

Design and Implementation of TPACK-Based Differentiated Interactive Multimedia for Enhancing Pancasila Education in Elementary Schools

Bunga Aulia¹, Surya Dharma², Sriadhi³

¹ Universitas Negeri Medan, Medan, Indonesia; bungaaulia30@gmail.com

² Universitas Negeri Medan, Medan, Indonesia; suryappkn@unimed.ac.id

³ Universitas Negeri Medan, Medan, Indonesia; sriadhi@unimed.ac.id

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ABSTRACT

This study aimed to develop and evaluate TPACK-based interactive differentiated multimedia for Pancasila Education in Grade V elementary schools. The goal was to enhance students' understanding of the application of Pancasila values within family and school environments. Employing a Research and Development (R&D) approach, the study followed the ADDIE model—Analysis, Design, Development, Implementation, and Evaluation. Participants included content, language, and media experts; teachers of classes V-A and V-C; and 33 fifth-grade students at Alwashliyah Private Elementary School Rentang 80. The result of the development process was an interactive learning application based on TPACK principles and differentiated instruction. This multimedia resource could be accessed via laptops or smartphones, both online and offline. Expert validation confirmed its feasibility, with material experts rating it at 90.6%, language experts at 85%, and media experts at 95%, all categorized as "Very Appropriate." Practicality assessments by classroom teachers yielded an average score of 94.95%, while student responses averaged 96.88%, both rated as "Very Practical." These findings indicate that the multimedia is both effective and practical for classroom use. It not only facilitates the teaching of Pancasila values but also serves as a valuable reference for the integration of TPACK and differentiated instruction in the development of future educational media.

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Corresponding Author :

Bunga Aulia

Universitas Negeri Medan, Indonesia; bungaaulia30@gmail.com

1. INTRODUCTION

The learning process that is carried out to achieve 21st-century competence and character no longer provides limitations on learning resources to students, but is adjusted to the needs of each student in order to be able to find the meaning of what is taught for themselves (Irdalisa, Fuadi, Elvianasti, & Yanto, 2022). Learning based on the needs of students is based on the view that each individual has unique and valuable potential, as well as the right to learn according to their respective aspects of diversity. This view boils down to the humanistic learning theory as a psychological study that prioritizes the value of humanizing humans and, as much as possible, exploring students' abilities and potentials (Atmojo et al., 2023). Based on this, education in Indonesia requires an education system that is able to meet the needs

of every student who comes from the aspect of diversity through the learning process in order to achieve potential in himself in order to be able to acquire the mastery of knowledge, skills, and attitudes consciously (Sugiarso, Sartika, HL, & Syarifuddin, 2023).

The Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia has introduced the Independent Curriculum, which promotes a paradigm of independent learning. This approach emphasizes the fulfillment of students' learning needs by recognizing and accommodating their diverse backgrounds and characteristics. One of the key pedagogical strategies embedded in this curriculum is differentiated learning, designed to cater to individual differences among students (Irdalisa, Fuadi, Elvianasti, & Yanto, 2022).

Differentiated learning, originally conceptualized by Carol Ann Tomlinson in the late 20th century, focuses on tailoring instruction based on students' readiness, interests, and learning profiles (Aryana, Subyantoro, & Pristiwati, 2022). According to Sit (as cited in Irdalisa et al., 2022), a learning profile includes a student's preferred method of receiving and processing information, commonly referred to as a learning style.

Ginting et al. (2021) highlight that the effectiveness of differentiated instruction heavily depends on the strategic use of learning media. In the context of 21st-century education, instructional media are no longer confined to traditional printed materials. Instead, they now include technology-based resources that integrate text, graphics, audio, and video into interactive formats—collectively known as *interactive multimedia* (Aminah, Waluya, & Rochmad, 2020).

Interactive multimedia provides learners with control over their educational experience, allowing them to make choices about the content they engage with and the pace of their learning (Xu, Chan, & Yilin, 2020). When integrated with differentiated learning strategies, interactive multimedia serves as a digital learning tool that empowers students to select content aligned with their individual learning needs and preferences (Manurung & Pangabean, 2017).

Differentiated interactive multimedia will be successfully applied in the learning process with the right learning approach, namely, learning that can integrate aspects of technology and pedagogical strategies in its implementation. The TPACK (Technological Pedagogical and Content Knowledge) approach is currently the center of attention in the digital era, making it very relevant to the application. (Santia et al., 2022). This can be realized because the TPACK approach has 3 (three) core areas of knowledge, namely Technological Knowledge or knowledge about mastery and technology skills in learning, Pedagogical Knowledge or knowledge about processes, methods, and practices in learning, and Content Knowledge or knowledge about the material studied in the learning process (Wuarlela, Jakob, & Kakaly, 2022). Based on this definition, the TPACK approach will be appropriate to use if you want to implement differentiated interactive multimedia in elementary schools (Dewi, 2021).

Differentiated interactive multimedia will be successfully applied in the learning process with the right learning approach, namely, learning that can integrate technological aspects and pedagogical strategies in its implementation. The TPACK (Technological Pedagogical and Content Knowledge) approach is currently the center of attention in the digital era, making it very relevant to apply (Sangidah, Khasanah, Mustofa, & Nisa, 2024). This can be realized because the TPACK approach has 3 (three) core scopes of knowledge, namely Technological Knowledge or knowledge about mastery and technology skills in learning, Pedagogical Knowledge or knowledge about processes, methods, and practices in learning, and Content Knowledge or knowledge about the material learned in the learning process (Rahmawati & Khoirurrosyid, 2022). Based on this definition, the TPACK approach will be appropriate if you want to implement differentiated interactive multimedia in elementary schools.

Based on classroom observations conducted in Grade V at Alwashliyah Private Elementary School 80 Range between July 23 and August 1, 2024, and supported by interviews with Grade V teachers, it was found that the most significant aspect of student diversity lies in their learning styles. According to *Quantum Learning* by DePorter and Hernacki (2015), students generally possess three primary learning modalities—visual, auditory, and kinesthetic (V-A-K)—which influence how they process and engage with educational content (Ichsan, Suhaimi, Amalia, Santosa, & Yulianti, 2022).

As facilitators, teachers are expected to create a learning environment that accommodates this diversity by integrating a variety of learning resources, including media. However, the current use of instructional media in Grade V remains limited to conventional tools such as whiteboards, printed texts, and images found in student and teacher textbooks. Teachers reported that upcoming lesson plans involve only minor improvements—namely, the use of printed pictures to aid the learning process (Ananda, Rani, & Fadhilaturrehmi, 2022).

In practice, many students struggle to comprehend material solely through text and traditional writing-based resources. They demonstrate a strong preference for technology-enhanced media that incorporate sound, visuals, video, and interactive elements like games. This observation is supported by unstructured preliminary interviews with both teachers and students, which revealed that learning media that do not address students' learning preferences lead to disengagement. Students often participate in lessons passively or reluctantly, potentially compromising their learning outcomes (Novawan & Aisyiyah, 2020).

The instructional content targeted for development through TPACK-based differentiated interactive multimedia centers on the application of Pancasila values in the family and school environments—part of the mandated Pancasila Education curriculum under the Independent Curriculum framework. This subject integrates civic and moral education, and its practical nature poses challenges for traditional teaching methods. Teachers have emphasized the need for interactive tools that align with students' learning styles to effectively deliver such content.

TPACK-based differentiated interactive multimedia is designed to enhance student engagement by offering multimodal content tailored to auditory, visual, and kinesthetic learners. It can be accessed both online and offline through a user-friendly application, allowing students to engage with the material autonomously and according to their individual learning needs (Akhwani & Rahayu, 2021).

Previous studies support the effectiveness of this approach. Research by Waluyo and Nuraini (2021), using the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model, showed that TPACK-based interactive multimedia received a "Very Feasible" rating from both material experts (average score: 4.7) and media experts (average score: 4.3). Similarly, a study by Yuliani, Heru, and Sari (2021) found that interactive multimedia significantly improved students' interest and learning outcomes in Civic Education at SMP Pasundan 1 Bandung.

Given these findings, the objectives of this study are twofold: (1) to design and develop TPACK-based differentiated interactive multimedia for Pancasila Education in Grade V at Alwashliyah Private Elementary School 80 Range, specifically focused on the material concerning the application of Pancasila values in family and school contexts, and (2) to assess the feasibility and practicality of this multimedia tool in meeting students' diverse learning style needs.

2. METHODS

The type of this research uses research and development (R&D) methods. The research and development model to be used is the ADDIE model, which consists of 5 stages, namely (1) analysis, (2) design, (3) development, (4) implementation, and (5) evaluation (Jauhar & Nur, 2022). The procedures and design of this research can be seen through the framework below:

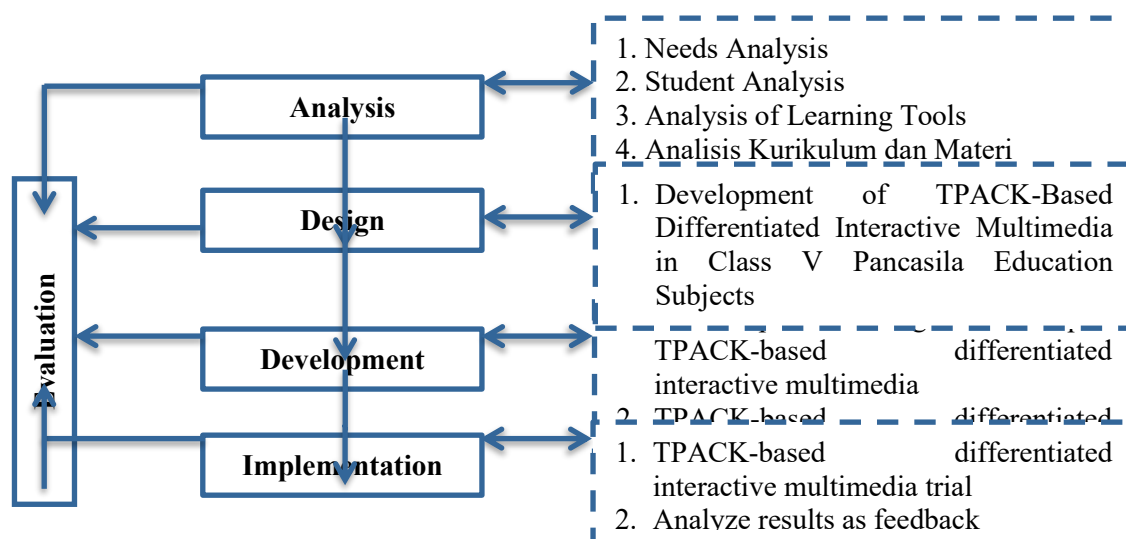


Figure 1. ADDIE Development Model Research Steps

This research was conducted at Alwashliyah 80 Kisaran Private Elementary School which is located on Jl. Mas Mansyur, Kisaran Baru, Kec. The time of this research starts from November 2024 to January 2025. The subject of this study is 33 students in grade V of Alwashliyah 80 Kisaran Private Elementary School. The validators of material experts, linguists, and media experts are lecturers who are experts in their fields, and practicality experts are teachers of classes V-A and V-C of Alwashliyah 80 Range Private Elementary School. Meanwhile, the object of this research is a TPACK-based differentiated interactive multimedia product in the form of a learning application as a learning medium in the subject of Pancasila Education, Pancasila values in the family and school environment used in learning.

Research and Development uses data collection techniques with a mixed methods approach. This means that researchers can use quantitative and qualitative approaches for comprehensive and more complete research results (Hayani & Sutarna, 2022). The data collection techniques in this study include observation, interviews, and angke. Meanwhile, the data collection instruments consist of validity instruments, learning instruments and practicality instruments. The validity instrument consists of a material expert assessment sheet, a linguist assessment sheet, and a media expert assessment sheet. Learning instruments include non-cognitive diagnostic tests in the form of learning style questionnaires. Meanwhile, the practicality instrument of TPACK-based differentiated interactive multimedia products is in the form of a practicality test sheet conducted by teachers and students. The assessment scale used on the validity and practicality instrument sheet is a Likert scale with 4 (four) alternative answers (Sugiyono, 2019).

Table 1. Scoring Criteria for Instrument Sheets Validity and Practicality

Score	Category
4	Strongly Agree
3	Agree
2	Disagree
1	Strongly Disagree

The data analysis techniques used in this study are qualitative and quantitative data analysis techniques.

1. Validity Data Analysis

The the results of the TPACK-based differentiated interactive multimedia validity test conducted by material experts and interactive media experts were changed in the form of percentages and then

analyzed. The percentage is calculated by the following formula (Fakhriyah, Masfuah, Hilyana, & Mamat, 2022):

$$\text{Percentage} = \frac{\text{Assessment Results Score}}{\text{Maximum Score}} \times 100\%$$

The percentage results obtained are then narrated into qualitative sentences, which can be seen through the following table (Widaningsih, Margo Irianto, & Yuniarti, 2023):

Table 2. Grade Interval and Eligibility Level

No.	Percentage Value Interval	Eligibility Level
1.	0-25%	Not Eligible
2.	26-50%	Less Worthy
3.	51-75%	Proper
4.	76-100%	Highly Worthy

2. Learning Style Analysis

a) Analyze Learning Styles Individually

Individual learning style analysis can be seen from the frequency of students' answers a, b, and c from non-cognitive diagnostic tests in the form of student learning style questionnaires.

Table 3. Criteria for Determining Individual Learning Styles of Students

No.	Frequency	Learning Style
1.	b<a>c	Visual
2.	ac	Auditory
3.	a<c>b	Kinesthetics

If there is the same frequency in answers a, b, and c, then the determination of individual students' learning styles will be supported by the results of the teacher's consideration as an observer or observer who has been observing the learning process and student interaction (Wen & Shinas, 2021).

b) Classically Analyzing Learning Styles

After the results of the analysis of individual learning styles are obtained, then take steps (1) make a frequency table, (2) calculate the total number of learning options, (3) calculate the percentage classically. The percentage is calculated by the following formula:

$$\text{Percentage} = \frac{\text{Number of Students in Each Learning Style}}{\text{Total Number of Students}} \times 100\%$$

3. Practicality Data Analysis

Practicality data was obtained by calculating teacher and student scores from the answers to each statement on the teacher's practicality test sheet and students' practicality test sheet. The data of the TPACK-based differentiated interactive multimedia practicality test were analyzed with the percentage of the formula (Farana, 2024) as follows:

$$\text{Practicality Level} = \frac{\text{The Total Score Obtained}}{\text{Maximum Score}} \times 100\%$$

Ideally, the percentage of data is classified into categories such as tables with Percentages symbolized (P).

Table 4. Value Interval and Practicality Level

No.	Percentage of Ideality (%)	Category
1.	$0 \leq P < 20$	Very impractical
2.	$20 \leq P < 40$	Less Practical
3.	$40 \leq P < 60$	Quite Practical
4.	$60 \leq P < 80$	Practical
5.	$80 \leq P < 100$	Very Practical

3. FINDINGS AND DISCUSSION

The results of the research at each stage in the development of TPACK-based differentiated interactive multimedia are as follows:

3.1 Analysis Stage

3.1.1 Needs analysis

The results of the needs analysis were known by making initial observations to the teachers of grade V of Alwashliyah 80 Range Private Elementary School. Based on the results of observations, the learning media used has not been able to meet the needs of students' learning styles as the most prominent aspect of diversity in class V. Thus, the learning media is still limited and less varied to attract students' interest and motivation to learn which can improve student learning outcomes, especially in the subject of Pancasila Education, the material on the Application of Pancasila Values in the Family and School Environment (Handayani, Yuberti, Saregar, & Wildaniati, 2021).

3.1.2 Student Analysis

The results of direct observation with teachers of class V-C of Alwashliyah 80 Range Private Elementary School on the learning process of Pancasila Education show that there are several characteristics of students in the implementation of learning, including:

- 1) Students always try to understand the material delivered by the teacher. However, especially the material related to "application" is very difficult to understand only by delivering the material through the teacher's explanation and the material in the printed book only.
- 2) Students listen to explanations from the teacher and do their assignments as best they can, even though they do not fully understand the material.
- 3) Students are distracted when they see a laptop placed on the teacher's desk. All students asked if learning was done using a laptop, if there were games on it, if there were videos, and so on. So, it can be concluded that grade V students are interested in learning using digital learning media such as laptops that contain various kinds of content them, such as videos, games, and songs that they can choose themselves.
- 4) Grade V students are more enthusiastic about learning in groups than individually because it is easier to understand and complete assignments.
- 5) Students have a variety of preferred learning styles that can be seen during the learning process. Therefore, non-cognitive diagnostic tests are needed to analyze students' learning styles and group them based on their learning styles.
- 6) Based on the results of non-cognitive diagnostic tests in the form of learning style questionnaires, it is known that out of 33 students in grade V, there are 17 students with visual learning styles, 12 students with auditory learning styles, and 4 students with kinesthetic learning styles.

3.1.3 Learning Tool Analysis

The analysis of learning tools in this study focuses on the learning media teachers use during the learning process. Based on the needs analysis, the learning media that is often used in class V is the whiteboard as the main media, and textbooks (print media), which are used at the same time as teaching

materials that do not meet the needs of students' learning styles to help students understand the material as a whole. Thus, the use of TPACK-based differentiated interactive multimedia can be one of the alternatives to support the learning process of Pancasila Education subjects, especially in the material on the Application of Pancasila Values in the Family and School Environment.

3.1.4 Curriculum Analysis and Learning Materials

The curriculum applied in grade V of Alwashliyah 80 Kisaran Private Elementary School is the Independent Learning Curriculum since the 2023/2024 school year. One of the compulsory subjects in the Independent Curriculum to be taught from the elementary education level to higher education is Pancasila Education, which includes the content of Pancasila education and civic education. Differentiated learning is one of the learning concepts in the Independent Curriculum to realize students who are able to develop their potential by placing the diversity of students as the key in the learning process. The selected learning materials will be developed into materials on TPACK-based differentiated interactive multimedia, namely the application of Pancasila Values in the Family and School Environment in class V/phase C (Suryandari, Destiara, & Rahmawati, 2022).

3.2 Design Stage

The planning stage is carried out through five phases, as follows:

3.2.1 Preparation of Teaching Modules

The preparation of teaching modules is carried out to make it easier for teachers to carry out the stages of learning activities. The teaching module consists of documents containing initial competencies, infrastructure, approaches, models, strategies, teaching methods, Learning Outcomes (CP), Learning Objectives (TP), Learning Objectives Flow (ATP), learning syntax, teaching materials, use of learning media, LKPD, assessments/assessments, and other information that will be used during the learning process.

3.2.2 Preparation of Diagnostic Tests

A non-cognitive diagnostic test in the form of a learning style questionnaire was administered to identify the dominant learning style of each student in Grade V-C at Alwashliyah Private Elementary School 80 Range. The purpose of this test is to categorize students based on their preferred learning modality—visual, auditory, or kinesthetic. The questionnaire consists of multiple-choice items with three response options, each tailored to reflect students' typical behaviors and daily activities. This diagnostic tool is adapted from the *Quantum Learning* framework developed by Bobbi DePorter and Mike Hernacki (2015), which emphasizes the importance of recognizing individual learning preferences to enhance the effectiveness of the learning process.

3.2.3 Product Planning

The stages of differentiated interactive multimedia product design based on TPACK, including 1) the use of Canva Pro Software, 2) the use of Adobe Animate 2021 Software, 3) the use of supporting applications and websites, 4) the determination of the final physical shape, 5) the improvement of the material content, 6) the selection of differentiation aspects, 7) the planning of functions, 8) the creation of the display design of each menu, 9) the selection of elements and fonts, and 10) the selection of the design of the button icons consistently (S. R. Manurung, 2020).

3.2.4 Preparation of Validation Instruments

The preparation of validity instruments consists of product validation instruments and learning instrument validation instruments. The product validation instrument is in the form of an expert assessment sheet on TPACK-based differentiated interactive multimedia, consisting of material experts, linguists, and media experts to assess the feasibility of its use. The preparation of product validation instruments is sourced from the National Education Standards Agency (BSNP), which has

been modified according to the research objectives to be achieved. The validation instrument of the learning instrument is in the form of an expert assessment sheet on non-cognitive diagnostic tests in the form of a learning style questionnaire to see how feasible its use is. The preparation of learning assessment validation instruments is adopted from previous studies that have been modified.

3.2.5 Preparation of Practicality Instruments

The preparation of practicality instruments consists of teacher practicality test instruments and student response questionnaires. The preparation of learning assessment validation instruments is adopted from previous studies that have been modified.

3.3 Development Stage

Some of the steps that will be taken at the development stage include:

3.3.1 Preparation of TPACK-based differentiated interactive multimedia

The preparation was carried out in accordance with the design of TPACK-based differentiated interactive multimedia in the previous stage. All processes for creating TPACK-based differentiated interactive multimedia in the form of learning applications are carried out using Adobe Animate 2021 Software with preparation stages, including 1) creating scenes, 2) importing backgrounds, elements, videos, and songs, 3) adding layers in the scene, 4) placing buttons, 5) programming stages (coding) and functions, 6) evaluating the entire learning application project, 7) extracting application files (Lestari & Apsari, 2022).

3.3.2 Validation Results of Diagnostic Test Instruments

The expert in this diagnostic test and validation is Prof. Dr. Anita Yus, M.Pd., a professor at the Faculty of Education, State University of Medan. Expert validation of non-cognitive diagnostic tests will be carried out face-to-face on Friday, December 13, 2024. The results of the validation of non-cognitive diagnostic test experts can be seen in the table below:

Table 5. Results of Expert Validation of Non-Cognitive Diagnostic Tests

No.	Assessment Aspects	Total Score
1.	Clues and Clarity	9
2.	Quality	27
3.	Structure and Systematics	15
4.	Quality of Answer Choice	20
Total		71
Percentage = $\frac{\text{Total Score}}{\text{Total Overall Score}} \times 100\%$		$\frac{71}{75} = 94.6\%$
Category		Highly Worthy

The results of validation carried out by diagnostic test experts in the form of a learning style questionnaire obtained a total score of 71 with a feasibility percentage of 94.6%. The non-cognitive diagnostic test in the form of a learning style questionnaire developed is included in the category of "Very Feasible" with the eligibility criterion "Feasible to use with revisions according to suggestions/comments".

3.3.3 Material Expert Validation Results

The material expert in this validation is Dr. Deny Setiawan, M.Si., who is the Deputy Director for Academic and Student Affairs in the Postgraduate Program and a Lecturer at the Faculty of Social Sciences, State University of Medan. The validation of material experts will be carried out face-to-face on Tuesday, December 10, 2024. The results of the validation of the subject matter experts can be seen in the table below:

Table 6. Material Expert Validation Results

No.	Assessment Aspects	Total Score
1.	Material	80
2.	Language	32
3.	Serving	33
Total		145
Percentage = $\frac{\text{Total Score}}{\text{Total Overall Score}} \times 100\%$		$\frac{145}{160} \times 100\% = 90,6\%$
Category		Highly Worthy

The results of the validation of the subject matter experts obtained a total score of 145 with a feasibility percentage of 90.6%. The material on TPACK-based differentiated interactive multimedia developed is included in the category of "Very Feasible" with the eligibility criteria of "Feasible for use for unrevised trials".

3.3.4 Linguist Validation Results

The linguist involved in the validation process is Dr. M. Oky Fardian Gafari, S.Sos., M.Hum., a lecturer in the Indonesian Literature Study Program at the Faculty of Languages and Arts, State University of Medan. The validation was conducted in two stages. The first stage took place during a face-to-face meeting on Wednesday, December 11, 2024. The results of this initial phase of expert validation are presented in the table below.

Table 7. Results of the First Stage of Linguist Validation

No.	Assessment Aspects	Total Score
1.	Businesslike	18
2.	Communicative	6
3.	Interactive	8
4.	Conformity	9
5.	Accuracy	10
Total		51
Percentage = $\frac{\text{Total Score}}{\text{Total Overall Score}} \times 100\%$		$\frac{51}{80} = 63,7\%$
Category		Proper

The results of the first stage of validation conducted by the linguist yielded a total score of 51, with a feasibility percentage of 63.7%. Based on these results, the use of language in the developed TPACK-based differentiated interactive multimedia falls into the "Feasible" category, with the feasibility criterion of "Feasible to use for trial after revision." The second stage of validation was conducted through a face-to-face meeting on Tuesday, December 17, 2024. The results of this second phase of expert validation are presented in the table below.

Table 8. Results of the Second Stage of Linguist Validation

No.	Assessment Aspects	Total Score
1.	Businesslike	21
2.	Communicative	8
3.	Interactive	12
4.	Conformity	13
5.	Accuracy	14
Total		68
Percentage = $\frac{\text{Total Score}}{\text{Total Overall Score}} \times 100\%$		$\frac{68}{80} = 85\%$
Category		Very Worthy

The results of the second stage of validation carried out by linguists obtained a total score of 68 with a feasibility percentage of 85%. The use of language in TPACK-based differentiated interactive multimedia developed is included in the "Very Feasible" category with the feasibility criterion "Feasible to use for trial without revision".

3.3.5 Media Expert Validation Results

The media expert in this validation is Dr. Amirhud Dalimunthe, S.T., M.Kom., who is the Vice Dean for General Affairs and Finance as well as a Lecturer of the Technology and Informatics Education Study Program at the Faculty of Engineering, State University of Medan. The validation of media experts will be carried out face-to-face on Tuesday, December 17, 2024. The results of the validation of media experts can be seen in the table below:

Table 9. Media Expert Validation Results

No.	Assessment Aspects	Total Score
1.	Quality	75
2.	Construction	21
3.	Functional	21
4.	Language	16
5.	Differentiation	19
Total		152
Percentage = $\frac{\text{Total Score}}{\text{Total Overall Score}} \times 100\%$		$\frac{152}{160} \times 100\% = 95\%$
Category		Highly Worthy

The validation results from media experts showed a total score of 152, corresponding to a feasibility percentage of 95%. The TPACK-based differentiated interactive multimedia, developed in the form of a learning application, was classified as "Very Feasible" with the criterion "Feasible to use for trial without revision." The outcomes of this development can be observed through several visual displays of the learning application, as presented below.



Figure 2. Product Visual Display

3.4 Implementation Stage

This study aimed to assess the practicality of the developed TPACK-based differentiated interactive multimedia by involving Grade V teachers and students at Alwashliyah 80 Kisaran Private Elementary School during the implementation phase. The evaluation was conducted using practicality test sheets completed by both teachers and students.

Prior to the trial, a non-cognitive diagnostic test in the form of a learning style questionnaire was administered to identify students' preferred learning styles. Individual analysis revealed that out of 33 students, 17 students (51.5%) had a visual learning style, 12 students (36.4%) were auditory learners, and 4 students (12.1%) had a kinesthetic learning style. Several students showed mixed learning styles, such as visual-auditory and kinesthetic-visual-auditory. To support these findings, unstructured interviews with teachers were conducted, confirming that students with mixed questionnaire responses still demonstrated dominant learning tendencies. For example, students with the initials ACE, MKP, and VA displayed kinesthetic characteristics during classroom activities.

Based on these results, students were divided into three groups according to their learning styles to participate in the field trial. The practicality test was conducted on January 9, 2025, with responses from two Grade V teachers: Mrs. Ratu Ayu Nadilla, S.Pd. and Mrs. Yonita Ade Gusna, S.Pd. The test aimed to evaluate the practicality of the TPACK-based differentiated interactive multimedia in real classroom settings. The results indicated that the multimedia tool was considered highly practical, as it effectively accommodated students' diverse learning styles.

Overall, this study demonstrates that a learning approach integrating TPACK and differentiated instruction based on learning styles is not only practical but also enhances student engagement and supports individualized learning in the classroom.

Table 10. Teacher Practicality Test Results

No.	Assessment Aspects	Teacher Practicality Test Score	
		V-A	V-C
1.	Media Display	16	16
2.	Material Content	10	11
3.	Practicality	20	17
4.	Benefits	12	12
Total		58	56
Average		96.6%	93.3%
		94.95%	
Category		Very Practical	

The practicality test conducted by the Grade V-A teacher resulted in a score of 58 with a practicality percentage of 96.6%, categorized as "Very Practical." Similarly, the Grade V-C teacher gave a score of 56 with a practicality percentage of 93.3%, also falling under the "Very Practical" category.

In addition, practicality testing was conducted with 32 Grade V students at Alwashliyah 80 Kisaran Private Elementary School using a questionnaire. The results showed a total score of 310, with an average practicality percentage of 96.88%. Based on this data, the TPACK-based differentiated interactive multimedia, particularly for the material on the application of Pancasila values in family and school settings, is categorized as "Very Practical" from the students' perspective as well (Syah, Desnita, Darvina, & Afrizon, 2023).

3.5 Evaluation Stage

The evaluation stage was conducted to analyze the overall effectiveness of the TPACK-based differentiated interactive multimedia based on the collected data. This stage includes the assessment of the product's feasibility as determined by expert validation. A recapitulation of the validation results

from product experts regarding the feasibility of the TPACK-based differentiated interactive multimedia is presented in the following table.

Table 11. Recapitulation of the Results of Expert Validation of TPACK-Based Differentiated Interactive Multimedia Products

No.	Expert Validators	Results of TPACK-Based Differentiated Interactive Multimedia Validation	
		Eligibility percentage	Category
1	Material Expert	90,6%	Highly Worthy
2	Language Expert	85%	Highly Worthy
3	Media Expert	95%	Highly Worthy
Total Score		270.6%	
Avarage		90.2%	Highly Worthy

Based on the recapitulation of expert validation results, the TPACK-based differentiated interactive multimedia achieved an overall average percentage of 90.2%, which falls under the "Very Feasible" category. This indicates that the multimedia product meets the necessary criteria for use in educational settings without requiring major revisions. The percentage results of the product expert validation are visually represented in Figure 3.

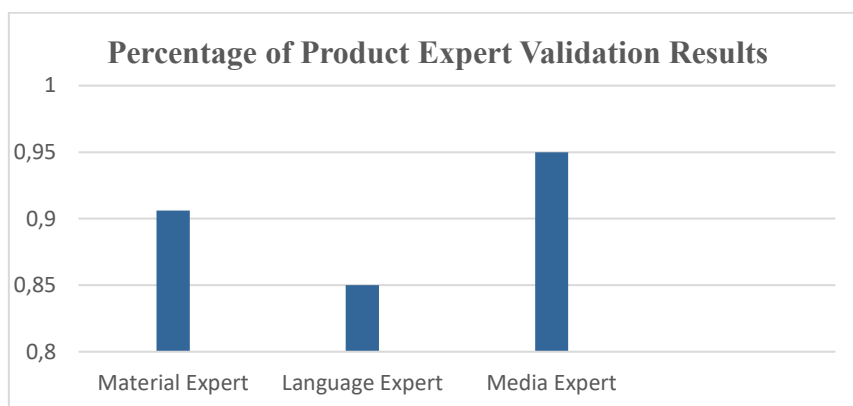


Figure 3. Percentage of Product Expert Validation Results

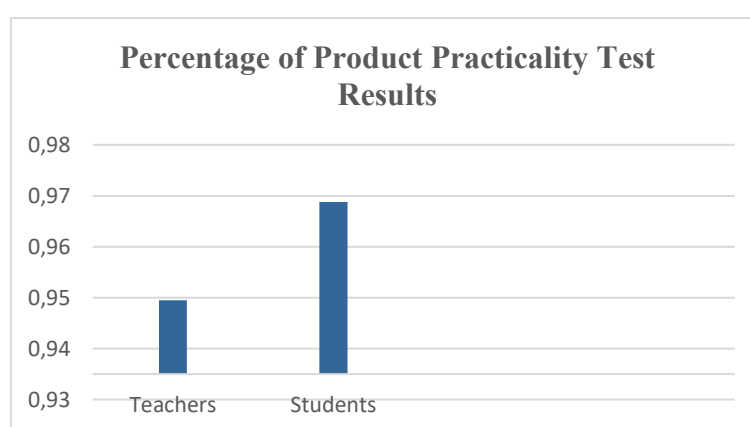
In addition to feasibility, the practicality of the multimedia was also tested with both teachers and students. The recapitulation of the practicality test results is summarized in Table 12, which includes responses from two groups of practitioners. Teachers rated the practicality of the multimedia at 94.95%, while students provided an even higher score of 96.88%, both of which are categorized as "Very Practical". The total combined score was 191.83%, resulting in an overall average practicality score of 95.92%. These results reflect a high level of usability and satisfaction among both educators and learners.

The percentage outcomes of the practicality test are illustrated in Figure 4, further supporting the conclusion that the TPACK-based differentiated interactive multimedia is highly practical and ready for broader classroom implementation.

Table 12. Recapitulation of the Results of the TPACK-Based Differentiated Interactive Multimedia Practicality Test

No.	Practitioners	Practicality Results	
		Percentage of practicality	Category
1.	Teachers	94.95%	Very Practical
2.	Students	96.88%	Very Practical
Total Score		191.83%	Very Practical
Avarage		95.92%	

Based on the recapitulation table, the results of the TPACK-based differentiated interactive multimedia practicality test show an overall average percentage of 95.92% with the category "Very Practical". The results of the TPACK-based differentiated interactive multimedia practicality test in % can be seen in the graph below.

**Figure 4.** Percentage of Product Practicality Test Results

The results of this research indicate that the development of TPACK-based differentiated interactive multimedia was aligned with the learning needs identified through a comprehensive analysis of students, learning tools, and the curriculum. Initial observations and non-cognitive diagnostic tests revealed significant diversity in students' learning styles, with 51.5% of Grade V students exhibiting a visual learning style, 36.4% auditory, and 12.1% kinesthetic. These findings confirm the need for media that support varied modalities in delivering content. The analysis also found that existing learning media—mainly textbooks and whiteboards—were insufficient to accommodate students' preferences and engagement levels, particularly in teaching abstract and application-based materials like the Pancasila values in civic education (Handayani, Yuberti, Saregar, & Wildaniati, 2021). The integration of differentiated learning with the TPACK framework was therefore considered essential in designing multimedia that not only aligns with curriculum goals but also responds to student diversity and 21st-century digital competencies (Suryandari, Destiara, & Rahmawati, 2022).

The feasibility and practicality of the developed multimedia were confirmed through expert validation and field testing. Validation by content, media, and linguistic experts yielded an overall feasibility score of 90.2%, categorized as "Very Feasible." Each component—material (90.6%), language (85%), and media (95%)—met or exceeded the standards for implementation without major revisions. Practicality testing further confirmed its effectiveness, with teachers rating the media at 94.95% and students at 96.88%, resulting in an overall average practicality of 95.92%—classified as "Very Practical" (Syah, Desnita, Darvina, & Afrizon, 2023). These results demonstrate that TPACK-based differentiated interactive multimedia is not only pedagogically sound but also highly engaging and user-friendly for both teachers and students. The use of tools such as Adobe Animate, along with content differentiation

based on learning styles, allowed for interactive, meaningful, and student-centered learning experiences, contributing to improved student engagement and potential learning outcomes (Manurung, 2020; Lestari & Apsari, 2022).

4. CONCLUSION

The research and development of TPACK-based differentiated interactive multimedia for the Pancasila Education subject—specifically the material on the application of Pancasila values in the family and school environment—has resulted in the creation of a practical and feasible learning application that effectively supports the diverse learning styles of Grade V students at Alwashliyah 80 Range Private Elementary School. The media, accessible via laptop or smartphone with or without an internet connection, was rated "Very Feasible" by material, media, and language experts, with average validation scores of 90.6%, 95%, and 85%, respectively. Moreover, the practicality test showed strong positive responses from both teachers (94.95%) and students (96.88%), categorizing it as "Very Practical." However, this research is limited to one subject, one school, and a single grade level, which may not reflect the broader applicability of the media across different subjects or educational contexts. Future research should involve broader testing across multiple schools, subjects, and grade levels to validate the generalizability and scalability of the developed multimedia. Additionally, integrating more advanced interactive features, adaptive learning paths, and feedback mechanisms could further enhance the media's effectiveness and user engagement. Researchers are also encouraged to explore the long-term impact of using TPACK-based differentiated multimedia on student learning outcomes and digital literacy development.

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