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Personal Context-based Digital Module Based on Teachers' Promote Action on Arithmetic Series and Sequence Material to Improve Students' Learning Outcomes

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Abstrak

Siswa belum terbiasa menyelesaikan soal deret aritmatika dalam bentuk soal cerita dan tidak terbiasa dengan indikator penyelesaian masalah karena sering mengerjakan soal konvergen sehingga mengakibatkan kesulitan ketika diberikan soal pada konsep baru. Penelitian ini bertujuan untuk mengembangkan modul digital berbasis konteks personal berdasarkan promote action guru pada materi barisan dan deret aritmatika untuk meningkatkan hasil belajar siswa. Jenis penelitian ini yaitu pengembangan. Penelitian ini menggunakan model pengembangan ADDIE. Responden adalah guru matematika dan siswa kelas X SMA. Metode pengumpulan data menggunakan observasi, wawancara, dan tes. Instrumen penelitian meliputi embar validasi modul digital berbasis konteks personal, lembar observasi kegiatan guru dan siswa, angket respon guru dan siswa, pre test dan post test, pedoman wawancara. Teknik analisis data menggunakan analisis deskriptif dan statistik inferensial. Hasil penelitian menunjukkan modul digital berbasis konteks personal memenuhi aspek valid, praktis dan efektif. Kevalidan diperoleh dari hasil validasi modul digital pada kriteria valid. Kepraktisan diperoleh dari hasil analisis angket respon guru pada kategori sangat baik, angket respon siswa pada kategori sangat baik dan lembar observasi siswa pada kategori baik. Hasil uji efektifitas didapatkan terdapat pengaruh antara sebelum dan sesudah diberi modul digital berbasis konteks personal terhadap hasil belajar siswa. Disimpulkan bahwa modul digital berbasis konteks personal dapat meningkatkan hasil belajar siswa.

Kata Kunci: *Modul Digital, Konteks Personal, Hasil Belajar, Barisan dan Deret Aritmatika, Promote Action*

Abstract

Students are not used to solving arithmetic series problems in the form of story problems. They are not used to problem-solving indicators because they often work on convergent problems, resulting in difficulties when given problems on new concepts. This study aims to develop a personal context-based digital module based on teacher promotion action on the arithmetic sequence and series material to improve student learning outcomes. This type of research is development. This study uses the ADDIE development model. Respondents are mathematics teachers and grade X high school students. Data collection methods use observation, interviews, and tests. The research instruments include personal context-based digital module validation sheets, teacher and student activity observation sheets, teacher and student response questionnaires, pre-test and post-tests, and interview guidelines. Data analysis techniques use descriptive analysis and inferential statistics. The study results show that the personal context-based digital module meets the valid, practical and effective aspects. Validity is obtained from the results of the digital module's validation of the valid criteria. Practicality is obtained from the analysis of the teacher response questionnaire in the very good category, the student response questionnaire in the very good category and the student observation sheet in the good category. The effectiveness test results showed an influence between before and after being given a personal context-based digital module on student learning outcomes. It is concluded that personal context-based digital modules can improve student learning outcomes.

Keywords: Digital Module, Personal Context, Learning Outcomes, Arithmetic Series and Sequences, Promote Action

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1. INTRODUCTION

Mathematics teachers have made many innovations related to their learning process. Teachers apply various methods to deliver the material and so that students can achieve learning objectives. Entering the 4.0 era, teachers must consider the innovation of using technology in their learning process, utilizing various technology-based learning media (Budiyono, 2020; Firmadani, 2020; Shintawati, 2016). Learning media can be a learning resource to support improving student achievement (Andrianingsih & Mustika, 2022; Falloon, 2020). Digital modules have many advantages, including students being more motivated to learn because the material is presented in an interesting way and the learning process is designed to improve the quality of mathematics learning compared to using textbooks (Surbakti et al., 2022). Mathematical ability and the ability of using mathematics are two important things for citizens. In everyday life, mathematical concepts are often used in solving problems (Tampubolon et al., 2019; Wulandari et al., 2020). Therefore, mathematics teaching should be designed as attractively as possible to motivate students to learn mathematics. Consequently, the development of digital modules is crucial, containing concepts in everyday life, referred to personal context-based digital modules. Personal context is one of the mathematical contexts in PISA which is a context that is directly related to students' daily activities, including their own activities, family activities, and peers activities (Dewantara, 2019; Hidayah, 2018). Mathematics is expected to play a role to interpret everyday problems and then to solve them (Putra & Vebrian, 2021; Wijaya et al., 2019).

One of the mathematics materials in high school, especially in grade 10, is arithmetic sequences and series. Arithmetic sequences and series is one of the materials that is widely used in everyday life. For example, it is used to calculate the amount of savings in several years if we save in a bank with a fixed increase each month, loans or investments, and business capital growth. Therefore, it is very important for students to understand and master the arithmetic sequences and series. However, based on several research, many students still find difficulties in solving arithmetic sequence and series problems. In her study, Septiahani showed that the ability of vocational high school students to work on arithmetic sequence and series problems is still relatively low (Septiahani et al., 2020). The results of other studies also show that high school students still have difficulty understanding the concept of arithmetic sequences and series, especially in the contextual problems and mathematical models (Kempirmase et al., 2019). Students are also not accustomed to solve arithmetic sequence and series problems in word problem and are still not familiar with problem-solving indicators because they often work on convergent problems resulting in their difficulty when given problems in new concepts (Kurniasari et al., 2022). Based on previous studies, it is important to conduct research that links contextual problem solving with arithmetic sequence and series material.

The learning process carried out by teachers is complex. Teachers must be able to create a comfortable learning atmosphere, provide modules that can be accepted and understood by students, and eventually facilitate students to achieve learning goals. Therefore, the activities need to be varied and not monotonous, and can make students active. Teacher actions that offer students to do activities and making students active are called *teacher promote actions* (Iffah et al., 2016). This promote action appears from the beginning to the end of learning, but not all teacher activities are considered as promote actions. Promote actions only cover activities that are in the nature of providing offers to students In this study, the development of a personal context-based digital module will be carried out by implementing mathematics learning that pays attention to the teacher's promote action. When the teacher's promote action learning process is responded to by students, the form of students' responses varied: some students accept, some respond (pseudo) and some reject the

teacher's promote action. These varied responses are the the characteristic of the teacher's promote action (Iffah et al., 2017). The implementation of learning starts from the initial activities, core activities and closing activities. The learning process is no longer with the teacher explaining and students only listening, but it has been designed to create learning that makes students more active.

Several studies have been conducted previously related to digital modules, including the results of the development of digital modules for mathematics learning based on an open-ended approach that can improve mathematical creative thinking skills (Auliah et al., 2020) and the use of e-modules that can support mathematics learning (Erawati et al., 2022). Among various applications for compiling digital modules, this study will develop a digital module using the flipbook application. The use of flipbook e-modules in previous studies can improve the critical thinking skills of elementary school students (Herianingtyas et al., 2023). Building on, this study developed a digital module to improve the learning outcomes of high school students. The development of STEM-based digital modules is carried out to meet the needs of students and lecturers in order to create an alternative teaching material based on a learning model that can improve students' ability to learn independently (Suryani et al., 2020).

Teacher promote action is accepted if students are able to understand and master the concepts given (Iffah, 2016; Jauhara Dian Nurul Iffah & Tristanti, 2022). Consequently, only high and medium ability students are dominant in showing accepted promote action. Promote action that is clearly accepted by students is also an action that requires students to be active in discussion. The teacher only provides an outline of the material, but does not provide an explanation. However, there has been no research that has developed a digital module based on a personal context by considering the promote action presented by the teacher. Therefore, due to the rapid development of technology, teachers must have innovation in mathematics learning. Students must be able to understand the material well, be well motivated and be able to achieve learning objectives. Therefore, it is important to develop a digital module based on a personal context on the material of arithmetic sequences and series. This study aimed to develop a digital module based on a personal context based on teacher promote action on the material of arithmetic sequences and series. It was expected that it can improve students' mathematics learning outcomes in terms of validity, practicality and effectiveness.

2. METHOD

The development of this digital module used the Research and Development (R&D). The R & D research is a type of research that creates or develops new products using certain steps (Cahyadi, 2019). The development model used in this study was to apply the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The ADDIE development model is one of the most effective tools for producing a product, because the ADDIE development model provides a very complex framework guideline (Rusdi, 2020; Wandari et al., 2018). This research was conducted at one private high school in Jombang with subjects being teachers and grade 10 students.

The instruments used in this study included: (1) Validation sheet for the validity aspects of the personal context-based digital module. This validation sheet contains 14 assessed aspects, including the components of the personal context-based digital module, the suitability of the learning material, the presentation of the learning material, the accuracy of the word and language choice used, and the appearance of the personal context-based digital module. (2) Observation sheet for the learning process to observe the teacher's promote action. There were 11 items that must be filled in by the observer, including 3 items of teachers' initial activity, 7 items in the core activity and 1 item in the closing. (3) Observation

sheet for student activities to test the practicality of the personal context-based digital module and observe students' responses to the teacher's promote action. (4) Teacher response questionnaire to determine teachers' responses to the personal context-based digital module that was developed as well as a test of the practicality of the digital module. There were 10 statement items that must be filled in by the teacher. (5) Student response questionnaire to determine students' responses to the personal context-based digital module as well as a test of the practicality of the digital module.

There were 14 statements filled in by students. (6) Learning outcome test to see the improvement in learning outcomes and whether or not there is an influence of the use of the personal context-based digital module on students' learning outcomes. This test consisted of two types, namely a pre-test given before the use of a personal context-based digital module and a post-test given after the use of a personal context-based digital module. Each test (both pre-test and post-test contained 5 essay questions with 3 conceptual problems and 2 word problems. (7) Interview guidelines were used to confirm promote action that teachers bring up during classroom learning. Product trials in this study consisted of expert validation and product revision. Validation included product validation and material validation from the validator. The validators in this study consisted of two people, namely a Mathematics Education lecturer who taught the learning media course and a mathematics teacher at high school level. The research process carried out by the researcher is described in Figure 1.

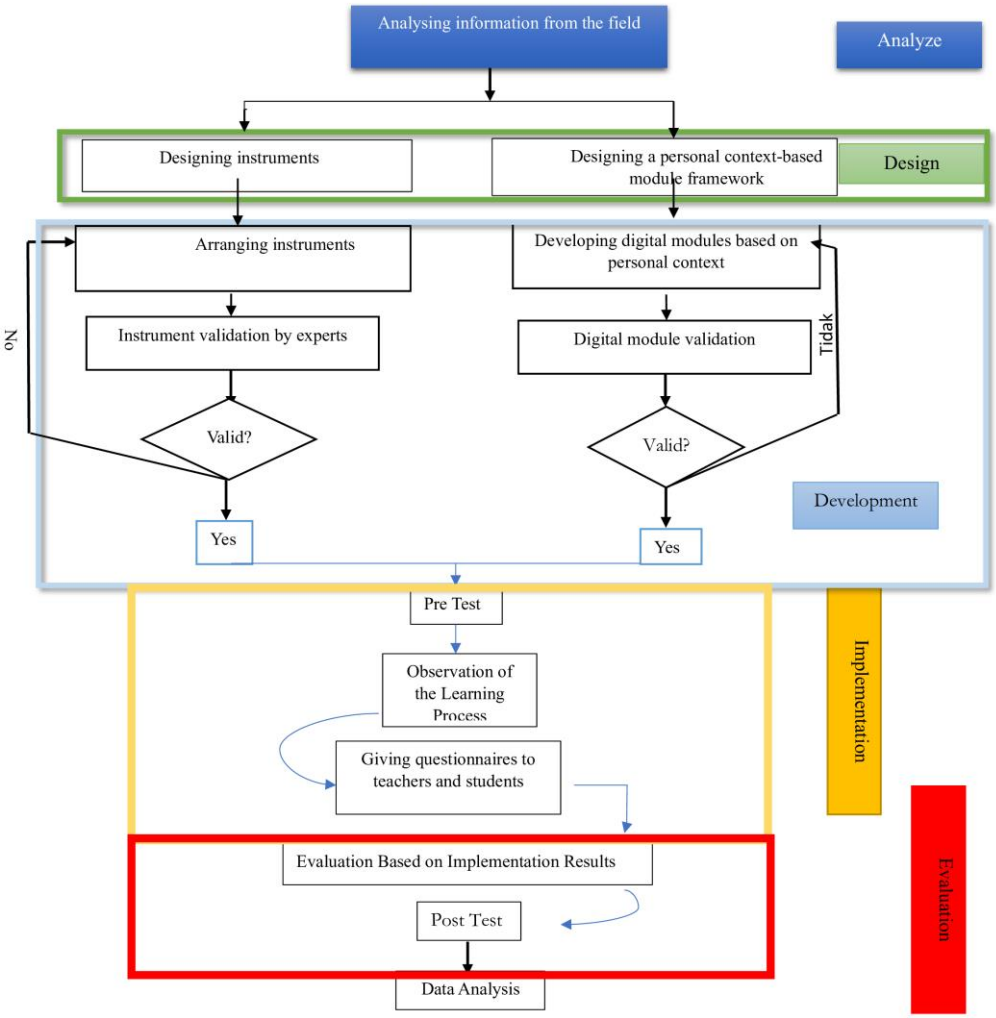

Figure 1. Research Development Process of ADDIE

This study has criteria for the developed personal context-based digital module. These criteria are valid, practical and effective aspects that are used to assess whether the personal context-based digital module can be categorised to be successfully developed and suitable for use in mathematics learning. The personal context-based digital module is considered to be successful if it can improve student learning outcomes. The data for valid aspect was obtained from the validation results given through assessment by the validator. The product was declared valid if it meets the minimum valid criteria. The classification of the validity criteria for personal context-based digital module products showed in Table 1.

Table 1. Classification of Valid Criteria

Criteria	Score
Valid	total score ≥ 86
Valid Enough	76 ≤ total score < 86
Less Valid	71 ≤ total score < 76
Invalid	total score < 71

Practicality aspect data was obtained from the results of observations of student activities, teacher response questionnaires and student response questionnaires. A product was declared practical if it meets the minimum practical criteria. Table 2 shows the classification of product practicality criteria. The data analysis technique for assessing practicality in this study used the percentage. Classification of Practical Criteria showed in Table 2.

Table 2. Classification of Practical Criteria

Criteria	Interval
Very Practical	80% - 100%
Practical	60% - 79%
Less Practice	40% - 59%
Not Practice	0% - 30%

The data for effectiveness aspect was obtained from learning outcome tests, namely pre-test and post-test. The results of the pre-test and post-test were analyzed for the average increase and whether there was an effect of using a personal context-based digital module on student learning outcomes using statistical tests. The effectiveness test conducted in this study used the Paired Sample T-test. In this study, it is said that there is an influence of a personal context-based digital module based on teacher promote action on student learning outcomes if there is a difference in the average learning outcomes of students between before and after being given a personal context-based digital module based on teacher promote action. This digital module is considered to be effective in improving student learning outcomes if the results of the hypothesis test show that H_1 is accepted

3. RESULT AND DISCUSSION

Result

The results of the study indicate that the developed personal context-based digital module met the criteria of valid, practical and effective. The development of this personal context-based digital module used the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). The analysis stage in the development of a personal context-based digital module was carried out by researchers by analyzing information from

the field. Researchers conducted interviews with several high school mathematics teachers, high school students to ask what material was difficult to understand and what teaching materials were commonly used in learning. The results of the interviews showed that the teaching materials used by teachers were still paper-based, and students often found it difficult to understand the content of word problems. Therefore, varied learning is needed and students need to be trained more to solve word problems related to everyday life.

Furthermore, researchers analyzed various teaching materials that were suitable for high school students, taking into account students' cognitive development, IT development and the attractiveness of the teaching materials. Several applications were considered to be used by researchers, but researchers eventually decided to use flipbooks which were most appropriate to the conditions needed. Thus, researchers decided that this personal context-based digital module was in accordance with the needs of students and teachers in the learning process of arithmetic sequences and series. This module contained mathematical literacy so that students become more active and independent in the learning process and find it easier to understand contextual problems. As a study conducted by (Pixyoriza et al., 2022), digital modules have quite an impact on developing problem-solving skills. Consequently, the developed digital modules can be used as learning materials in class or independently from a distance class to support ongoing learning. Results are the main part of scientific articles, containing: clean results without data analysis process, results of hypothesis testing. The results can be presented with tables or graphs, to clarify the results verbally. Discussion is the most important part of the overall content of scientific articles. The objectives of the discussion are: Answering research problems, interpreting findings, integrating findings from research into existing knowledge sets and developing new theories or modifying existing theories.

In the design stage, the researcher designed a framework for a personal context-based digital module and research instruments. The framework was based on theories or references that support the module and instrument. First, the researcher designed a digital module, namely what components would appear in the personal context-based digital module. The components of the personal context-based digital module consisted of: teaching materials, problem examples, and practice questions. Practice questions consisted of several problems based on personal context, namely problems presented in the form of word problems related to everyday life. The purpose of providing practice questions was to strengthen students' understanding in learning the concept of sequences and series. Second, the researcher designed a software that would be used in creating the digital module, using the flipping book application. Furthermore, the researcher designed the research instrument consisting of: product validation sheets, teacher and student observation sheets, teacher and student response questionnaires, pre-test and post-test sheets, and interview guidelines.

In the development stage, there were two activities carried out by researchers, namely creating instruments and validating products or digital modules based on personal context. First, researchers created digital modules based on personal context, research instruments, and validation sheets. The initial step taken by researchers in creating digital modules based on personal context was to determine the materials used in creating and developing digital modules based on personal context, which was arithmetic sequences and series. Furthermore, researchers created digital modules based on personal context that contained some components, namely covers, forewords, learning objectives, arithmetic sequence and series materials and problems based on personal context. The initial part of the personal context-based digital module contains a cover, foreword, basic competencies and learning objectives. The basic competencies and learning objectives presented by the researcher were sourced from the curriculum and student handbook for grade 10 students. The initial part of the personal context-based digital module showed in Figure 1.

The next part of the personal context-based digital module is the substance of the material, namely arithmetic sequences and series. The material in the teaching module begins with a contextual problem that describes the material on arithmetic sequences and series. Furthermore, the problem was solved in detail at each step for students to read. The material ends with the definition of arithmetic sequences and series along with their formulas. In the material section, there is also a YouTube link that students can click to watch a video of the material on arithmetic sequences and series. This video was provided to make it easier for students to understand the material. The next section contains problems that must be solved by students. This section consisted of three contextual problems. Students were asked to complete them independently, take photograph of their answer and upload it to the provided Google form.. Students were asked to complete and write down the answers on the answer sheet, photograph the answer and upload it to the Google form link in the image on the right.

Figure 1. Initial Part of Personal Context-based Digital Module

The second activity in the development stage was validation. This activity was carried out by researchers by validating research instruments in the form of teacher and student observation sheets, teacher and student response questionnaires, pre-test and post-test questions, and interview guidelines. The validation results showed that the instrument was valid and could be used to collect data. The next validation activity was to validate the product, namely a personal context-based digital module. The resulting product must undergo validation activities in order to obtain the best results (Risnawati et al., 2019). The assessed aspects included the components of the personal context-based digital module, the suitability of learning materials, the presentation of learning materials, the accuracy of the choice of words and language used and the appearance of the personal context-based digital module. Validation of the personal context-based digital module was carried out by two validators, namely a lecturer in the learning media course and a high school mathematics teacher. The results of the validation of the personal context-based digital module by the two validators showed in Table 3.

Table 3. Results of validation of personal context-based digital module by both validators

Validator	Validation Result Score Based on Assessment Indicators					Total Score
	Module components	Suitability of materials	Presentation of material	Choice of words and language	Module view	
I	35.71	21.43	14.28	14.28	11.9	97.6
II	33.33	21.43	11.9	11.9	14.28	92.84

Based on Table 3, the first validator gave a score of 97.6 for the validation of the digital module, while the second validator gave a score of 92.84 for the validation of the digital module. The validation results from both validators were in the valid criteria. This states that the personal context-based digital module met the valid criteria and could be used. In addition, the validation results from other research instruments also met the valid criteria and could be used. After the digital module was validated by the validator, the researcher then conducted a readability test with six grade 10 students who had various mathematical abilities. The test was to check the clarity of the language and understanding of the instructions from the designed digital module, the questionnaire and the test questions. Based on the results of this small-scale readability test, it was suggested that there were sentences that needed to be edited with other sentences more familiar to students. This became the basis for the researcher to conduct an evaluation.

The evaluation stage in this study aimed to improve the digital module and instruments during the development process to produce a digital module based on personal context and instruments as expected. Before proceeding to the implementation stage, the researcher has conducted several evaluations. First, evaluation was carried out at the design stage to improve the components of the digital module based on personal context, namely completing the module with instructions for using the module, cover, foreword, and table of contents. Second, evaluation was carried out at the development stage, namely (1) including video elements in the material components in the form of links that can be opened by students, (2) improving mathematical symbols using the equation tool, and (3) improving the digital module based on personal context and research instruments based on feedback from the validator. Third, evaluation was carried out based on the results of the readability test. After the researcher conducted an evaluation at the design and development stage, the researcher then implemented a personal context-based digital module in learning based on the teacher's promote action. Based on the results of observations of teacher activities in the learning process based on the teacher's promote action, some activities were accepted by students and some were rejected. At the end of the learning, teachers and students were given a questionnaire on thier responses to the digital module based on personal context.

The practicality of the personal context-based digital module was analyzed based on the results of the teacher response questionnaire, student response questionnaire and student activity observation sheets. Based on the results of the teacher response questionnaire analysis, a percentage of 100% was obtained, meaning in the very practical category. While the results of the student response questionnaire analysis obtained an average percentage of 84.33%, meaning in the very practical category. Furthermore, the results of the student observation sheet analysis obtained a percentage of 75%, meaning in the practical category. Based on the three category results, the personal context-based digital module meets the practical criteria for use.

The effectiveness of the personal context-based digital module was analyzed based on the results of the pretest and posttest given to students. The average pre-test of students' score obtained was 6.4, while the average post-test of students' score was 45. Thus, the increase in the average pre-test and post-test of students' score was 38.62857. Furthermore, the researcher investigated whether there is an influence of learning outcomes between before and after being given a personal context-based digital module. Based on data analysis, the t-test (paired sample t-test) above, there was a significant difference between the results before and after being given a digital module based on personal context. The t-value is greater than t-table, which is $13.587 > 2.032$ and Sig. (2 tailed) $= 0.000 < 0.05$, then H_0 was rejected and H_1 was accepted. Thus, it can be concluded that there was an influence on student learning outcomes between before and after being given a digital module based on personal context. Based on the results of the analysis, there was an increase in the average between the pre-test

and post-test and there was influence of the digital module based on personal context on student learning outcomes. Thus, it can be concluded that the digital module based on personal context was effective.

Discussion

This development research produces a product in the form of a personal context-based digital module that was considered valid, practical and effective. This digital module was presented in the form of an application connected to the internet. The development of this personal context-based digital module paid attention to the teacher's promote action. The personal context-based digital module was declared valid after fulfilling the completeness of the personal context-based digital module components, the suitability of the learning materials, the presentation of the learning materials, the accuracy of the choice of words and language used, and the appearance of the personal context-based digital module. This is in accordance with the purpose of the personal context-based digital module, which is to improve student learning outcomes. This is in line that the personal context-based digital module is said to be valid and suitable for use because the module meets the material in accordance with the indicators, the material is in accordance with the learning objectives, the explanation of the sentences is short and clear and does not cause double meanings, and the language used is in accordance with the level of thinking development (Aspriyani & Suzana, 2020; Rahmaniah & Zainuddin, 2023). In addition, the results also stated that the worksheet is said to be valid because it meets the didactic, content, presentation, and linguistic aspects (Erawati et al., 2022; Erita et al., 2022).

This development research produces a product in the form of a personal context-based digital module that was considered valid, practical and effective. This digital module was presented in the form of an application connected to the internet (Auliah et al., 2020; Erawati et al., 2022). The development of this personal context-based digital module paid attention to the teacher's promote action. The personal context-based digital module was declared valid after fulfilling the completeness of the personal context-based digital module components, the suitability of the learning materials, the presentation of the learning materials, the accuracy of the choice of words and language used, and the appearance of the personal context-based digital module. This is in line with that the personal context-based digital module is said to be valid and suitable for use because the module meets the material in accordance with the indicators, the material is in accordance with the learning objectives, the explanation of the sentences is short and clear and does not cause double meanings, and the language used is in accordance with the level of thinking development (Herianingtyas et al., 2023; Suryani et al., 2020).

Meanwhile, the results of the student response questionnaire analysis in the very practical category. Students responded to the personal context-based digital module that was used very well. Students stated that the appearance of the personal context-based digital module was attractive, the writing, pictures, tables on the digital module were easy to read and clear, the material on the personal context-based digital module was easy to understand because it was related to everyday life, the module helped students understand arithmetic sequences and series, and students were more motivated to learn. This is in line with the results of research that students are very motivated when learning using digital modules (Aspriyani & Suzana, 2020; Indariani et al., 2018; Rahmaniah & Zainuddin, 2023). Digital media is also easy to use and very helpful in the learning process because it is able to provide a concrete picture of mathematics material (Mardati, 2021). Students made good use of personal context-based digital modules and solved all problems in the personal context-based digital module. Learning activities carried out by teachers also gave rise to promote actions or activities that are in the nature of offering students to carry out activities. This was shown

when the digital module link was shared with students, students immediately opened and studied the existing activities themselves. Students understood the material and problems given in the personal context-based digital module, through the instructions given without any explanation from the teacher. Students asked for clarity of the concept and intent of the problem given because they did not understand, without waiting for a request to ask questions from the teacher.

Based on the influence of personal context-based digital modules on student learning outcomes and the increase in learning outcomes from pre-test to post-test, it can be concluded that personal context-based digital modules on sequence and series material were effective. Previous research findings also revealed that E-modules can make it easier for students to learn (Chia et al., 2023; Nurhandayani et al., 2022). Based on the results of this study and several previous studies, it can be said that e-modules that are well designed and developed based on student characteristics will be practical and effective for use in mathematics learning (Aspriyani & Suzana, 2020; Chia et al., 2023; Melasari et al., 2022; Nurhandayani et al., 2022). This could be because students have never used e-modules before, so e-modules provide a new atmosphere in the learning process. In addition, e-modules are also designed in such a way that they are in accordance with student characteristics, the material in the module is presented clearly and easily to understand, and practice questions are given to strengthen student understanding. As a result, students become motivated in their learning so that it has an impact on better learning outcomes. A better learning outcome will simultaneously have a positive effect on problem-solving abilities. Mathematics learning outcomes show students' ability to solve mathematics problems, both routine and non-routine (problems). This means that e-modules that are valid, practical, and effective can be said to have an effect on students' problem-solving abilities. The ability to solve problems itself is one of the main goals in learning mathematics (S Maf'ulah, 2022; Syarifatul Maf'ulah & Juniati, 2020). Thus, the development of mathematics e-modules can be used as an alternative learning resource for students to develop problem-solving skills.

4. CONCLUSION

The personal context-based digital module based on teacher promote action met the valid aspects based on the validation results by the validator with valid category. The personal context-based digital module based on teacher promote action met the practical aspects based on student observation results, teacher response questionnaires and student response questionnaires with practical category. The personal context-based digital module based on teacher promote action met the effective criteria based on the average increase between the pre-test and post-test and the influence of the personal context-based digital module based on teacher promote action on student learning outcomes. Therefore, based on those three results, the personal context-based digital module based on teacher promote action was proved to be feasible to use because it met the valid, practical and effective aspects to improve students' learning outcomes in the topic of arithmetic sequences and series.

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