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Technological Pedagogical Content Knowledge on Statistics Material in Junior High School

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ABSTRACT

Learning modules designed based on Technological Pedagogical Content Knowledge (TPACK) are very important to improve the learning experience of students. This research tries to develop a module-based TPACK for statistics in MTs Keppe, Larompong, and Luwu. This study aims to assess the feasibility and effectiveness of statistical learning modules developed based on TPACK. This research is R&D with the ADDIE models. The statistics module was developed based on the needs of junior high school students in Keppe and tested on grade VIII students. The instruments used are expert validation questionnaires practicality questionnaires to assess product feasibility, and learning outcomes tests to assess product effectiveness. The results showed that the TPACK-based statistics module can be feasible to use with validation of 85% by media experts and 87.5% by material experts, with a practicality level of 91%. This module is also effective in improving student learning outcomes with a percentage of 89.5%.

Keyword: Learning Outcomes; Statistics Module; TPACK.

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1. Introduction

Science and technology are two essential things today. A teacher besides having good knowledge must also be able to use technology to support learning activities in the classroom (Arifa et al., 2022). TPACK is a framework that highlights the use of digital technology in learning activities. In TPACK, a teacher is allowed to combine Pedagogic Knowledge (PK), Content Knowledge (CK), and Technological Knowledge (TK) (Hew et al., 2019; Schmid et al., 2021).

The use of TPACK-based learning media encourages students to be active in learning activities because it involves new ways of learning (Wijaya et al., 2020). TPACK can improve (Pramita & Wiranda, 2023) and facilitate students' mathematical problem-solving skills (Putri et al., 2022), as well as increase teachers' creativity towards mathematical literacy (Jamaan & Yerizon, 2023).

Electronic learning modules (e-modules) are modules presented in digital form that already have images, sounds, animations, and videos so they are very helpful in increasing understanding of learning. E-modules are proven to improve students' creative thinking skills (Komarudin, 2022) and understanding of mathematics learning (Ferdianto & Alfiani, 2019).

Initial observations show that there are limitations for teachers in using modules in MTs Keppe. In addition, students have difficulty learning at home due to limited access to textbooks. Therefore, this study tries to design a learning module for Statistics material. Modules are designed based on the needs of students known through the ADDIE stage of this research. Modules are designed in the form of Android-based applications that use a Realistic Mathematics Education (RME) approach. Expert validation and practicality tests are carried out to see the feasibility of the modules that have been designed. After that, an effectiveness

test was carried out to see the level of effectiveness of the module on student statistics learning outcomes.

2. Method

This research is a Research and Development research using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). This research will be conducted in April 2023 at MTs Keppe, Luwu Regency, South Sulawesi. The subject of this study was a grade VIII MTs Keppe student. The instruments used are module validation questionnaires, student response questionnaires, and learning outcomes tests.

The analysis of module validity and practicality is based on the results of tabulations by material experts and learning media experts who each look for percentages using the formula:

$$percentage = \frac{\Sigma Score\ per\ item}{maximum\ score} x100\% \quad (1)$$

These results are then categorized using the following table

Table 1. Product validity categories (Arifa et al., 2022)

%	Category
81 - 100	Very Valid / Very Practical
61 - 80	Valid / Practical
41 - 60	Sufficiently Valid / Sufficiently Practical
21 - 40	Less Valid / Less Practical
0 - 20	Invalid / Impractical

The effectiveness of using modules is known by calculating the completeness of student learning using the following formula

$$\bar{x} = \frac{\Sigma Students\ score}{total\ students} x100\% \quad (2)$$

These results are then categorized using the following table

Table 2. The Category of Minimal Completeness in Mts Keppe

%	Category
90 - 100	Very Good
80 - 89	Good
72 - 79	Enough
61 - 71	Less
0 - 60	Not at All

The e-module developed is declared effective for student statistics learning outcomes if at least 61% of students have a minimum score of 72.

3. Result and Discussion

This R&D research uses ADDIE design. At the *Analysis*, a needs analysis and curriculum analysis are carried out, the results of which can be seen in Table 3.

Table 3. Description of Needs Analysis and Curriculum Analysis

The Analysis	Result	Methode
Needs Analysis	• The ability of students to understand statistical material is still lacking because textbooks are still limited • Textbooks are owned only by teachers, not students. • The LCD projectors are available and but their use is limited, not every meeting • Students do not experience obstacles in using technology • From this, students need modules that can be accessed from anywhere	Interview with teacher on December 29, 2022
Curriculum Analysis	• The curriculum used is curriculum 201 • The core competencies and basic competencies that exist for statistical materials support the use of modules that integrate science and technology	Curriculum Document Analysis

At the *Design*, the findings obtained at the analysis stage are followed up. In this case, the design of statistical material modules that integrate science and technology is carried out. First, the module was designed using *power point 2019*, then converted with *iSpring Suite 9*, and finally used *website 2 Apk Builder* to be converted again into an Android-based application. Navigation structure designed following Figure 1.

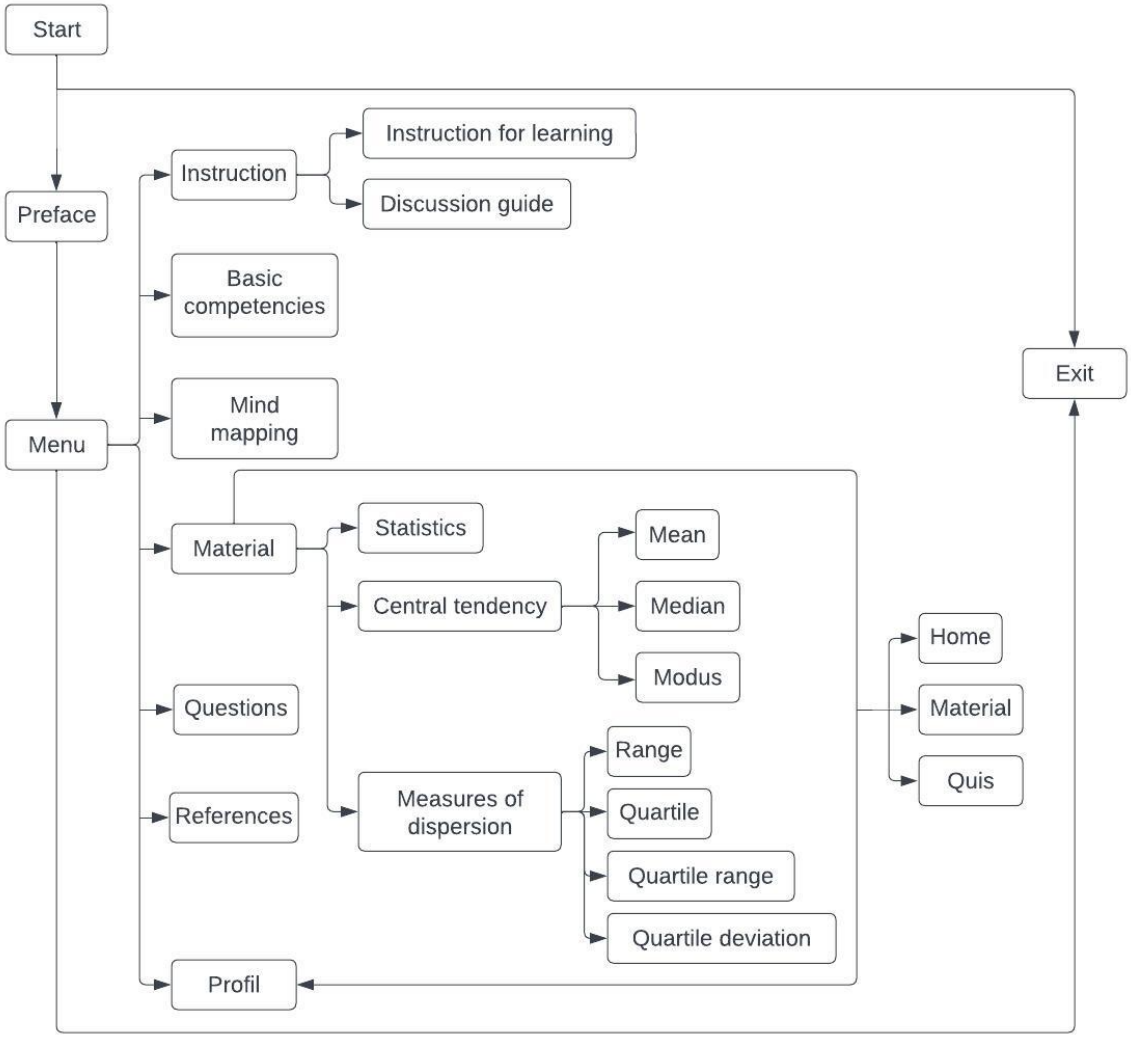

Figure 1. The Navigation Structure Design

Modules that have been designed at the design stage, then validated and carried out practicality tests. This activity is hereinafter referred to as the development stage. Validation of the statistics module was carried out by 3 (three) people with the results as shown in Table 4.

Table 4. Validation Results Data

Validator	Measured Aspects	Score	Suggestions
Validator of media	• Display • Programming	85,00%	• Consistent with the font used • Fix navigation buttons • Add a list of references
Validator of contents	• Learning • Content of the material • Language • The Question • Usability	87,50%	• Adapt sample questions to cases that students often encounter • There are still some non-standard words

Based on Table 4 and Table 1, the statistics module that has been developed is very valid. The module has also been practical based on practicality tests conducted on students. The results of the practicality test are shown in Table 5.

Table 5. Practicality Test Results Data

Measured Aspects	The Statement	Score
Display	The animations used are interesting	88,00 %
	The module display is attractive so it is not boring	
	The images used are clear and attractive	
	The navigation buttons are clear and easy to learn	
Material / Content	The material presented is easy to understand	92,00 %
	The material presented is interesting and fun	
	The clues and sentences are clearly stated	
Usability	This module makes it easy to understand statistical material	93,00 %
	This module is easily accessible and supports self-study activities	
	This module helps in studying statistical material	

The statistics module developed has been declared valid by experts and practical by students. Furthermore, it was tested on 12 students at MTs Keppe. This stage is hereinafter referred to as the implementation stage. From here, it is known the effectiveness of using the statistics module on student learning outcomes in statistical material. The trial was carried out directly by first providing an explanation related to the contents of the statistics module that had been designed. Student learning outcome scores can be seen in Table 6.

Table 6. Student Learning Outcomes Score

Student Name	Score			Sum
	I	II	III	
ZF	25	40	20	85
RY	40	40	5	85
NR	25	40	5	70
NH	40	40	20	100
RIRP	40	40	20	100
NRI	40	40	20	100
ARA	40	40	20	100
MM	40	40	15	95
DRA	25	40	5	70
AH	35	40	15	90
ARN	40	40	20	100
RS	40	20	20	80
Average				89,58

Based on Table 6, there are 10 students who have achieved scores above 72 or equivalent to 83.33%. Based on Table 2 and effective criteria, the statistics module that has been applied is declared effective in improving student statistics learning outcomes with an average score of student statistics learning outcomes of 89.58.

Furthermore, formative and summative evaluations of the statistics module were carried out. Formative evaluation has been carried out at every stage of development by adjusting the development of the statistics module to the TPACK concept. The statistics module developed has fulfilled the technological aspect (TK) because the module has been based on Android and can be accessed anytime and from anywhere via mobile phone. This module has also fulfilled pedagogic aspects (PK) because its presentation has been adapted to the RME approach, which can help students build their own understanding through exploration, manipulation of physical objects or visual representations, critical thinking through examples of given problems, and collaborating with classmates (Ananda, 2018). In addition, this module has also fulfilled the content or material aspect (CK) because the existing module has described statistical material adapted to the 2013 Curriculum. Summative evaluation is carried out based on expert assessment at the validation stage and practicality test whose results can be seen in Table 4 and Table 5.

4. Conclusion

This article has show the development of a statistics module using ADDIE. The mathematics module is produced in the form of an Android-based application that has been valid by validators and practical by the junior high school students in Keppe Luwu Regency, South Sulawesi. This module has also been tested for use and is effective in improving student statistical learning outcomes. This module can still be developed by adding an interactive exercise column and integrated with a recap of student evaluation results.

6. References

Ananda, R. (2018). Penerapan Pendekatan Realistics Mathematics Education (RME) Untuk Meningkatkan Hasil Belajar Matematika Siswa Sekolah Dasar. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *2*(1), Article 1. https://doi.org/10.31004/cendekia.v2i1.39

Arifa, N., Aswad, M. H., & Arifanti, D. R. (2022). Development of Learning Media Based on Technological Pedagogical Content Knowledge Concepts for the Eight Grade Junior High School. *International Conference of Learning on Advance Education (ICOLAE 2021)*, 805–811. https://www.atlantis-press.com/proceedings/icolae-21/125974276

Ferdianto, F., & Alfiani, N. (2019). Digital Module and Treffinger Model: Can Improve Mathematics Ability. *Journal of Physics: Conference Series*, *1360*(1), 012035. https://doi.org/10.1088/1742-6596/1360/1/012035

Hew, K. F., Lan, M., Tang, Y., Jia, C., & Lo, C. K. (2019). Where is the "theory" within the field of educational technology research? *British Journal of Educational Technology*, *50*(3), 956–971. https://doi.org/10.1111/bjet.12770

Jamaan, E. Z., & Yerizon, Y. (2023). Enhancing Teacher Creativity in Digitalizing Math-Literacy Modules Through Technological Pedagogical Content Knowledge Training. *Al-Jabar : Jurnal Pendidikan Matematika*, *14*(1), Article 1. https://doi.org/10.24042/ajpm.v14i1.16832

Komarudin, K. (2022). STEM-Based E-Module in Improving Students' Mathematical Creative Thinking Ability: A Needs Analysis for Indonesian Students. *Cartesian: Jurnal Pendidikan Matematika*, *2*(1), 124–136. https://doi.org/10.33752/cartesian.v2i1.2685

Pramita, M., & Wiranda, N. (2023). Penerapan TPACK dan Model CPS Dalam Meningkatkan Kemampuan Pemecahan Masalah Siswa. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *12*(1), Article 1. https://doi.org/10.24127/ajpm.v12i1.7181

Putri, I., Oktaviyanthi, R., & Khotimah, K. (2022). Perancangan E-Modul Interaktif Berbasis Technological Pedagogical Content Knowledge (TPACK) untuk Memfasilitasi Kemampuan Pemecahan Masalah Matematis. *Jurnal Pendidikan MIPA*, *12*, 820–830. https://doi.org/10.37630/jpm.v12i3.693

Schmid, M., Brianza, E., & Petko, D. (2021). Self-Reported Technological Pedagogical Content Knowledge (TPACK) of Pre-Service Teachers in Relation to Digital Technology Use in Lesson Plans. *Computers in Human Behavior*, *115*, 106586. https://doi.org/10.1016/j.chb.2020.106586

Wijaya, T. T., Purnama, A., & Tanuwijaya, H. (2020). Pengembangan Media Pembelajaran Berdasarkan Konsep TPACK Pada Materi Garis dan Sudut Menggunakan Hawgent Dynamic Mathematics Software. *JPMI (Jurnal Pembelajaran Matematika Inovatif)*, *3*(3), Article 3. https://doi.org/10.22460/jpmi.v3i3.p%p