

# Digital Module of Scientific Writing Materials Based on TPACK for 11<sup>th</sup> Grade SMA/MA Students

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## Abstract

The purpose of this research is to design, validate, and implement digital modules for scientific writing based on TPACK (Technological Pedagogical and Content Knowledge) for 11th-grade SMA/MA students. The study uses the Research and Development (R&D) method and follows the ADDIE model, which includes analysis, design, development, implementation, and evaluation phases. The development process begins with an analysis of teacher needs, curriculum, and environmental factors. The TPACK-based scientific writing digital module is then validated by experts in material content, digital media, and practical application. The validation results indicate high feasibility, with assessments of 80%, 97%, and 78% from material, media, and practitioner experts, respectively. The structure of the module consists of three main sections: the beginning, content, and end. The beginning includes the cover, foreword, table of contents, glossary, and a draft map. The content section introduces the module's identity, basic competencies, description, and usage instructions. Each learning activity contains objectives, material descriptions, summaries, practice questions, and self-assessment opportunities. Implementation results show a significant improvement in student learning outcomes. Before using the TPACK-based digital module, the average score was 69.86, which increased to 82.86-83.88 after its implementation. Statistical analysis using paired t-tests confirms the effectiveness of the module. The first t-test shows a value of  $13.073 > 1.687$  with a significance (2-tailed) of  $0.000 < 0.005$ . The second t-test shows a value of  $6.637 > 1.7109$  with the same significance level. These results indicate a significant positive impact of the TPACK-based digital module on student learning outcomes. In conclusion, the study demonstrates that the TPACK-based scientific writing digital module is effective and significantly enhances students' learning achievements in scientific writing.

**Keywords:** Digital Module, Scientific Writing, TPACK

## I. INTRODUCTION

The progress of science and technology also impacts the field of education. This technological advancement can be utilized by teachers to facilitate the teaching process, Ramadhan MA (2023). Transforming the education system from conventional to a more advanced system by harnessing the progress of science and technology. Education activists are required to utilize technology to create more advanced education, Musdahlipah (2023). In another study by Anggraeni et al. (2022), the influence of technological and communication developments is significant for teachers and learners. This means that the more technology and communication develop, the higher the quality of learning.

Being a 21st-century teacher is certainly not an easy matter. Preparing a golden generation with 21st-century skills such as critical thinking, creativity, innovation, communication, collaboration, and competitiveness requires a qualified teacher. To provide quality education services, teachers need to be able to harness the power of computers and technology in their field to create effective teaching, Rahayu et al. (2023).

21st-century learning demands that students possess 4C skills. Students must have skills in creative thinking, critical thinking and problem solving, communication skills, and collaboration skills. Overall, the learning process should aim towards 4C skills, from lesson planning, implementation, to evaluation.

Educators are required to use teaching models that enable students to think critically, creatively, solve problems, and collaborate with other students. In addition, educators are also required to use teaching materials and media that lead to 4C skills, and finally, educators are also required to use evaluations that lead to these 4C skills. One way that can be done by teachers is to prepare appropriate and good learning tools in Indonesian language subjects.

Learning modules play an important role in developing 21st-century skills of students. Through modules, teachers can design their learning process, and students can also learn independently through activities and exercises to deepen their material. Modules are now not only available in print form but also in digital/electronic form. With the easy access to technology for students, integrating technology into learning modules has the opportunity to enrich students' learning experiences. Electronic modules can significantly increase students' interest and motivation in learning, Mulyasa (2018).

The advantages of electronic modules are that they can create and improve students' abilities to learn independently, because electronic modules are integrated with technology that can present information in the form of text, images, sounds, moving images, and videos explaining material in modules and can be used anytime, anywhere. Electronic modules can present information sequentially and structured, providing interesting and interactive impressions so they can be used independently anywhere and anytime without depending on the teacher as a source of information.

Support applications used to produce digital modules include those that are more familiar with 3D, consisting of: Paker Flip Professional, Erxerlearning, Ncersoft Flip Book Maker, Kvisoft Flip Book Maker, and Flip PDF Professional. In this research, the author focuses on Flip PDF Professional media. The teaching material to be developed in this research is a digital module for scientific writing based on TPACK (Technological, Pedagogical, and Content Knowledge).

Scientific writing material is a curriculum material that is included in the 2013 curriculum. In the 2013 curriculum for even semester grade XI there is KD 3.15 Analyzing the systematic and linguistic aspects of scientific work and 4.15 Constructing a scientific work in terms of content, systematic and linguistic. Even though the curriculum has switched to a derivative curriculum, this material still exists in the learning outcomes of Indonesian Language and Literature subjects. This material is new and studied by students in grade XI, most of whom have been studied at a lower level of education. Not like other materials, for example, have been studied at a higher level of education, it's just that the depth of the material is different. It's reasonable if this material is felt to be difficult to study by students. This material is also a foundation for students in writing research at the next level. So it must be studied more seriously.

Writing scientific work is not an easy matter. Many students are hindered in studying this material, they do not understand how to write good and correct scientific works. Therefore, teachers need to design interesting teaching materials that can increase students' motivation in learning the materials writing proposals.

TPACK is an approach to learning that is suitable for 21st-century skills. TPACK is a way for teachers to convey material/content according to certain pedagogical technological knowledge that can interest students in following learning so that the learning objectives can be achieved maximally.

TPACK was first designed by Mishra and Koehler (2008), which was developed by Shulman (1986) from PCK Theory. This theory states that pedagogical understanding must be associated with understanding towards the content or material taught in PCK. Teachers try to explain teaching methods that are used in accordance with the characteristics of the material taught. Mishra and Koehler (2008) add understanding of technology to the PCK so that it becomes TPACK or understanding about technology that is used based on the characteristics of the nature of the material and aspects of pedagogy. TPACK involves several interactions in terms of form and structuring between material, pedagogy, and technology (Sertyawati: 2022).

Based on several previous studies such as Kurnianti et al., (2021) explaining that learning with TPACK approach influences student learning motivation. Because TPACK planning is intended for teachers to adapt with pedagogical understanding and their content. Thus in managing learning using technology makes it

easier for students to understand the material, make it easier for students to understand, and provide opportunities to use technology to increase learning motivation.

There are several advantages of applying TPACK in learning, including encouraging students to recognize the problem that becomes the topic of learning, training in literacy about problem-solving. The TPACK approach can be integrated into a model that can train students to find new information independently but remain in the teacher's guidance. TPACK is an approach that is suitable for use in learning. However, the application of TPACK in learning has provided teaching materials that are burdensome (Sertyawati: 2022).

The development of learning materials that contains the TPACK component in-depth provides an opportunity for students to develop skills from the perspective of technology understanding (Purnawati et al., 2020). The development of learning materials that contain TPACK aspects is very important to improve the learning process and also can make it easier for teachers and students to solve the learning process. Gurnawan et al., (2020).

Wijaya, et al. (2020) TPACK is a combination of three basic types of knowledge, namely, Pedagogical Knowledge (PK), Content Knowledge (CK), and Technological Knowledge (TK). TK is technological knowledge as a tool and learning resource. PK is knowledge about pedagogical which includes planning, implementation, and evaluation in learning. CK is knowledge about the content that must be mastered by teachers in teaching a material. Therefore, TPACK-based learning means that teachers not only teach a material (CK) using a particular approach or method of learning (PK) but also integrate technology (TK) that is adjusted with the teaching approach to teach a content. Hopefully, in Indonesian language learning, it is also based on TPACK.

Based on interviews with 6 Indonesian Language teachers at SMA/MA/SMK, there are several obstacles faced in teaching KTI material at the SMA/MA level. The obstacle is that students are less motivated to start writing scientific papers. The use of teaching materials for scientific writing is still limited. Teachers only rely on government-published textbook as a teaching material, not supported by other supplementary books for its development. There are also who use LKS with materials that are still limited. Based on preliminary study results on 8 students, 6 said that scientific work material was a difficult material. This material is only studied in class XI. To study it requires additional teaching materials to facilitate students and teachers in studying it.

The obstacles found by students when studying scientific work are very diverse. Starting from students being confused in determining the research topic, formulating the correct research title, compiling and developing it, finding theoretical basis, writing a correct Bibliography, determining research methodology, processing the correct data up to the conclusion. This is very important to be studied as the basis of students' knowledge in making scientific work on the next level.

The presence of regulations for students to bring cellphones to school needs to be utilized as well as possible. Students are directed to use cellphones as a learning tool. Finding materials, accessing exercises and finding more varied learning sources. Based on the above background, researchers are interested in conducting research entitled "Digital Modules of Scientific Writing Materials Based on TPACK in High School Students/MA".

## II. METHOD

The type of research used in this study is Research and Development (R&D). The research is aimed at creating an instructional product and assessing the quality of the developed product (Sugiono, 2013). The research development strategy is guided by procedures developed by Robert Maribe Branch using the ADDIE method, which includes 1) Analysis, 2) Design, 3) Development, 4) Implementation, and 5) Evaluation. According to Surryani et al., this procedural development is a systematic work procedure where each process is carried out based on previous processes, ultimately producing effective products. The ADDIE model is chosen to ensure systematic field trials, evaluation, and revision to produce procedures and products that meet effective media standards, high quality, and expected standards.

The subjects of this study are directed towards high school students to implement the use of digital modules for scientific writing based on TPACK, using qualitative and quantitative data analysis techniques. Data analysis techniques in this research include validity analysis and effectiveness analysis using Likert scales and tests for normality and hypothesis testing.

### III. RESULTS AND DISCUSSION

#### 3.1 Research Results

##### 3.1.1 Analysis Results

At this stage what is done is to carry out needs analysis, curriculum analysis and environmental analysis. The results obtained at this stage are as follows:

a. Results of Needs Analysis

The needs analysis stage aims to find out the obstacles that occur in studying scientific writing material. At this stage the researcher conducted interviews using Google form to find out the difficulties in teaching scientific writing material in class XI. The results of interviews with several Indonesian language teachers showed that students were less interested in studying scientific writing material due to the limited media used which was less innovative and enjoyable. Apart from that, KTI material is material that has only been studied at the SMA/MA level, unlike poetry and short story material that has been studied since elementary school. So the KTI material focused on writing research proposals felt difficult, as a result the grades obtained were below the KKM.

Based on what is found in the field, it is necessary to develop teaching materials in the form of digital modules for scientific writing materials based on TPACK which can facilitate students to be more active in mastering concepts. Based on this, researchers developed this digital module.

b. Curriculum Analysis Results

At the curriculum analysis stage, researchers analyze various applicable curriculum tools. KTI material is material contained in the Indonesian language curriculum for class XI. This material is considered difficult for students to learn and understand quickly. There is a need for interactive media that can motivate students to learn this material. So that students are interested in studying this material, considering that KTI material is the basic material that will be used in writing scientific papers at the next level. Learning objectives are adjusted to the KI/KD contained in the curriculum and then aligned with the current TPACK-based curriculum.

The formulation of indicators based on basic competencies can be seen in the table below.

**Table 1 Basic Competencies and Indicators**

Basic Competencies (KD)	Indicator
3.13 Analyze the content, systematics and language of a proposal	3.13.1 Students find the topic/theme of the proposal
	3.13.2 Students describe the systematics/parts of the proposal
	3.13.3 Students discover the linguistic characteristics/rules of the proposal
4.13 Design a scientific paper proposal by taking into account the objectives and essence of the required scientific work	4.13.1 Students prepare a proposal framework

	4.13.2 Students develop a proposal framework
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c. Environmental Analysis Results

Environmental analysis is a stage used by researchers to determine the condition of the learning environment and the learning models that have been used. This stage analyzes the methods commonly used by educators in studying KTI material. So far, it is still conventional using the lecture method with minimal media. Based on the analysis above, the TPACK-based scientific writing digital module can be applied to students with the hope of improving student learning outcomes.

### 3.1.2 Design Results ( *Design* )

The second stage of ADDIE development research is the design stage. At this stage the researcher begins to design the digital module that will be developed. There are 6 steps at this design stage, including preparing the learning module framework, creating a flowchart, designing the initial design of the digital module draft in word format, designing the digital module draft design into Canva and PDF, designing the digital module draft from PDF format to professional flip PDF format. , create a testing strategy.

The following are the results of the design of a digital module for scientific writing based on TPACK (Technological, pedagogical, and content language), namely a digital module which contains video and audio which can help students understand in depth. Apart from that, the final evaluation part of this module has been digitally integrated in the form of a Google form which makes it easier for students to work on questions there and see their scores directly. An explanation of the design of this module is as follows.

1. Digital Module Design Stage for Scientific Writing Based on TPACK ( *Technological, Pedagogical, and Content Knowledge* ). This TPACK-based scientific writing digital module will be designed in the form of a Mine Map (Concept Map).
2. Stage of Making Digital Module Products for Scientific Writing Based on TPACK ( *Technological, Pedagogical, and Content Knowledge* ).

At this stage, researchers begin to create digital media/teaching materials and validate their level of feasibility.

#### a). Creating Media

According to Suryani, et al., there are 5 steps that will be taken at this teaching material design stage, namely determining core competencies, basic competencies and indicators at this stage, including preparing the learning module framework, designing the initial digital module draft design in word format, designing the module draft design. digital into Canva and PDF, designing digital module drafts from PDF format to professional flip PDF format, creating testing strategies. The following is the explanation below.

##### 1) Learning Module Framework

The preparation of this module framework is based on the Indonesian language syllabus for class XI. The digital module that will be developed consists of three main parts, namely beginning, content and end. The initial part contains a cover, foreword, table of contents, glossary, concept map. The contents section contains an introduction which includes module identity, basic competencies, descriptions, instructions for using the module. Learning activity section 1 contains learning objectives, material descriptions,

- summaries, practice questions, self-assessment. Likewise, learning activities 2 and 3 have the same composition.
- 2) Designing a Preliminary Draft Digital Module Design in Word Format.  
At this stage, the researcher prepares the scientific writing module material by referring to the rules for writing a module and adapting to the framework that has been created in the flowchart in word form. Starting from the front cover to the bibliography section.
  - 3) Designing Digital Module draft designs into Canva and PDF  
After finishing designing the initial draft in word form, then proceed with designing the word module in Canva from the cover page to the bibliography. The process is as follows:

a. Open the Canva site, here are the steps

- 1). To access Canva, first we search for the Canva site via Google Chrome. For the record, you can only access Canva books or modules via Google Chrome. Open the Google search field ► type Canva ► press enter on the keyboard.

- 2). After that, the Canva site will appear as in the image below. Then click the top link that appears on the page.

b. *Sign-In* using Email

*Sign-in* is used to log in via an existing account on Canva. To sign-in, researchers used email and passwords that had been previously verified. So in short, sign-in is done by clicking ► enter the registered email and password.

c. Create Module Contents by Copying module contents from Word to Canva



d. Designing Digital Module Drafts from Pdf Format to Professional Flip Pdf Format.

e. After the Digital Module Draft becomes Flip Pdf Professional, it is published in exe form so that it can be accessed on laptops and in apk form so that it can be accessed on cellphones. The advantage of Flip Pdf professional is that students can access it without using a quota.

The initial design view of the module can be seen in the following link  
<https://drive.google.com/drive/folders/16MR3rUW6WWxReejU8NTPCCpjl1vJFh-J?usp=sharing>

### 3.13 Development Stage (*Development*)

#### 1. Expert Validation Results

Furthermore, the draft digital module for scientific papers based on TPACK will be validated by material experts, media experts and practitioner experts along with suggestions and improvements. To calculate the percentage of product suitability, use the formula  $P = \frac{F}{NX} 100 \%$ . P = final value, F= score obtained, and N= maximum value. If there are revisions, the *development process* is carried out. If there are no revisions, then the research continues at the next stage, namely *implementation* (trial). Data analysis and module validity were carried out by 3 validators, namely material expert validators, media and practitioners. The following data were obtained.

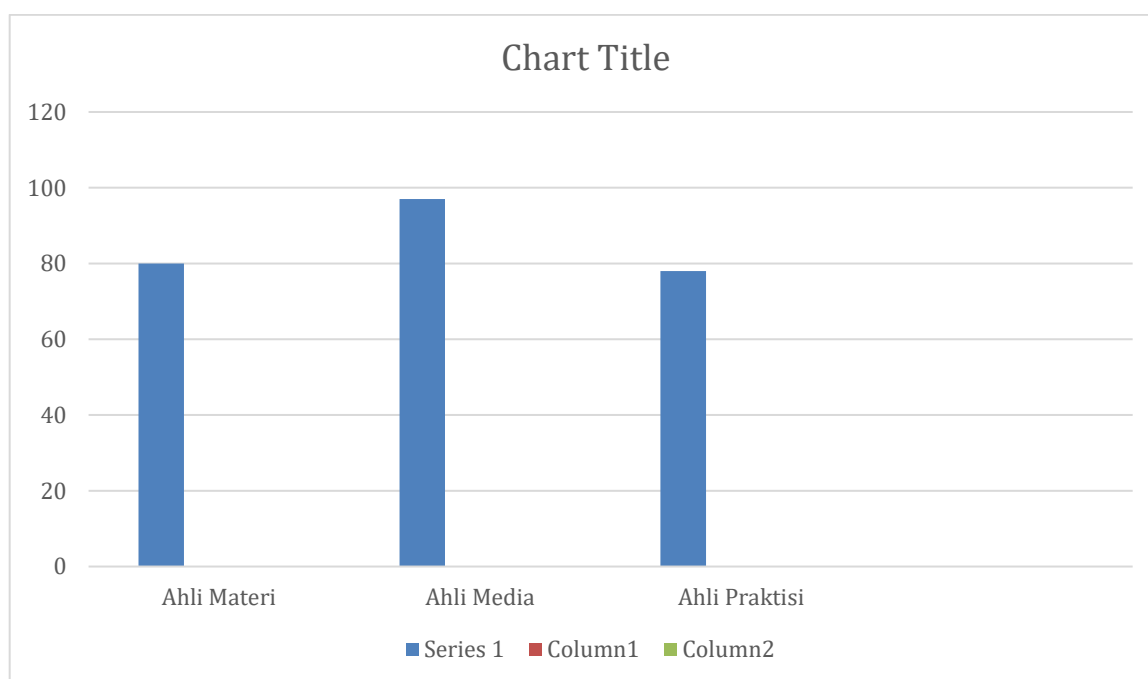


Diagram Figure 41 Expert Validation Results

This data can also be seen in the table below

Table 2. Expert Validation Results

No.	Validator	Mark	Criteria
1.	Materials Expert	80	
2.	Media Expert	97	
3.	Practitioner Expert	78	
	Total Value	255	
	Average	85	<b>Valid</b>

Based on the data above, it can be concluded that the total average results of the average material experts, media experts and practitioner experts is 85. Based on the media eligibility criteria according to Sugiono (2015: 135) according to the following categories.

Percentage	Qualification	Criteria
90 - 100	Very Valid	Not Revised
75 - 89	Valid	Not Revised
65 - 74	Fairly Valid	Needs Revision

55 - 64	Less Valid	Revision
0 - 54		Revision

A value of 85 is in the "Valid" category. Thus, the KTI digital module based on TPACK (Technological, Pedagogical and Content Knowledge) is worthy of being tested. However, based on advice from experts, there are still things that need to be improved.

2. Product Revision

The following are responses and suggestions from experts regarding the teaching material products being developed;

a. Material Expert Revision

There are several word errors in writing the product title, there are two words that were written incorrectly before the correction "DIGITAL MODULE OF SCIENTIFIC WRITING BASED ON TECHNOLOGICAL PEDAGOGICAL AND CONTENT LANGUAGE" after the improvement "DIGITAL MODULE OF SCIENTIFIC WRITING BASED ON *TECHNOLOGICAL PEDAGOGICAL AND CONTENT KNOWLEDGE*."



(a) Before Revision



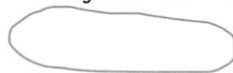
(b) After Revision

b. Media Expert Revision

Media experts suggest that the link/button for evaluation be clarified by adding several command sentences for students to work on the final evaluation questions. Initially there was no command sentence to do the questions, after it was revised there was a link/button and command sentence to do the final evaluation questions.

Tujuan proposal berdasarkan penguasaan latar belakang di atas adalah ...

- A. Memasyarakatkan tari daerah
- B. Melestarikan tari daerah
- C. Mendemonstrasikan tari daerah
- D. Menyelenggarakan pentas tari daerah
- E. Mengenalkan tari daerah



(a) Before Revision

Tari-tarian itu akan lebih menarik apabila dipentaskan secara kolosal.

Tujuan proposal berdasarkan penguasaan latar belakang di atas adalah ...

- A. Memasyarakatkan tari daerah
- B. Melestarikan tari daerah
- C. Mendemonstrasikan tari daerah
- D. Menyelenggarakan pentas tari daerah
- E. Mengenalkan tari daerah

Silahkan klik link di bawah ini untuk mengerjakan soal evaluasi pada link google form berikut ini!

<https://forms.gle/4HcxyQw7USTfgtDXA>

(b) After Revision

3.1.4 Trial Phase (Implementation)

This stage is the process of implementing or testing the module after the digital module is declared suitable for implementation. The trial was carried out at two schools, namely SMAN 1



Luragung students, totaling 25 people and Man 3 Kuningan students, totaling 36 people. This trial was held twice at different schools, namely 29 & 5 February 2024 at SMA and 13 & 20 March 2024 at Man 3 Kuningan.

This trial was carried out to determine the effectiveness of the TPACK-based KTI digital module. At the first meeting the researcher gave a conventional explanation using the lecture method, then students were given an initial test on scientific writing on the topic of the research proposal. Next, the researchers sent digital modules to be studied independently at home. At the next meeting, students study the digital module in groups. If there is a part that is not yet understood, the teacher as a facilitator provides a detailed explanation, then students are given a learning outcomes test by working on final evaluation questions. The learning outcome test is used as a basis for assessment to measure the effectiveness of the module.

Based on tests conducted at two schools, the following scores were obtained. Values before and after using the TPACK-based KTI digital module for Man 3 Kuningan students and SMAN 1 Luragung students.

No.	School name	Average before using the Digital Module	Average after using the Digital Module	Information
1.	Man 3 Kuningan	69.86	82.86	Increase
2.	SMAN 1 Luragung	75.92	83.88	Increase

Based on the data above, for Man 3 Kuningan students the average score before using the digital module was 69.86 after using the digital module, the score was 82.86, while for SMAN 1 Luragung students the score before using the digital module was 75.92 after using the module 83.88. This shows an average increase in each school. This means that in general, digital teaching materials for scientific writing based on TPACK can effectively improve students' understanding in studying proposal material.

### 3.1.5 Evaluation Stage ( *Evaluation* )

At this stage, researchers measure the effectiveness of student test results, whether the increase is significant or not. To measure it, use the pired sample t-test type t-test formula. To find out the level of significance, the researcher first determines the hypothesis.

H1: Rejected: There is no significant difference in learning outcomes between before using the TPACK-based KTI digital module and after using the TPACK-based KTI digital module.

H1: Accepted: There is a significant difference in learning outcomes between before using the TPACK-based KTI digital module and after using the TPACK-based KTI digital module.

Next, we compare it with an alpha of 5%, meaning we compare it with 0.05.

As for the criteria, if the sig (2 tailed) probability is  $> 0.005$ , then H1 is rejected

If the probability of sig (2 tailed)  $< 0.005$ , then H1 is accepted

Based on calculations, the following data is obtained.

		Paired Samples Test								
		Paired Differences				95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)	
Pair 1	Sebelum_menggunakan_modul_KTI_berbasis_TPACK - Sesudah_menggunakan_modul_KTI_berbasis_TPACK	-13.00000	5.96657	.99443	-15.01880	-10.98120	-13.073	35	.000	

paired sample t-test table, it is known that the average learning outcomes before and after using teaching materials are 13,000; calculated t value 13.073 > t 1.687; sig value (2-tailed) 0.000 < 0.005. So it can be concluded that there are differences before and after using the TPACK-based scientific writing digital module. This difference has increased significantly.

		Paired Samples Test								
		Paired Differences				95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)	
Pair 1	Sebelum_menggunakan_Modul_Digital_KTI_Berbasis_TPACK - Sesudah_menggunakan_Modul_Digital_KTI_Berbasis_TPACK	-7.96000	5.99639	1.19928	-10.43519	-5.48481	-6.637	24	.000	

Paired sample t-test table, it is known that the average learning outcomes before and after using teaching materials are 7.960; calculated t value 6.637 > t 1.7109; sig value (2-tailed) 0.000 < 0.005. So it can be concluded that there are differences before and after using the TPACK-based scientific writing digital module. This difference has increased significantly.

### 3.2 Discussion

Based on the research results, the implementation of instructional materials using digital modules for scientific writing based on TPACK significantly influences the improvement of student learning outcomes. This can be seen from the research data indicating that many teachers encountered difficulties in teaching this material due to the lack of long-used references. Eight teachers interviewed stated that they had been teaching this material using traditional learning sources, lacking digital modules. When students use this instructional material, they become more interested in learning because of the full-color designs with examples and videos that enhance their understanding. Teachers find it easier to direct students in their practice exercises, achieving learning goals. This corresponds with Yasa's findings, stating that digital modules can enhance student interest and motivation to learn. Similarly, Arsyad notes that digital modules provide students with opportunities to explore learning by adapting programs used (Maharcika, et al.: 2021).

These digital modules are very attractive, from the cover page to the last page, full of colors presented in Canva media so that authors can choose attractive color designs. The instructional display uses the Flip PDF Professional application, which presents digital modules as flip pages that can be flipped when reading. The Flip PDF Professional application has several advantages, such as adding videos, images, and links, making the content more interactive. Additionally, video integration in the evaluation section digitally through a Google form simplifies students in completing direct questions, Himmaturl Waro (2021). This is the uniqueness of TPACK. Similar findings are presented by Harisman, Yurlianti (2022), Dersryanti (2023) in their research that students are more interested because the TPACK framework is supported by software such as Flip

Book and animation videos. Himaturl Waro 2021 adds that instructional materials based on the application and Flip PDF Professional modules have several interesting features such as learning videos, answering questions in Google forms, and adding videos. Videos taken can be streamed through YouTube or uploaded directly from the teacher's device. This integrated digital material can be accessed by all students using Android or laptops. With the Flip PDF Professional application, students can access it without using a keyboard because the application has been installed previously. This practical instructional material can be accessed on Android, only some students cannot open this module. Problems on the Oppo brand HP.

The results of implementing digital modules for scientific writing can improve students' understanding. This is evidenced by research data showing an increase in average grades obtained before and after receiving input. At Man 3 Kuningan, the average grade obtained using modules was 69.86, and after receiving input, it was 82.86, while at SMAN Luragung, the average grade obtained was 75.92, and after receiving input, it was 83.88. This increase demonstrates the effectiveness of implementing digital modules. Based on the t-test calculation, the average learning outcomes before and after using instructional materials amounted to 13.000; t-value  $13.073 > t 1.687$ ; sig value (2-tailed)  $0.000 < 0.005$ . Thus, it can be concluded that there is a difference between learning outcomes before and after using digital modules for scientific writing based on TPACK. This difference experienced a significant increase at Man 3 Kuningan. The average learning outcomes before and after using instructional materials amounted to 7.960; t-value  $6.637 > t 1.7109$ ; sig value (2-tailed)  $0.000 < 0.005$ . Thus, it can be concluded that there is a difference between learning outcomes before and after using digital modules for scientific writing based on TPACK. This difference experienced a significant increase at SMAN Luragung.

#### IV. CONCLUSION

Based on the development objectives, research problems and research results, it can be concluded as follows.

1. Teachers really need digital modules for scientific writing based on TPACK because so far the sources of books and references used are still limited. Apart from that, the sources used are still in printed form, there are no digital teaching materials designed for studying scientific work proposals. This module is designed in print and digital form using the Canva application and Professional PDF flipbook. It is hoped that this will make it easier for students to use teaching materials to support quality in learning at the following link <https://drive.google.com/drive/folders/16MR3rUW6WWxReejU8NTPCCpjpg1vJFh-J?usp=sharing>
2. Teaching materials for Indonesian language subjects, especially scientific writing materials as part of research proposals specifically for class XI SMA and MA, are produced in the form of digital modules. This teaching material product is equipped with a title page, foreword, table of contents, module identity, basic competencies, module description, instructions for using the module, concept map, learning activities in the form of learning objectives, material descriptions, sample questions, self-assessment, evaluation in the form of multiple choices, glossary, bibliography, which aims to measure students' understanding of the material they have studied. This digital module of TPACK-based scientific writing has been validated by material experts, media experts and practitioner experts with an average of 85. Based on the criteria, it is considered feasible. This means that this module can be applied in learning scientific papers on research proposal topics with some input and direction from the three experts.
3. The implementation of digital modules for students was carried out in two schools. The results of implementing the digital module in Man 3 obtained an average result before using

the digital module of 69.86 while after using the digital module it was 82.86. The results of the implementation of digital modules in high school obtained an average result before using the module of 75.92 while after using the module it was 83.88. To measure the significance of the use of digital modules in MAN 3, the following data was obtained. Based on the *paired sample t-test* table, it is known that the average learning outcomes before and after using teaching materials are 13,000; calculated t value  $13.073 > t 1.687$ ; sig value (*2-tailed*)  $0.000 < 0.005$ . So it can be concluded that there are differences before and after using the TPACK-based scientific writing digital module. This difference has increased significantly. To measure the significance of the use of digital modules in high school, the following data was obtained. Based on the *paired sample t-test* table, it is known that the average learning outcomes before and after using teaching materials are 7.960; calculated t value  $6.637 > t 1.7109$ ; sig value (*2-tailed*)  $0.000 < 0.005$ . So it can be concluded that there are differences before and after using the TPACK-based scientific writing digital module. This difference has increased significantly.

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