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Application of TPACK for Student Learning Motivation in Science Subjects d in Elementary School

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Abstract. Motivation Learning science and technology in elementary school is a problem faced by teachers. Students think social studies lessons are boring so teachers need to apply Technology Pedagogy and Content Knowledge (TPACK) to increase student learning motivation by integrating technology in learning, creating relevant, active and varied learning experiences, as well as facilitating effective collaboration between students, and can improve student engagement and understanding. This research aims to develop TPACK-based teaching media to increase learning motivation in Natural and Social Sciences (IPAS) learning. This research is included in the Research and Development (R&D) category, using the ADDIE development model as stages in developing learning materials. Data collection techniques using interviews, observation, questionnaires and documentation. Data analysis used parametric statistical methods, namely the t-test with a significance level of 0.05. The research results show that: (1) there are significant differences in motivation to learn science S especially historical material between the TPACK learning model and the conventional model, the t - test results show a significance value of 0.002 or sig (2-tailed) < 0.05; (2) the use of the TPACK learning model has been proven to be more successful in increasing students' motivation in studying historical material compared to conventional approaches. This was revealed from the posttest results, where the experimental group that took part in TPACK-based learning achieved an average score of 71.52, while the conventional group only achieved an average score of 58.89.

Keywords: TPACK; Learning Motivation; Science.

1. Introduction

Technological and information advances are developing rapidly from Era 4.0 (industrial revolution) to era 5.0 (society). The application of technology has become a basic need not only in industry but also in the field of education. Because students can search for information and various knowledge using technology and information sources anytime and anywhere through search engines (Pujiriyanto, 2019). Education is now an indicator of social status because of its essential role in influencing, changing, and even developing an individual's views, attitudes and life skills. In line with the Independent Learning Program, which gives teachers the freedom to develop learning resources, methods, and strategies so that students can explore broader knowledge and skills, as well as form the character of responsibility, courage and independence (Marwan et al. 2024). In the current technological era, developing educational teaching media is very important and adapted to the ever-growing needs of students. Teaching media plays an essential role in science learning, especially history learning, using TPACK because it functions as a guide in carrying out learning activities aimed at achieving predetermined learning goals. In this context, the teacher's role in developing teaching media becomes an indicator or benchmark for effectively achieving learning objectives.

In practice, science and science learning, especially history, tends to be just a process of transferring knowledge, so history learning as a historical education practice cannot be fully actualized (Pramono, 2012). This causes learning to become a boring topic; In the end, students are not interested in history because memorizing it is considered useless (Nafi'ah, U. , & Utami, 2017; Putro, 2012: 208). Apart from that, there is a lack of parental participation in

supporting historical literacy activities at home to increase students' motivation and interest in reading and build relationships in the learning environment (Nurhayati et al., 2024) . This historical learning phenomenon still exists today in learning practices in schools, including in the city of Yogyakarta, namely SD Kanisius Demangan Baru Yogyakarta. Educators in preparing media are often inadequate. Ready-to-use learning tools include materials, models, strategies or learning media that are less effective in achieving learning objectives. History learning should not only function to provide historical knowledge as a collection of factual historical information but also aim to raise or increase students' historical awareness (Harris, et al., 2011; Lestari, 2015). The importance of strengthening Indonesia's cultural identity in the 21st century, particularly through studying history, highlights the need for relevant solutions. The ADDIE development model, consisting of Analysis, Design, Development, Implementation, and Evaluation, offers a comprehensive framework. Teachers, as the main agents in education, have a crucial role in driving the learning process. However, research shows that there is still a lack of use of innovative learning methods. Only a small percentage of teachers have successfully integrated learning media and TPACK with technology in history learning. Therefore, increasing teacher professional competence in creating innovative teaching media that can increase student learning motivation is the key to improving the quality of education in Indonesia.

1.1. Problem Statement

The application of TPACK (Technology Pedagogy and Content Knowledge) relates to the integration of technology in learning, which includes not only the use of technology tools and platforms but also a deep understanding of how to integrate such technology with effective learning strategies, a strong sense of subject content, and knowledge about student needs and characteristics. Even though technology has entered everyday life, challenges still exist in utilizing it effectively in learning. Conventional approaches often need to improve in optimizing technology to create exciting and significant student learning experiences. Based on the results of initial observations, which included interviews and observations of class IV science learning, especially history material at Kanisius Demangan Baru Elementary School, Yogyakarta, it was discovered that although teachers' abilities in designing lesson plans were good, not many teachers understood how to create learning media that could motivate students. Learning only focuses on lectures, memorization, and reading textbooks. So students look bored and have no motivation to study social studies because there is too much memorization. Of the 20 teachers interviewed, only four have started integrating technology-based learning media into the classroom learning process.

Learning motivation can be interpreted as internal and external encouragement that makes someone carry out certain learning activities, arousing enthusiasm for learning. Increased learning motivation can have an impact on improving student learning outcomes. Teachers have an important role in motivating students; therefore, the teacher's ability to motivate students also plays a role in determining student learning achievement (Adriani, 2019). Apart from motivation, an essential aspect of learning is the approach applied by the teacher in teaching students. In developed countries, integrating technology into learning has become necessary for teachers, one of which is through a learning approach called technological, pedagogical, and content knowledge (TPACK). The concept of TPACK was first introduced by (Mishra & Koehler, 2008), which was a development of the theory of pedagogy and content knowledge (PCK) (Shulman, 1986). According to PCK theory, teachers must be able to combine knowledge about how to teach with knowledge about the material being taught. In further development (Punya & Koehler, 2006), the PCK elements were expanded with technology knowledge, thus forming the TPACK concept. TPACK refers to a teacher's ability to integrate technology appropriately based on an analysis of the nature of the material and its pedagogical aspects. This requires complex interactions and compatibility between learning materials, learning approaches, and the use of technology in learning.

The educational process focuses on the activities of teachers and students to achieve predetermined goals. Through interaction with the surrounding environment, it is hoped that new behavioral changes will occur through learning experiences. The success of this process does not only depend on the school and curriculum, but also the skills of the teachers who

teach (Topal & Korkmaz, 2023). Teachers' abilities were revealed from observations and interviews with school principals, namely; lack of teachers designing interesting learning media, and lack of teacher ability to integrate technology in the learning process. Teachers have a very important role in learning; therefore, their roles need to be improved, and their skills enriched because they greatly influence the course of the learning process and outcomes. Teachers must possess four overarching competency standards based on the Regulation of the Minister of National Education of the Republic of Indonesia Number 16 of 2007. These encompass professional, pedagogical, personal, and social competencies. Professional competence pertains to holistically comprehending educational content, which involves mastery of the curriculum material and its associated facets and imparting scholarly perspectives as an educator (Hanum et al., 2023). Therefore, teacher competence is one of the determining factors in achieving educational goals in the school environment. Good teacher competency will produce intelligent and responsible actions as drivers of learning, combining knowledge, skills and attitudes.

Prior to commencing the educational process, teachers are tasked with essential preparations, notably the creation of a lesson plan. As outlined in Minister of Education and Culture Regulation Number 22 of 2016 and Number 65 of 2013 regarding Primary and Secondary Education Process Standards, a lesson plan consists of a sequence of educational activities devised for each in-person session, spanning one or multiple meetings. This instructional design, developed by the teacher at the onset of the semester, guides classroom learning. When crafting these Learning Plans (RPP), teachers must grasp the curriculum's targeted competencies, acknowledge individual student differences, and foster student-centered learning to kindle enthusiasm, motivation, curiosity, creativity, initiative, inspiration, innovation, and independence. Additionally, emphasis is placed on integrating media, educational resources, and information technology pertinent to the subject matter, aligning with multiliteracy-based values and norms. Finally, integrated, systematic, and effective positive feedback, reinforcement, enrichment, and enhancement are tailored to the prevailing circumstances and context (Zainuddin & Hardiansyah, 2023; Önal, 2023).

Abilities lie in the ability to organize learning materials in general and basic teaching skills using technology (Abas et al., 2023; Muhammad et al., 2023). Therefore, this research is needed to understand how TPACK can be implemented effectively to increase student learning motivation. This research explores how teachers integrate technology with a deep understanding of pedagogy and learning content to create learning environments that are motivating, relevant, and meaningful for students. Thus, a better understanding of TPACK can bring innovation in learning approaches, increasing student learning motivation in the current digital era. According to previous research such as that conducted by (Kurnianti et al., 2021), learning using the TPACK approach positively impacts student motivation. The TPACK approach promotes the integration of pedagogical and content knowledge with technology in teaching, fostering enhanced student comprehension and motivation through the utilization of technology.

Consequently, students find it easier to grasp the subject matter and are afforded opportunities to engage with technology, boosting their motivation to learn. Moreover, implementing TPACK yields additional advantages, including fostering problem-solving skills related to the learning topics and nurturing literacy for problem-solving. Furthermore, TPACK can be seamlessly integrated with a learning model that empowers students to independently explore new knowledge while still receiving guidance from the teacher, as expressed by (Ulva & Atun, 2017). Therefore, TPACK is a suitable approach to be implemented in the current education system. However, to apply TPACK in learning, learning materials are needed that support its implementation (Mairisiska et al., 2014).

Based on the problems mentioned, this research aims to provide a better understanding of the process of developing learning media using the TPACK approach to increase student learning motivation. This research is expected to provide insight into what aspects or skills elementary school teachers need to improve to be able to teach 21st century skills to students through the use of TPACK-based learning media. The focus of this research is to increase students'

motivation to learn Natural and Social Sciences (IPAS), especially class IV history material, by implementing TPACK.

1.2. Related Research

Several studies have been conducted on the application of TPACK in learning. For example, according to (Afsari, 2021), research shows that the use of TPACK-based learning videos in teaching fraction material for fourth grade elementary school students has proven to be effective, practical, and successful in improving learning outcomes. This learning media is considered valid and very suitable for use in the learning process. Other relevant research, conducted by Handayani (2024), also found positive results in implementing the TPACK Model using learning videos on expository text material for class X students. In addition, research by Kuliawati (2021) shows that the TPACK approach providing a positive impact on online learning and limited face-to-face learning (PTMT) at SDN Duri Kepa 05 Pagi. There has been no research on the application of TPACK in history learning by integrating digital technology into the learning process which will make the learning process more active, effective, interesting, lively, innovative and of high quality. This is one way to answer the challenges of the Industrial Revolution 4.0 era (Kimmons, 2015). Research conducted by Pusparini et al. (2017) similarly indicates that possessing high Technological Knowledge (TK) does not necessarily translate to high levels of Technological Content Knowledge (TCK). The findings suggest that this discrepancy arises from participants' challenges in selecting suitable technology for educational purposes. Several studies have implemented the Technological Pedagogical Content Knowledge (TPACK) framework in teaching, focusing on teachers' aptitude in choosing appropriate materials and technology. The assessment of teachers' TPACK implementation reveals notably positive outcomes, particularly in the domains of Technological Knowledge (TK), Technological Content Knowledge (TCK), and Technological Pedagogy Knowledge (TPK) (Fajero et al., 2021). In addition, according to (Joldanova et al., 2022), the inclusion of TPACK in the learning process increases students' motivation and self-confidence because technology makes it easier for them to access learning materials that suit their needs, which also contributes to self-development, self-confidence, social skills, and communication

Developing teaching media by implementing TPACK components provides opportunities for students to improve their abilities in using technology (Purnawati et al., 2020). This is in line with several research findings which state that a more flexible and adaptive learning approach allows teachers to adapt learning experiences according to individual student needs and supports collaboration between them in a digitally structured learning environment (Pubian & Herpratiwi, 2022; Devya et al ., 2022). According to research (Gunawan et al. , 2020), developing learning materials that integrate TPACK aspects is very important to improve the learning process and make it easier for teachers and students to implement it. It is hoped that this can increase students' learning motivation, especially in social studies subjects with historical material . The novelty of the teaching media developed in this research uses Google Sites which is a a platform provided by Google to easily create websites without the need for knowledge of complex programming or web design. Google sites are presented with various forms of interesting features in conveying and explaining the concepts of historical material in which students live (Hwee & Koh, 2011; Karaca et al., 2013; Luik, Taimalu, & Suviste, 2018; Nofrion et al., 2018). Google Sites allows teachers to create easy-to-use websites to organize information, learning materials, assignments, resources, and more in a virtual environment that is structured and easy for students to access (Adzkiya & Suryaman, 2021). With features such as integration with Google Drive, the use of multimedia, and the ability to collaborate online, Google Sites enables more interactive teaching, allowing students to access materials anytime and anywhere.

1.3. Research Objectives

This research is classified as development research or Research and Development (R&D) using the ADDIE design. The focus of the research is to increase learning motivation in Natural and Social Sciences (IPAS) learning, especially historical material, by implementing TPACK-based Google Sites teaching media. The development of this teaching media was applied to 40

grade IV elementary school students at Kanisius Demangan Baru Elementary School, Yogyakarta.

2. Theoretical Framework

Education today goes beyond traditional concrete media; learning can also be facilitated through educational video games, an area that has been studied extensively to explore the impact of today's educational video games (Komala & Rifai, 2021). Collaboration between peers can pose challenges for students, especially those with social motivation vulnerabilities and reading difficulties. The emotional aspects of such collaborations need to be better understood. In a learning environment, teachers and fellow students interact and influence each other in a dynamic system, as highlighted in research (Salo et al., 2022). Reading comprehension also plays an important role in young students' ability to acquire knowledge and apply it effectively in their studies and future careers, underscoring its importance, as emphasized by (Sakolrak, 2014).

One of the learning models currently recommended, especially at the elementary school level, is the ADDIE development model which has significant relevance in developing the learning curriculum in elementary schools. The Analysis Stage in ADDIE allows collecting appropriate information regarding student needs, appropriate curriculum and learning approaches that are appropriate to the student's level of development (Rosnaningsih et al., 2021). The Design Stage allows teachers to plan teaching that is interesting and in line with learning objectives in elementary schools, including selecting materials, learning resources, teaching media, and teaching strategies that accommodate various student learning styles. Development at the ADDIE stage allows the creation of learning materials or media that are relevant to the characteristics of elementary school students, including teaching materials or media that are interesting, interactive, and in line with curriculum needs (Sari et al., 2019; Arisanti & Adnan, 2021). Implementing the ADDIE stage allows teachers to teach with strategies and materials that have been designed effectively. And evaluation is an important stage that allows teachers to evaluate the effectiveness of learning, identify areas that need improvement, and improve teaching methods to ensure students in elementary schools receive optimal learning experiences and in accordance with educational goals (Rizkitania & Arisetyawan, 2021; Ranuharja et al., 2021).

In the realm of technology proficiency, educators are urged to enhance their skills by familiarizing themselves with the TPACK framework introduced by Shulman (Fazilla et al., 2023). This framework encapsulates Pedagogical Content Knowledge (PCK), elucidating the fusion of pedagogical expertise with subject matter comprehension. Teachers must grasp the interplay among technology, pedagogy, and content to effectively deploy these strategies and facilitate student comprehension of the material (Ütkür Güllühan & Bekiroğlu, 2023; Yıldırım & Karabulut, 2023). The development of the TPACK instrument aims to assess the technological competence of future educators, encompassing pedagogical aspects and relevant subject matter. This process involves categorizing TPACK framework domains into online and offline TPK, resulting in seven dimensions: Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPACK) (Schmid et al., 2021). TPACK embodies the knowledge framework essential for educators to integrate technology into teaching practices, fostering innovation in education. Koehler (2013) elucidates TPACK as a pedagogical approach that harmonizes technology, pedagogy, and content. Embracing and implementing TPACK principles enhances educators' teaching competencies in the contemporary era, fostering the development of critical, creative thinking skills, and adept utilization of technology in learning, particularly in primary and secondary education contexts (Syafie, 2019).

Life in the complex era of the 21st century also emphasizes the importance of support for students at school in developing abilities, qualities and dispositions for effective lifelong learning. This adds urgency to adopting learning motivation as an educational goal at all levels

(Harlen & Deakin Crick, 2003). McClelland et al. (1953) explained that motivation is the result of learned considerations which are characterized by changes in effective responses caused by the stimuli or stimuli received, which in turn produce clear changes in affection when motives and efforts to achieve goals arise. Another point of view also emphasizes something similar, that motivation is a change in energy within an individual which is characterized by the emergence of feelings and reactions to achieve goals (Sholeh & S'adiah, 2018). Good will, whether originating from within the individual or from the external environment, is an important factor in determining the quality of individual behavior in various contexts, including studying, working and daily life (Suprihatin, 2019). Motivation is the main driving force in encouraging learning, especially in the classroom environment. Learning motivation is a crucial foundation in preparing students for a better learning experience (Wijayani et al., 2017).

Motivation is usually instilled during the learning process, and it is the main responsibility for teachers to have good skills in motivating students, especially in designing and delivering learning so that students have high motivation in completing tasks or activities given by the teacher (Lowman, 1990) . Mostly, motivation to learn depends on the teacher's ability to develop motivation and students' natural inclination to learn. When individuals are motivated to learn, this can facilitate the development of higher order learning and thinking skills that support increased learning achievement of students (McCombs, 1991). Teachers play a key role in determining student learning motivation, where they need to find a balance between students' desires for learning and the learning design they implement (Corno & Mandinach, 1983).

3. Method

3.1. Research Design

This research uses Research and Development (R&D) research and the model used is the ADDIE Development model . The ADDIE model is a framework consisting of five stages used in instructional design for developing learning programs (Dadi et al., 2019). The first stage is Analysis, where identification of learning needs is carried out together with a deep understanding of learner characteristics, learning objectives, as well as relevant environmental factors. After analysis, the Design stage involves planning a learning strategy that includes the overall learning structure and plan. Then, at the Development stage, learning materials are created according to a previously designed plan , namely by creating teaching media using Google Sites . The next stage is Implementation, where the Google Sites learning media that has been developed is applied in the actual learning context by the teacher or facilitator. Finally, the Evaluation stage involves collecting data to evaluate the effectiveness of the learning program, with the aim of ensuring that the learning objectives are achieved and to identify areas that need improvement. The ADDIE model provides a systematic and structured approach to instructional design, guiding instructional designers in developing effective learning programs.

The research method used is quantitative descriptive with data collection techniques using interviews, observation, questionnaires , and documentation in order to determine students' strengths and weaknesses before participating in learning. The main aim is to increase learning motivation in learning Natural and Social Sciences (IPAS), especially history material by implementing TPACK . The success of the research will be determined to what extent the media developed can help fourth grade elementary school students and teachers in the learning process in elementary school. Research variables can be categorized into two main aspects, namely: (1) development of class IV teaching media , and (2) Increasing student motivation for learning .

3.2. Participants

Participants in this research were selected using a purposive sampling method, namely a non-random sampling technique where sample selection is adjusted to the context and specific characteristics that are in accordance with the research objectives (Breidt & Opsomer, 2017). The research participants consisted of 40 fourth grade students in the even semester of the

2022/2023 academic year at Kanisius Demangan Baru Elementary School, Yogyakarta. The selection of fourth grade students as research subjects was based on their low ability and motivation to learn science , especially history material . In our research we used control and experimental classes. The control class was used as a group that did not receive TPACK intervention, while the experimental class was a group that received TPACK intervention. The control class provides an overview of learning conditions without TPACK integration, while the experimental class allows evaluation of the positive impact of implementing TPACK on student learning motivation. By comparing these two groups, research can provide insight into the effectiveness of TPACK in increasing students' learning motivation in science subjects.

3.3. Data Collection

Data collection is carried out by interviews, observations, questionnaires , and documentation, apart from that, recording devices and notes are tools used to record data in the field. At this stage, there are two important tasks that must be carried out. The first task is to analyze the need for history lesson content or materials in science learning ; The second task is to determine the effectiveness and provide learning motivation in learning (IPAS), especially historical material with the Application of Pedagogical Content Knowledge Technology (TPACK), the application of which is Recognizing, Accepting, Adapting, Exploring, Advanced level.

At this stage the focus is on carrying out activities to ensure the content or learning materials needed to develop teaching media. Specifically, the aim is to identify all relevant content based on the history syllabus which emphasizes teaching media and analysis of science and science subjects , especially history, which is aimed at fourth grade students . Apart from that, the development of this media is to increase student learning motivation by looking at the syllabus and valid learning implementation plans (RPP) for students.

The techniques and tools used to collect research data are observation sheets as learning media for science subjects , especially history. The research data obtained will be analyzed using descriptive statistics and document analysis. Procedures for analyzing data from research instruments using a Likert scale according to table 1:

Table 1. Likert Scale Categories

Hoses	Criteria
2.5 < score ≤ 4	Very Useful (VU)
1.5 < score ≤ 2	Helping (H)
1.5 < score ≤ 2	Quite Useful (QU)
1 < score ≤1.5	Less Useful (LU)
0 < score ≤1	Not Useful (NU)

The investigation focused on determining the need for learning media that facilitates the ability to analyze content needs or history subject matter in science learning . The aim is to identify the important components needed to develop effective learning media that can increase understanding and increase learning motivation in science learning, especially historical material with application. TPACK.

Table 2. Results of Media Expert Trials

Criteria		Obtain	Score	Core Maximum S_	Average Score	Percentage per Criterion
Media Eligibility	Completeness of teaching media materials	1	4	4	4	100%
		2	4	4		
		3	4	4		
		4	4	4		
		1	4	4		
	Depth of material in teaching media	1	4	4	3.25	85%
		2	3	4		
		3	3	4		

		4	3	4		
	The accuracy of the material contained in the teaching media	1	4	4	4	100%
		2	4	4		
		3	4	4		
		4	4	4		
	Learning support materials in teaching media	2	4	4	4	100%
		3	4	4		
Suitability Material	Compatibility with developmental level	1	4	4	3.6	91.6%

Furthermore, the needs analysis aims to assess the need for teaching media comprehensively, by considering the complex interaction of various factors that contribute to increasing student learning motivation in learning science, especially history material with the application of TPACK. These factors include teacher guidance strategies, learning environment, student background, individual differences between students, specific tasks, and the media itself. In the context of implementing TPACK -based learning media , various learning models are considered, as highlighted in research (Oo & Habók, 2022). Apart from that, the emergence of this media provides new opportunities to increase student learning motivation and the effectiveness of the media can influence increased student learning in history subjects, as stated by (Diprossimo et al., 2023). In the context of psychology, motivation is an internal process that triggers, sustains and directs individual behavior, while effectiveness is achieving desired results or achieving goals in an efficient and adequate manner.

3.4. Data Analysis

The data analysis process was carried out using qualitative methods which included steps such as data reduction, verification and drawing conclusions. All information collected in this research, which includes the results of observations, interviews and document reviews, was sorted and assessed qualitatively. The data collected is in the form of narratives regarding opinions, knowledge, experiences and other elements which are then analyzed and presented with the aim of obtaining meaningful results .

3.5. Validity and Reliability

The overall assessment of Indonesian media experts shows that this learning media received a score of 95% of the maximum total score of 100%. These results show that this learning media product is very suitable for general application. According to applicable standards, products with a score of 75% or more are considered suitable for use in the learning process. In this case, each criterion also manages to meet or even exceed the 75% threshold which indicates excellent product quality.

Table 3. Graphic Expert Test Results

	Criteria	**Obtain**	**Score**	**Core Maximum S_**	**Average Score**	**Percentage per Criterion**
Media covers	Completeness of teaching media materials	1	4	4	3.5	87.5%
		2	3	4		
	Typography teaching materials	1	3	4	3	75%
		2	2	4		
		3	4	4		
Content Graph	Each media material	1	4	4	3	75%
		2	2	4		
	Layout of teaching media materials	1	4	4	4	100%
		2	4	4		
		3	4	4		

	Typography	1	4	4		
	teaching media	2	3	4	3.6	91.6%
	materials	3	4	4		
	Illustration of	1	4	4		
	teaching media	2	4	4	4	100%
	materials	3	4	4		

Meanwhile, three criteria that are below 100% are still considered appropriate, namely media mastery with a score of 75%, depth of teaching media material with a score of 85%, and language suitability with the level of media mastery for students with a score of 91.6%. Looking at these results, all criteria can be categorized as suitable teaching media for use in learning . However, improvements are not only based on percentage scores, input and suggestions from experts are also considered. This assessment of the feasibility of teaching media also considers each component and subcomponent. For the media suitability component, the media completeness subcomponent received a score of 75%, meeting the minimum requirements for implementation without revision. The depth of the media received a score of 85% which shows high feasibility and usefulness in teaching media for students.

The subcomponents of material accuracy and learning support materials both received a score of 100%, which shows that they are feasible to implement without revision. Regarding the suitability of teaching media for students, the subcomponent of assessing the suitability of media for students' level of development received a score of 91.6% with the predicate "very suitable". Apart from that, the communicative subcomponent and the integration and unity of ideas each received a score of 100% with the predicate "very feasible" to be implemented without revision. However, it is important to note that the percentage score is not the only determining factor in product viability and subsequent actions.

Assessment of all graphic aspects of the cover and contents resulted in a percentage of 89%. Based on the product suitability guidelines presented in the research, this value shows that the teaching materials are feasible and can be implemented. However, this data is not the only reference for improving student teaching media, especially in science and science learning, especially history subjects. Assessment of each subcomponent and expert advice also play a role in product improvement.

For creating teaching media, the percentage values for each subcomponent are as follows: layout 87.5%, typography 75%, and illustration 75%. This value shows that the three subcomponents are feasible and can be implemented. Likewise for graphic content, the percentage values are 100% for layout, 91.6% for typography, and 100% for illustrations. With a percentage above 75%, all graphic content subcomponents are considered feasible and suitable for use.

4. Findings

This research found that the application of Google Sites-based teaching media with the TPACK approach was effective in increasing students' learning motivation in science and science subjects, especially history material at the fourth grade elementary school level. Through the integration of TPACK, Google Sites teaching media is designed to present historical material with an interesting and relevant approach, combining elements of pedagogy, content and technology. It was found that students showed higher levels of participation and involvement in learning, as well as showing greater interest in social studies learning material. In addition, this teaching media provides flexibility in access and interaction with learning material, allowing students to learn independently and collaboratively. These findings confirm that the application of TPACK-based Google Sites teaching media can be an effective solution in increasing student learning motivation in IP AS subjects at the fourth-grade elementary school level.

Table 4. T test results

	N	Means	Std. Deviation	Std. Meaning of Error
Control class	40	2.2750	.71567	.11316
Experimental class	40	1.5250	.50574	.07996

Table 5. One Sample Test Results

	Test Score = 0					
	Q	df	signature. (2-tail)	Meaningful Differences	95% Confidence Interval of the Difference	
					Lower	On
Control class	20,105	39	,000	2.27500	2.0461	2.5039
Experimental class	19,071	39	,000	1.52500	1.3633	1.6867

In implementing TPACK for student learning motivation in science and science subjects in elementary schools, the T test is used to compare learning motivation between two different groups of students. First, two sample groups will be formed, namely the experimental class (which received the TPACK intervention) and the control class (which did not receive the TPACK intervention). After that, the level of student learning motivation in both classes will be measured using the SPSS application . Based on the table above, it is obtained signature value (2-tail) is 0,000 <0.05, so it can be concluded that there is a significant difference in student learning motivation between the experimental class which uses TPACK-based teaching media and the control class which does not use TPACK-based teaching media or only lectures. and read textbooks.

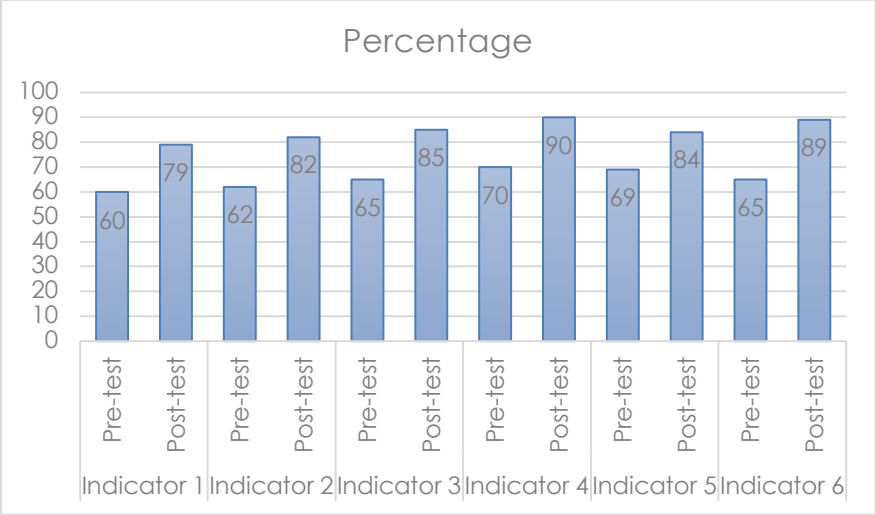

Figure 1 . Results of achieving student learning motivation before and after implementing TPACK-based teaching media

The pre-test and post-test showed an increase in all indicators of student learning motivation. In Indicator 1, the percentage increased from 60% to 79%. Indicator 2 also increased from 62% to 82%. Furthermore, in Indicator 3, there was an increase from 65% to 85%. Likewise, in Indicator 4, there was an increase from 70% to 90%. Indicator 5 also shows an increase from 69% to 84%. Finally, Indicator 6 increased from 65% to 89%. This shows that all indicators of students' learning motivation experienced a significant increase after learning using TPACK-based teaching media . This indicates that all aspects of students' learning motivation have increased in learning, and the product in the form of TPACK-based teaching media is effective in implementing and achieving learning in class IV Kasnis Demangan Baru Elementary School,

Yogyakarta . Therefore, it can be concluded that TPACK-based teaching media has been successful in increasing student learning motivation at the school.

5. Discussion

The application of TPACK-based teaching media with the ADDIE development model to increase fourth grade students' learning motivation in learning Natural and Social Sciences (IPAS), especially in historical material, shows promising results. With the TPACK approach, teachers can integrate technology, pedagogy, and content knowledge to design learning materials that are more interesting and relevant for students. The ADDIE development model provides a systematic framework from needs analysis to evaluation, ensuring that teaching media development is carried out in a planned and effective manner. Through the analysis stage, teachers can understand students' needs and characteristics, so that learning materials can be adjusted to their level of understanding. Next, the design stage allows teachers to design learning materials that utilize technology appropriately and according to students' learning needs. The development process ensures that the learning materials are created to high quality standards and are in line with learning objectives. When teaching materials are applied in learning, teachers can monitor student responses and make adjustments if necessary. The evaluation stage allows teachers to evaluate the effectiveness of TPACK-based teaching media in increasing student learning motivation. Thus, the application of TPACK-based teaching media with the ADDIE development model can be an effective strategy in increasing fourth grade students' learning motivation in history material in science and science learning.

5.1. Analysis

The application of TPACK-based teaching media with the ADDIE development model at the analysis stage is a crucial first step in efforts to increase fourth grade students' learning motivation on historical material in Natural and Social Sciences (IPAS) learning. At this stage, the teacher carries out a thorough evaluation of the students' needs and characteristics, and understands the challenges they may face in learning. This analysis involves collecting data about students' interests, level of understanding, and learning styles, so that learning materials can be tailored to their needs. Unlike traditional learning which usually focuses on increasing students' knowledge , the latest technology can encourage the development of effective understanding , as observed in research (Fitri Mulyani, 2021). In addition, this analysis also involves an assessment of available technological resources and the teacher's ability to integrate technology in learning. With a deep understanding of student needs and the potential of available technology, teachers can design learning material ideas that are relevant, interesting, and can increase student learning motivation. Apart from that, a basic creative mindset is also needed, so that ideas can emerge. and acceptance of learning something new, as stated by (Lestari , 2023) . Thus, the analysis stage in implementing TPACK-based teaching media with the ADDIE development model is an important foundation in creating effective learning and oriented towards student learning motivation.

5.2. Design

The application of TPACK-based Google Sites teaching media with the ADDIE development model at the design stage is a strategic step in increasing student learning motivation. Motivation refers to internal or external forces that encourage a person to act or behave in a certain way and is defined as the analysis, evaluation and synthesis of information to make decisions, as explained by (Sapitri et al., 2022) . In line with the cognitive approach, it combines certain theories, such as constructivist learning theory, cognitive development theory, sociocognitive theory, cognitive information processing theory, and adult education theory, all of which form the basic principles that encourage students to use motivation in constructing new knowledge. effectively (Yusuf , 20 20 ; Vong & Kaewurai, 2017). At this stage, the teacher designs the structure and content of Google Sites carefully, integrating technology, pedagogical knowledge, and historical material content. Teachers set clear learning objectives and select teaching strategies that take advantage of the interactive features

offered by the Google Sites platform. In designing Google sites , teachers pay attention to students' needs and preferences, and present learning material in an interesting and relevant way (Ekawati, 2016; Nuraini , et al ., 2023).

Apart from that, Google Sites is also designed to provide a learning experience that is responsive and easily accessible to students from various devices, such as computers, tablets or smartphones. This research is a breakthrough in the development of technology-based motivation programs for more sophisticated and advanced educational applications, as highlighted by (Shalikhah, 2016; Adriansah & Nana , 2020). Thus, through careful and planned design, the application of TPACK-based Google Sites teaching media at the design stage is expected to create a learning environment that motivates and inspires students to learn more actively and enthusiastically in understanding historical material in science learning. Increasing motivation is very important to develop student interest and learning outcomes . By integrating motivational teaching, students gain the ability to process information, analyze original sources, and refrain from choosing inappropriate answers (Sari et al., 2018).

Figure 2. Main Menu Display

On the main menu there is a pre-test, objectives, material, video, assessment, and post-test. The pre-test is carried out to measure students' initial abilities before participating in learning activities according to the learning objectives. Learning material that contains explanations of story material about my region and the history of Indonesia as well as important questions to stimulate student activity and reflective questions after explaining the teaching material. Learning videos that can be connected to the YouTube application. Reflection is an interactive quiz that can improve students' understanding of the material. Finally, a post-test is carried out by the teacher at the end of the presentation of the material to determine the level of students' knowledge of the material that has been taught. Data before and after the test were collected using test techniques. The pre-test is carried out before the learning process, while the post-test is carried out after the treatment is given.

5.3. Development

The implementation of TPACK-based Google Sites teaching media with the ADDIE development model at the development stage marks an important step in increasing student learning motivation. At this stage, the teacher implements the previously designed design into Google Sites carefully and thoroughly. This process involves creating well-structured Google Sites pages, adding relevant and interesting content, and setting up interactive features to increase student engagement. Teachers also ensure that Google Sites is easy to navigate and can be accessed smoothly by students. Innovative teachers design teaching media to foster mutual respect between students and teachers, by prioritizing a more student-oriented

approach (Agustiningsih, 2019 ; Magnusson et al., 2023). During the development stage, teachers have also tested Google Sites to ensure its functionality and identify potential improvements or adjustments that are needed. With directed efforts and a focus on implementing the design that has been designed, the implementation of TPACK-based Google Sites teaching media at the development stage is expected to create a learning environment that supports and motivates students to learn more effectively and enthusiastically in understanding historical material in science learning.

At the development stage, researchers make improvements to the learning media that has been developed based on values and input from the results of expert tests and limited scale tests. The development stage consists of several steps, namely validation of material experts and media experts, product revision, limited trials, so that it becomes a final learning media product that is suitable for use. The validation stage was carried out by material experts and media experts. Expert validation aims to determine the feasibility and suitability of learning media created according to student needs. Development Teaching media is used to meet the needs of teachers and students. The results of this stage are in the form of Google Sites teaching media that is structured and in accordance with the required competencies.

Based on student response assessment It seems that they are still not used to using the media that was developed because the learning media is different from usual. Solutions that can be implemented by students as users must be able to understand Google learning media so that interactive learning can run smoothly. According to (Assidiqi & Sumarni , 2020), from the results of research conducted, digital platforms such as Google Sites are one tool that can support success in interactive learning. The usability aspect of the website includes an explanation of the use of Google Sites as a website learning medium. Based on the results obtained, it makes it easier for students to study the material because they do not require stationery, books and websites can be accessed anytime and anywhere. Based on the results of research conducted by (Suryantari & Mulyono, 2023), Google Sites is one of the services used for learning because it has several advantages such as a free website, easy to use and can collaborate with other applications so that Google Sites can be used as a learning website media. To get better results, the product will be revised according to input and suggestions given by students so that it becomes the final product of website-based interactive learning media using Google Sites on story material about my area for class IV.

5.3. Implementation

Implementing TPACK-based Google Sites teaching media with the ADDIE development model at the implementation stage is essential in increasing fourth-grade students' motivation to learn history material in Natural and Social Sciences (IPAS) learning. After the product is deemed feasible by experts, it continues to the individual trial stage, followed by small group trials and field trials. If deficiencies are found in the trial, it is necessary to conduct the evaluation stage again to improve the teaching materials being developed. Evaluation activities at this stage are not limited to the design and development or product implementation stages but are carried out at all stages of ADDIE model development. At this Implementation stage, the teacher actively implements the learning plan that has been designed by integrating Google Sites into the teaching process on Tuesdays and Thursdays every week according to the lesson schedule. Teachers ensure that students have easy and convenient access to Google Sites and provide clear directions on using and accessing the various features available. Teachers also facilitate students' interaction and collaboration via Google Sites in online discussions, collaborative assignments, and other interactive learning activities. During the implementation phase, teachers actively monitor student participation and engagement in using Google Sites and provide constructive feedback to help students utilize these learning resources effectively. Thus, through planned and structured implementation, the application of TPACK-based Google Sites teaching media at the implementation stage is expected to create a motivating and enriching learning experience for students in understanding historical material in science learning.

5.4. Evaluation

At the evaluation stage, teachers collect data regarding the level of student participation, level of involvement in learning, and achievement of learning outcomes through Google Sites teaching media. The evaluation stage is the final step in developing ADDIE model teaching materials. The aim is to provide value to the teaching materials developed, ensuring their effectiveness and alignment with the desired objectives (Lingga et al., 2023). In addition, teachers also collect feedback from students regarding their experience in using Google Sites and whether it has increased their interest and motivation in learning history material. Evaluation also involves an analysis of the success of achieving predetermined learning objectives and assessing the adequacy and relevance of the content presented in Google Sites. The results of this evaluation were then used to evaluate the success of implementing TPACK-based Google Sites teaching media in increasing the learning motivation of class IV students in science learning. Thus, the evaluation stage is important in ensuring that the application of teaching media is in accordance with learning objectives and has a positive impact on student motivation and learning achievement.

6. Conclusion

The application of TPACK-based Google Sites teaching media with the ADDIE development model is a strategic step in increasing fourth grade students' learning motivation on historical material in Natural and Social Sciences (IPAS) learning. Through the process of analysis, design, development, implementation, and evaluation, teachers can design and implement Google Sites that carefully combine technology, pedagogical knowledge, and historical material content. A comprehensive evaluation of the effectiveness of Google Sites allows teachers to understand the extent to which this teaching medium has succeeded in increasing student learning motivation and achieving the stated learning objectives. Evaluation results also provide valuable insights for future improvements and adjustments. Thus, in conclusion, the application of TPACK-based Google Sites teaching media with the ADDIE model is an effective strategy in increasing fourth grade students' learning motivation on historical material in science and science learning, as well as providing a strong foundation for the development of innovative and adaptive learning in the future.

Limitations

The limitations in this research mainly lie in the research stages. One of the main challenges is the readiness of the students interviewed, including the number of students and the existing infrastructure at the school to support the implementation of TPACK- based Google Sites teaching media in classroom learning.

Recommendation

The results of the research show that although elementary school teachers' understanding of professional competence is quite good, their ability to plan project Learning Plans (RPP) and understanding of creating TPACK-based teaching media is still lacking. This condition can be seen from the lack of technology integration in learning plans and how well TPACK is used in that context. So that history learning is not boring, it is necessary to prepare the teacher's understanding so that they are able to prepare TPACK-based media that is relevant to the science and science learning objectives , especially history, and can integrate technology. There is a need to increase capacity and assistance in designing lesson plans which are linked to the creation of TPACK-based teaching media .

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Conflict of Interest

The authors declare no conflict of interest.

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