research comprises determining the necessity for TPACK-based teaching modules in class IV primary schools. Observations demonstrate that in the process of learning science in class IV primary schools, instructors have been unable to create TPACK-based IPAS teaching modules, preventing students' scientific skills from improving. The training modules utilized are strictly based on what is accessible on the Internet (Hasibuan, R., Haerullah, I. S., & Machmudah, 2023; Sung et al.,

2016). This issue highlights the necessity for teaching modules based on Technological Pedagogical Content Knowledge (TPACK) to increase primary school students' scientific domain. The demands of an autonomous curriculum, which requires instructors to be able to build and develop instructional modules based on student learning requirements, support this need (Chaipidech et al., 2022; R. F. Schmid et al., 2023). Competencies connected to the application of technological pedagogical content knowledge are investigated in order to integrate them in the content or content of teaching modules in IPAS disciplines.

According to the characteristics of grade IV, students enjoy demanding learning activities. As an example, consider experimental activities or experiments. This condition demonstrates that learning in primary schools differs from learning at later levels of schooling. For example, experimental exercises or experiments to develop curiosity that were inhibited by the Covid epidemic are difficult for a teacher to implement. In the learning process, it appears that youngsters prefer to learn in groups (collaborative) rather than alone. The capacity of students to ask questions and the readiness of students to carry out tasks in line with the work processes provided by the instructor demonstrate student curiosity (Anggraini et al., 2020; Chang et al., 2020). The findings of the observations also reveal that students are familiar with the usage of technology, such as laptops and handphones. Researchers identified the IPAS learning material utilized in the produced training modules based on a study of these features. The design or design stage is carried out by following the previously created narrative board. The content of the designed product refers to the results of the analysis step.

In media validation, the average percentage obtained was 96%. These results indicate that the products developed meet the criteria for media use, especially the application of TPACK in the learning process. To determine the feasibility of the products developed, it is necessary to carry out a validation stage, one of which is media validation. Furthermore, in the material validation, an average percentage of 98% was obtained in the high validity category. These results also show that the material contained in the teaching module is in accordance with the demands of the curriculum and the characteristics of elementary school students (Agustini et al., 2019; Hilton, 2016). In line with the material validation that has been carried out, the material feasibility validation aims to determine the suitability of the content developed with student needs. In language validation, 88.89% validation results were obtained with a high validity category. This means that the language in the teaching module developed is in accordance with Indonesian spelling and in accordance with the level of elementary school students. Spelling is used as a standard form in scientific and official writing. The accuracy of using spelling will certainly provide many benefits such as accuracy in conveying meaning. In addition, the use of proper spelling is the basis of good and correct use of Indonesian.

The implementation stage is when the product is used in the actual class in the form of trials. Small group and large group trials are conducted when the product is declared to be genuine. The small group test was carried out to assess the readability of the approved training module product. The collected results were then improved such that the product was ready for use in the big group test. The usability of the product was evaluated by the users, mainly students and teachers, in the large group test via a questionnaire distributed at the end of the class. The evaluation stage carried out at each stage shows the results that the teaching module based on technological pedagogical content knowledge to improve the science domain of elementary school students developed is suitable for use in the learning process, especially learning IPAS grade IV elementary school. This is based on the level of validation and practicality that has been obtained. In the ADDIE development stages, evaluation is useful for improving the four stages that have previously been carried out.

In its implementation, changes in curricula or educational policies may affect the implementation of TPACK. Teachers may need to adjust their approach to comply with the new rules or adjust the curriculum. In its implementation, many primary schools may not have adequate access to the technology and software necessary to implement TPACK effectively. Some teachers may not see the benefits of using technology in learning or may feel uninterested in developing their TPACK capabilities. This can hinder the progress of TPACK implementation (Pane et al., 2022; Yang & Lai, 2020). Moreover, teachers in primary schools may not have adequate training in using the technology in teaching. They may feel insecure or lack sufficient knowledge to integrate technology well into learning. The use of technology in learning should be consistent with the purposes of the curriculum and should not be felt as an irrelevant addition. Elementary school students may have different levels of access to technology devices at home. It can create inequalities in learning if some students have better access than others.

Teachers should have pedagogical skills, including the development of learning tools in the form of teaching modules. This pedagogic competence is part of the competencies that teachers absolutely possess as well as competencies that distinguish teachers from other professions. In this context, the teacher has a role as a learning resource, manager, guide, provider and motivator of students in education (Huang et al., 2022; Sung et al., 2016). The tough challenge faced by the world of education in Indonesia in

global complexity is the skill of developing a teaching module development plan collaborated with teacher skills in aspects of Technological Pedagogical Content Knowledge.

TPACK promotes collaborative and participatory learning in practice. Teachers can utilize technology to connect students to external resources, undertake collaborative projects, or enhance student communication and cooperation. TPACK helps students build the digital skills and literacies they need to flourish in an increasingly technological environment by incorporating technology into instruction. Technology enables teachers to offer students with rapid and effective feedback, which can help students identify which parts of their learning require work. Because students are generally more engaged and motivated when technology is used successfully in the classroom, TPACK can promote student participation in learning. Furthermore, TPACK can assist teachers in better managing their time and resources. Technology may be used to automate administrative duties and give access to online instructional materials.

4. CONCLUSION

Based on the results of research on the development of teaching module development based on technological pedagogical content knowledge (TPACK) to improve the science domain of elementary school students, it can be concluded that the development of teaching module development based on technological pedagogical content knowledge (TPACK) is carried out through three stages consisting of Analysis, Design, Development, Implementation, and Evaluation. The result of product validation, media validity, material validation is high validity, and language validation obtain high validity category. The level of practicality obtained good practical category. The existence of this research is expected that teaching modules based on technological pedagogical can be used as a means to facilitate students in understanding the material, especially to facilitate students in understanding IPAS material. In addition, teachers' understanding and skills related to the implementation of TPACK in the learning process still need to be improved so that the teaching modules developed can be used in accordance with the available content or content.

5. REFERENCES

Agustini, K., Santyasa, I. W., & Ratminingsih, N. M. (2019). Analysis of competence on "TPACK": 21st century teacher professional development. *Journal of Physics: Conference Series*, *1387*(012035), 1–9. https://doi.org/10.1088/1742-6596/1387/1/012035.

Akhwani, A., & Rahayu, D. W. (2021). Analisis Komponen TPACK Guru SD sebagai Kerangka Kompetensi Guru Profesional di Abad 21. *Jurnal Basicedu*, *5*(4), 1918–1925. https://lp3m.unuja.ac.id/unduh_jurnal/389/42 Siti Qurratul Aini.pdf.

Al Shammari, M. H. (2021). Devices and Platforms Used in Emergency Remote Learning and Teaching During Covid-19: A Case of English Major Students in Saudi Arabia. *Arab World English Journal (AWEJ*, *1*, 80–94. https://doi.org/10.24093/awej/covid.6.

Alegre, E. M., & Galado, J. (2023). Technological Competence and Pedagogical Content Knowledge Practices of Junior High School Science Teachers. *International Journal of Membrane Science and Technology*, *10*(2), 566–579. https://doi.org/10.15379/ijmst.v10i2.1266.

Ambaryanti, A., Retnaningdyastuti, R., & Roshayanti, F. (2020). Pengaruh Keterampilan dalam ICT dan Etos Kerja Terhadap TPACK Guru SD di Kecamatan Tengaran Kabupaten Semarang. *Jurnal Manajemen Pendidikan (JMP)*, *9*(1). https://doi.org/https://doi.org/10.26877/jmp.v9i1.6838.

Anggraini, D., Khumaedi, M., & Widowati, T. (2020). Validity and reliability contents of independence assessment instruments of basic beauty students for class X SMK. *Journal of Research and Educational Research Evaluation*, *9*(1), 40–46. https://doi.org/10.15294/jere.v9i1.42558.

Augustine, R. B., & Mohamed, S. (2023). Pengetahuan Teknologi Pedagogi Kandungan (TPACK) Guru Prasekolah. *Malaysian Journal of Social Sciences and Humanities (MJSSH)*, *8*(6). https://doi.org/https://doi.org/10.47405/mjssh.v8i6.2291.

Cahyadi, R. A. H. (2019). Pengembangan Bahan Ajar Berbasis Addie Model. *Halaqa: Islamic Education Journal*, *3*(1), 35–42. https://doi.org/10.21070/halaqa.v3i1.2124.

Chaipidech, P., Srisawasdi, N., Kajornmanee, T., & Chaipah, K. (2022). A personalized learning system-supported professional training model for teachers' TPACK development. *Computers and Education: Artificial Intelligence*, *3*(March), 100064. https://doi.org/10.1016/j.caeai.2022.100064.

Chang, T. Y., Hong, G., Paganelli, C., Phantumvanit, P., Chang, W. J., Shieh, Y. S., & Hsu, M. L. (2020). Innovation of dental education during COVID-19 pandemic. *Journal of Dental Sciences*, *155*.

https://doi.org/10.1016/j.jds.2020.07.011.
Dewi, S. Z., & Ibrahim, T. (2019). Pentingnya pemahaman konsep untuk mengatasi miskonsepsi dalam materi belajar IPA di sekolah dasar. *Jurnal Pendidikan UNIGA*, *13*(1), 130–136. https://doi.org/10.52434/jp.v13i1.823.
Fajero, T., Festiawan, R., Anggraeni, D., & Budi, D. R. (2021). Analisis Technological Pedagogical Content Knowledge (TPACK) dalam Implementasi Metode Pembelajaran Daring pada Era Covid-19 di SMA Negeri se-Kota Tegal. *Jurnal Pendidikan Kesehatan Rekreasi*, *7*(2). https://doi.org/https://doi.org/10.5281/zenodo.4914831.
Fauziah, S. R., Sutisnawati, A., Nurmeta, I. K., & Hilma, A. (2022). Pengaruh Metode Eksperimen Berbantuan Media Kit IPATerhadap Kemampuan Literasi Sains dan Karakter Rasa Ingin Tahu Siswa Sekolah Dasar. *Jurnal Cakrawala Pendas*, *8*(2). https://doi.org/https://doi.org/10.31949/jcp.v8i2.2283.
Galingging, R. (2020). Analisis Desain Cover Buku Anak Ayo Sekolah Lukisan Aini. *Magenta| Official Journal STMK Trisakti*, *4*(1). https://doi.org/https://doi.org/10.61344/magenta.v4i01.71.
Hasibuan, R., Haerullah, I. S., & Machmudah, U. (2023). TPACK dalam Pembelajaran Bahasa Arab (Studi Implementasi dan Efektivitas). *Islamic Manuscript of Linguistics and Humanity*, *5*(1). https://ejournal.uinib.ac.id/jurnal/index.php/imlah/article/view/7103.
Herlina, P., & Saputra, E. R. (2022). Pengembangan Media Power point Sebagai Media Pembelajaran Bahasa Indonesia di Sekolah Dasar. *Jurnal Basicedu*, *6*(2), 1800–1809. https://doi.org/10.31004/basicedu.v6i2.2207.
Hilton, J. T. (2016). A Case Study of the Application of SAMR and TPACK for Reflection on Technology Integration into Two Social Studies Classrooms. *The Social Studies*, *107*(2), 68–73. https://doi.org/10.1080/00377996.2015.1124376.
Huang, B., Siu-Yung Jong, M., Tu, Y. F., Hwang, G. J., Chai, C. S., & Yi-Chao Jiang, M. (2022). Trends and exemplary practices of STEM teacher professional development programs in K-12 contexts: A systematic review of empirical studies. *Computers and Education*, *189*(January), 104577. https://doi.org/10.1016/j.compedu.2022.104577.
Kodrat, D. (2019). Urgensi Perubahan Pola Pikir dalam Membangun Pendidikan Bermutu. *Islamic Research*, *2*(1). https://doi.org/https://doi.org/10.47076/jkpis.v2i1.23.
Kurnianto, B., & Sarwono, R. (2023). Pengembangan Perangkat Pembelajaran Berbasis TPACK dalam Meningkatkan Aktivitas Belajar dan Kemampuan Pemecahan Masalah Siswa. *Scolaria : Jurnal Pendidikan Dan Kebudayaan*, *13*(3). https://doi.org/https://doi.org/10.24246/j.js.2023.v13.i3.p210-221.
Oyanagi, W., & Satake, Y. (2016). Capacity Building in Technological Pedagogical Content Knowledge for Preservice Teacher. *International Journal for Educational Media and Technology*, *10*(1). https://doi.org/https://ijemt.org/index.php/journal/article/view/238.
Pane, S. M., Lubis, M., & Sormin, S. A. (2022). Lembar Kerja Peserta Didik (LKPD) Bermuatan Kearifan Lokal Terintegrasi TPACK untuk Siswa Kelas V Sekolah Dasar, Efektifkah? *Jurnal Penelitian Dan Pengembangan Pendidikan*, *6*(3), 377–384. https://doi.org/10.23887/jppp.v6i3.52482.
Putri, I. A. (2023). Modernisasi Pembelajaran IPS Berbasis TPACK Di Era 4.0 Kelas Tinggi Sekolah Dasar. *Jurnal Elementaria Edukasia*, *6*(2). https://doi.org/https://doi.org/10.31949/jee.v6i2.5333.
Rahmadi, I. F. (2019). Technological Pedagogical Content Knowledge (TPACK): Kerangka Pengetahuan Guru Abad 21. *Jurnal Pendidikan Kewarganegaraan*, *6*(1). https://doi.org/http://dx.doi.org/10.32493/jpkn.v6i1.y2019.p65-74.
Rahmah, S., Harahap, A. B., & Nasution, A. S. (2021). Pengembangan Media Berbasis Power Point Untuk Penyajian Bagian-Bagian Tumbuhan Melalui Ctl Di Kelas. *Jurnal Pendidikan Dan Pembelajaran Terpadu (JPPT)*, *03*(02), 128–137. https://jurnal-lp2m.umnaw.ac.id/index.php/JPPT/article/view/1069.
Rusman. (2014). *Model-model Pembelajaran Mengembangkan Profesionalisme Guru*. PT Raja Grafindo Persada.
Schmid, M., Brianza, E., & Petko, D. (2020). Developing a short assessment instrument for Technological Pedagogical Content Knowledge (TPACK.xs) and comparing the factor structure of an integrative and a transformative model. *Computers and Education*, *157*(June), 103967. https://doi.org/10.1016/j.compedu.2020.103967.
Schmid, R. F., Borokhovski, E., Bernard, R. M., Pickup, D. I., & Abrami, P. C. (2023). A meta-analysis of online learning, blended learning, the flipped classroom and classroom instruction for pre-service and in-service teachers. *Computers and Education Open*, *5*(April), 100142. https://doi.org/10.1016/j.caeo.2023.100142.
Su, J., Zhong, Y., & Ng, D. T. K. (2022). A meta-review of literature on educational approaches for teaching

AI at the K-12 levels in the Asia-Pacific region. *Computers and Education: Artificial Intelligence*, *3*(March), 100065.1-18. https://doi.org/10.1016/j.caeai.2022.100065.

Sung, Y. T., Chang, K. E., & Liu, T. C. (2016). The effects of integrating mobile devices with teaching and learning on students' learning performance: A meta-analysis and research synthesis. *Computers and Education*, *94*, 252–275. https://doi.org/10.1016/j.compedu.2015.11.008.

Syahfitri, J., Panjaitan, C. J., & Anggreni, F. (2023). Pengembangan Media Petualangan Cerdas Berbasis Permainan dengan Model ADDIE. *Al-Azkiya: Jurnal Ilmiah Pendidikan MI/SD*, *8*(1). https://doi.org/https://doi.org/10.32505/azkiya.v8i1.6288.

Syarifah, Z. A., & Yanuarto, W. N. (2023). Eksplorasi Pembelajaran Matematika Berbasis TPACK. *Proximal: Jurnal Penelitian Matematika Dan Pendidikan Matematika,* *6*(2). https://doi.org/https://doi.org/10.30605/proximal.v6i2.2722.

Syavira, N. (2021). Pengembangan Media Pembelajaran Berbasis Powerpoint Interaktif Materi Sistem Pencernaan Manusia Untuk Siswa Kelas V Sd. *OPTIKA: Jurnal Pendidikan Fisika*, *5*(1), 84–93. https://doi.org/10.37478/optika.v5i1.1039.

Wilujeng, I., Tadeko, N., & Dwandaru, W. S. B. (2020). Website-based technological pedagogical and content knowledge for learning preparation of science teachers. *Cakrawala Pendidikan*, *39*(3), 545–559. https://doi.org/10.21831/cp.v39i3.31228.

Yang, R., & Lai, Y. C. (2020). E-Learning Practices for English Teacher Education: Fourth-Tier Chinese Cities within Technological Pedagogical Content Knowledge Framework. *Ubiquitous Learning: An International Journal*, *13*(2). https://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=18359795&AN=144409607&h=51xlojNf%2BlyJfs2ZYMbbry6uQSow3mUrguRvwRThj5%2BkoeyLgHDdleJftLw5s%2FOSk7K2AhpJlZftvto5M47www%3D%3D&crl=c.