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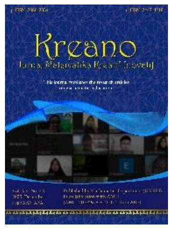

Design Of Student Live Worksheet to Support Students' Computational Thinking Skills Through Differentiation Learning

Echa Alda Melinia[1], Budi Mulyono[1], and Anita Desiani[1]

[1]Universitas Sriwijaya, Palembang, Indonesia

Correspondence should be addressed to Budi Mulyono: budimulyono.unsri@gmail.com

Abstract

Current mathematics learning methods limit students' computational thinking (CT) skills, because teaching focuses on knowledge and lacks abstraction and algorithmic thinking. To improve CT skills, a differentiated learning approach can be applied, using problem-solving strategies such as direct worksheets and technology-based learning. This study designed a Student Live Worksheet (SLW) for arithmetic sequences and series material, which combines Pagaralam contexts to motivate learning. The ADDIE development model was used to create a valid and practical SLW, which was tested on grade X students of one private vocational school (SMK) in Pagaralam. The SLW, which was validated by three experts, received a validity rating of 84.28% after revision and based on the practicality questionnaire, the percentage of practicality was 89,58%. Its practicality was demonstrated by student engagement during the trial. The SLW is independent, adaptive, and user-friendly, with facilities provided according to students' learning interests, and an attractive design. It serves a variety of electronic devices and fosters creativity in learning. This research can serve as a reference for further development in other mathematical topics to support computational thinking skills. The SLW developed is proven to be valid and practical, and effectively supports students' computational thinking skills. Therefore, it can be used as a useful tool in differentiated mathematics instruction and adapted to various contexts.

Keywords: Design and Development; Student Live Worksheet; Computational Thinking Skill; Differentiated Learning.

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Abstrak

Metode pembelajaran matematika yang ada saat ini membatasi kemampuan berpikir komputasional (CT) siswa, karena pembelajaran berfokus pada pengetahuan dan kurang abstraksi serta berpikir algoritmik. Untuk meningkatkan kemampuan CT, pendekatan pembelajaran terdiferensiasi dapat diterapkan, dengan menggunakan strategi pemecahan masalah seperti lembar kerja langsung dan pembelajaran berbasis teknologi. Penelitian ini merancang Lembar Kerja Siswa (LKS) untuk materi deret dan deret aritmatika, yang menggabungkan konteks Pagaralam untuk memotivasi pembelajaran. Model pengembangan ADDIE digunakan untuk membuat LKS yang valid dan praktis, yang diuji coba pada siswa kelas X di salah satu SMK swasta di Pagaralam. LKS yang telah divalidasi oleh tiga orang pakar ini memperoleh peringkat validitas sebesar 84,28% setelah direvisi dan berdasarkan angket kepraktisan, persentase kepraktisannya sebesar 89,58%. Kepraktisannya ditunjukkan dengan keterlibatan siswa selama uji coba. LKS bersifat mandiri, adaptif, dan mudah digunakan, dengan fasilitas yang disediakan sesuai dengan minat belajar siswa, dan desain yang menarik. Ini berfungsi untuk berbagai perangkat elektronik dan menumbuhkan kreativitas dalam pembelajaran. Penelitian ini dapat menjadi referensi untuk pengembangan lebih lanjut dalam topik matematika lainnya untuk mendukung keterampilan berpikir komputasional.

INTRODUCTION

Technological developments have experienced rapid progress, especially in the field of education which requires students to have knowledge, innovation, life skills and abilities in the fields of technology, media and information (Helsa, Turmudi, et al., 2023; Komar et al., 2022). In the 21st century, we are expected to be able to think in a complex way and also be able to think computationally (Mendrofa, 2024). Computational thinking is the most important thing in dealing with the dynamics of life (Diantary & Akbar, 2022). Computational Thinking skills are suitable or appropriate to be applied in a wide range of fields (Maharani et al., 2020; Mustafa, 2023). This is supported by Wu, Silitonga, and Murti (2024), who demonstrated that integrating CT into writing instruction significantly improves students' writing abilities and higher-order thinking skills. Their findings indicate that CT can be effectively applied across various disciplines, not limited to STEM fields. One of these skills can help teachers adapt to technological developments. (Mardianti et al., 2023). In addition, Piedade and Dorotea (2023) demonstrated that fourth-grade students who engaged in Scratch-based learning activities throughout the year scored significantly higher in computational thinking assessments than those in the control group. Their study reinforces the idea that digital and interactive learning platforms can be effective tools to support CT development, even from an early age.

Computational thinking skills are a person's way of solving problems, not a person's way of thinking like a computer (Suharto, 2022). However, despite its wide endorsement, computational thinking remains inconsistently defined and often conflated with programming (Ezeamuzie & Leung 2021). Wing (2006) said that CT uses one of the techniques in understanding, examining and digesting a problem faced by adopting the way of thinking of computer experts, including Decomposition, Pattern Recognition, abstraction and algorithms (Maharani et al., 2019). To further operationalize computational thinking in educational settings, PALTS and Pedaste (2020) proposed a structured model consisting of three stages: defining the problem, solving the problem, and analyzing the solution. Each stage includes essential CT skills such as abstraction, decomposition, algorithmic design, generalization, and evaluation. This model provides a strong foundation for developing learning tools like Student Live Worksheets (SLW), which aim to cultivate CT in a more systematic way. In line with this, Kafai and Proctor (2022) emphasize that cosmputational thinking has evolved beyond merely technical problem-solving. It has expanded into a broader concept known as computational literacies, which incorporate aspects such as identity, participation, creative expression, and critical awareness of the social impacts of computing. This transformation reflects a redefinition of what it means to be computationally literate in the 21st century. Despite the increasing attention given to computational thinking in education, there remain several unresolved issues in designing effective learning experiences. According to Angeli and Giannakos (2020), "there is still limited evidence around the several issues and challenges someone needs to be aware of in order to design appropriate learning experiences for CT competences." This highlights the urgent need for practical, student-centered tools such as Student Live Worksheets (SLW) to support the implementation of CT in meaningful ways. Students' computational thinking abilities in Indonesia are still low, especially in terms of abstraction and algorithmic thinking. Their findings show that students tend to be proficient only in basic aspects such as decomposition and pattern recognition, while their ability to think abstractly and systematically is still underdeveloped (Angraini et al., 2024).The low computational thinking skills of students in Indonesia are also a serious concern for education experts (Dahshan & Galanti, 2024). That students have limitations in computational thinking abilities, in solving mathematical problems they are still limited to decomposition and pattern recognition only, and abstract thinking and algorithmic thinking abilities are not yet visible because in solving problems students are not complete and systematic (Meitjing & Fuad, 2023).

In order to support computational thinking, it is necessary to integrate it into learning tools. One of the learning tools that can be used is in the form of student activities called student worksheets (SW) which need to be arranged in accordance with the independent curriculum (Kwon et al., 2024). In the 21st century era where increasingly sophisticated technology provides convenience in arranging SW, namely by utilizing electronic-based SW or what is often called SLW. In line with previous studies to support the need for the development of SLW related to CT, including Rahmania's research (2023) the need to develop SLW with a computational thinking approach to improve students' critical thinking skills (Rahmania et al., 2023). Batul et al, (2022) states that computational thinking skills have a significant influence due to the development of learning tools based on a realistic approach.

The material of sequences and series is material that is closely related to indicators of computational thinking abilities which include decomposition, pattern recognition, algorithmic thinking, pattern generalization and abstraction.According to Hapizah, Mariela and Mulyono (2024), the results of their study on seventh-grade students showed that students' computational thinking skills were strongest in the aspects of algorithm and decomposition, while their abilities in pattern recognition and abstraction were still relatively low. This finding indicates that students face difficulties in thinking abstractly and systematically, which are essential components in developing computational thinking skills. Lack of CT abilities in students can hinder their progress in understanding information and communication technology, which is an important need in this digital era (Angraini et al., 2022) Therefore, it can be concluded that computational thinking skills in mathematics are still low, which can be an obstacle in understanding the material on sequences and series. This material is taught in grade X of SMA/SMK.

The factor that causes the low computational thinking ability of students in mathematics is that the current learning method limits the CT ability of students. Most students feel that learning tends to be boring because educators only teach knowledge so that students do not have abstraction and students' algorithmic thinking is not yet visible (Aminah et al., 2023; Muslimin et al., 2022). In accordance with existing conditions, according to Afifah et al., (2023) a learning strategy is needed that is adjusted to improve students' abilities, especially for students with medium and low abilities, Therefore, the learning strategy that has been formulated to support students' computational thinking skills is to use a differentiated learning approach. Differentiated learning is a form of effort in the learning process that pays attention to students' needs in terms of learning readiness, student learning profiles, interests and talents (Nurfata & Pujiastuti, 2023). In addition to supporting students with medium and low readiness, differentiated online learning is also essential for engaging high-ability learners. McKoy and Merry (2023) emphasized that differentiated learning environments must also include enriched tasks, flexible pacing, and deeper content access to keep advanced learners meaningfully challenged and motivated. This reinforces the importance of designing SLW that accommodates all levels of student readiness. The interesting thing about implementing the independent curriculum is that differentiated learning presents learning that facilitates the diversity of characters and can be realized in content differentiation, process differentiation and product differentiation (Balkist et al., 2023) However, implementing differentiated learning to facilitate the diverse characters of students is not an easy thing (Nurfata & Pujiastuti, 2023).

In the material on sequences and series that is designed and developed regarding the use of learning media, it really supports teachers in the learning process (Helsa, Suparman, et al., 2023), In this case, the use of SLW with a differential approach is an effective and efficient solution (Mulyono et al., 2023). One of the problem-solving strategies that can be used as an electronic learning media for mathematics is liveworksheet. The liveworksheet program can provide a design for SLW interactively. This is in line with research (Utami et al., 2022) SLW that uses liveworksheet can be designed according to its users, making it easier to understand the material, and honing students in critical thinking. This is also supported by Le and Prabjandee (2023), who reviewed the Liveworksheets platform and found that "students can do the worksheets online and submit their answers to the teacher. This feature provides immediate feedback to students. It also helps teachers save time for task design, and formative assessment, and is environmentally friendly." Furthermore, they state that "teachers can integrate audio, video, and hyperlinks to transform learning beyond the printed pages." These findings support the use of Liveworksheet as a platform to design Student Live Worksheets (SLW) that are interactive, efficient, and aligned with 21st-century learning needs. The addition of digital visualization makes the learning process more interesting and effective for students (Ostian & Mulyono, 2023). and learning that links mathematical concepts and local wisdom of the area where students live can help students' understanding and achievement of the material being studied (Farman et al., 2021). The characteristics of SLW that will be developed related to differentiated learning supporting computational thinking skills are taken from the process aspect, in the differentiation process teachers can provide a variety of learning activities to students that are adjusted based on student mapping. In the process aspect, forms of differentiation in SLW may include activities such as group discussions, independent exploration, contextual experiments, and digital-based simulations. These activities are designed according to students' readiness, learning styles, and interests. This design approach is in line with the findings of Kim, Leftwich, and Castner (2024), who found that teachers at the early childhood level consider both personalized activities and pre-designed curricula to foster computational thinking. They emphasized that curriculum design must align with students' developmental appropriateness, learning preferences, and social contexts. Such practices not only enhance CT skills but also support students' motivation, collaboration, and growth mindset. According to Gheyssens (2024), an effective differentiated instruction approach adjusts the learning process so that students can access the material in ways that best suit them, thereby encouraging active participation and deeper understanding. Mathematics teachers have widely carried out this learning, but digital applications for this learning, especially for the relationship between the concept of sequences and series and local wisdom of Pagaralam, are not yet available.

In previous research conducted by previous researchers, Computational Thinking Skills used many project-based problem-solving learning strategies (Astuti et al., 2023). help students' mathematical understanding (Azmi & Ummah, 2021). In previous studies that used problem-based mathematics learning strategies, students' learning outcomes were able to improve, when compared to classes that did not use learning strategies (Kharomah et al., 2023; Mulyono et al., 2019). *Computational Thinking Skills have become part of the independent curriculum with intracurricular learning with diverse content so that students can be more optimal and have enough time to explore concepts.* (Mukhibin et al., 2024), strengthen student competencies so that the right learning strategy greatly supports student problem solving in mathematics. However, there has been no research related to Computational Thinking Skills through differentiated learning with the characteristics of SLW that uses local wisdom of Pagaralam related to sequence and series material, where differentiated learning is closely related to the concept of the Merdeka curriculum. Technology-based learning plays an important role in the learning process, so by using SLW teaching materials with Pagaralam local wisdom, it can expand students' knowledge and motivate students in learning, because technology with nuances of local wisdom of the students' area in learning aims to facilitate the learning process. However, there has been no research that integrates Student Learning Worksheets (SLW) based on local wisdom with differentiated learning strategies to support computational thinking skills in the context of sequence and series topics. This gap indicates the need to design SLW that aligns with students' characteristics and promotes higher-order thinking through differentiated learning approaches. Based on the description above, the problem formulation in this study is: How to design Student Live Worksheets (SLW) based on local wisdom and differentiated learning to support students' computational thinking skills in the context of sequence and series material?.

METHOD

This study is a design research study with the ADDIE development studies model type which aims to produce Student Live Worksheets (SLW) for sequence and series material to support valid and practical computational thinking skills and to see the potential effects of the SLW produced. The subjects in this study were grade X students of SMK Muhammadiyah Pagaralam in the odd semester of the 2024/2025 academic year. The selection of subjects used a purposive sampling technique, where the selection was based on recommendations from teachers and the availability of students.

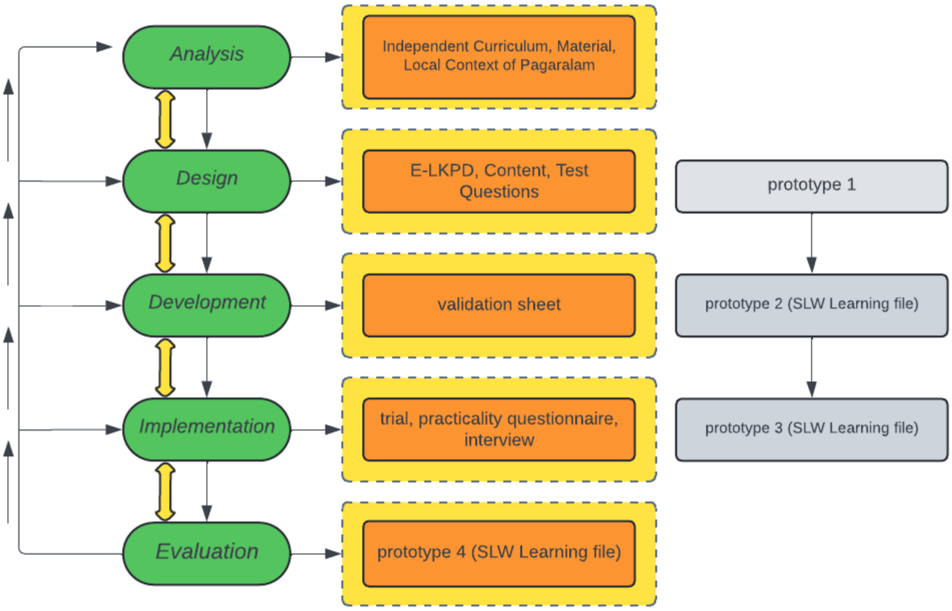


Figure 1. Flowchart of Research Development Model

At the analysis stage, problems in learning mathematics at vocational schools and environmental conditions based on the applicable curriculum are carried out. Things that are done at the analysis stage are analyzing student needs, analyzing student characteristics, analyzing learning resources, analyzing the curriculum and learning materials. The purpose of the design stage is to verify the needs required. The general procedure associated with the design stage is to design the problem. Designing Problems/Questions is a real problem that is in accordance with the knowledge of grade X vocational school students. Designing SLW, the SLW that is designed is SLW to support Computational Thinking Skills. At this development stage, SLW is created with an initial design that is made directly through the Canva application. The questions that have been created are included in the design. At this implementation stage, a field test was carried out on 32 research subjects using SLW learning media for 4 meetings. At the evaluation stage, the target was to assess the validity and practicality of the SLW product. The validation was conducted at the expert review stage, involving three experts in mathematics education and instructional media. These experts assessed the SLW using a validity questionnaire covering content, construct, and language aspects. Their feedback was used to revise the product before field testing. The practical aspect was then tested through small group implementation using student questionnaires to evaluate usability in the learning process.

The research instruments used in this study were expert validation sheets and student questionnaires. The expert validation sheets were designed to assess the SLW product in terms of content, construct, and language aspects. Meanwhile, student questionnaires were administered to evaluate the practicality and usability of the product after implementation. The data collection technique in this study was a questionnaire for product validation and a questionnaire to obtain the practicality of the developed product. The questions used were closed-ended and designed using a 4-point Likert scale. The analysis techniques applied were validity analysis and practicality analysis. The results from both questionnaires were calculated using the Likert scale, and the final validity score was interpreted using the criteria presented in Table 1.

Table 1. Validity Criteria

Validity Level	Validity Criteria
0,1% - 50%	Invalid
50,1% - 70%	Invalid or may not be used
70,1% - 85%	Quite valid or usable with minor revisions
85,1% - 100%	Very valid or can be used without revision

Adapted from (Tuljannah & Khabibah, 2021)

The questionnaire that was given at the small group stage was then analyzed to see the practicality of the product, the scores obtained were presented based on the criteria in Table 2.

Table 2. Practicality Criteria

Achievement Level	Information
$84\% \leq N_a \leq 100\%$	Very practical
$68\% \leq N_a \leq 84\%$	Practical
$52\% \leq N_a \leq 68\%$	Less practical
$36\% \leq N_a \leq 52\%$	Impractical
$20\% \leq N_a \leq 36\%$	Very non-proactive

(Sugiyono, 2013)

The Student Live Worksheet is declared practical if the average student response is at least in the practical category.

RESULT AND DISCUSSION

Results

The initial stage of this research is the analysis stage. Analysis of needs, curriculum, students and materials was carried out. Analysis of needs at SMK

Muhammadiyah Pagaralam designed the SLW learning device as a solution to learning innovation at SMK Muhammadiyah Pagaralam. The curriculum analysis of SMK Muhammadiyah Pagaralam is the Independent Curriculum, considering that the educational plan used for sequence and series material is material that is concentrated in class X odd semester. At the analysis stage, the students used for one to one became 3 people and 6 people will be subjects at the small group stage. Regarding the analysis of the material, the researcher used sequence and series material. At this design stage, the questions that will be used in the SLW that will be developed began to be designed. The researcher created problems with sequence and series material. After that, the researcher designed the SLW using Canva. The researcher designed any pages on Canva that would be used in the research. At this development stage, several stages were carried out to test the validity of the product that the researcher had developed, namely expert validation or expert review, one to one, and small groups.

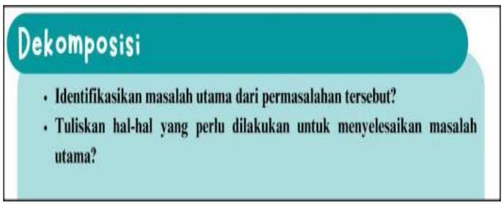
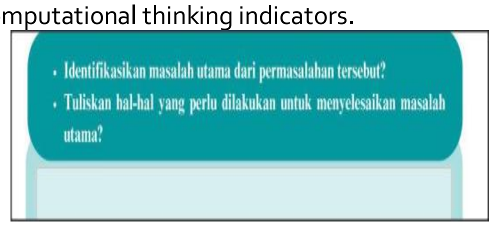
At this stage, Prototype I which has been prepared and evaluated by the researcher is then validated by several experts containing content, construct and language validation. Validation consists of 2 expert validators and 1 subject teacher. The result of valication can be seen in Table 3.

Table 3. Percentage of Validation Results for Each Aspect

No.	Aspects Assessed	Presentation
1.	Content	83,93%
2.	Construct	83,93%
3.	Language	84,82%
4.	Presentation	84,28%

Based on Table 1, the level of validity obtained is 84.28% which shows that the SLW material on arithmetic sequences and series is included in the category of quite valid and can be used with revisions so that it can be improved according to suggestions and input from the validators. The comment and suggestions and responses from validators can be seen in Table 4.

Table 4. Comments and Suggestions and Responses

Comments and Suggestions	Responses
The indicators in computational thinking for each question are deleted.  	Accepted, only questions that lead to computational thinking indicators. 

<table>
<tr>
<td>The background of the question is replaced with a brighter color contrast.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<td>Accepted, background color is replaced with light color.


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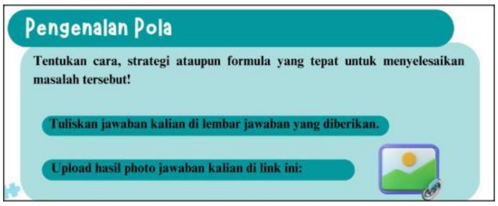
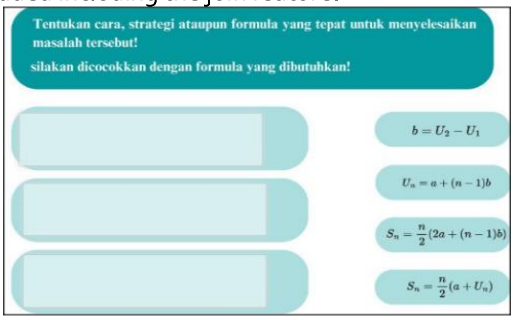
<tr>
<td>Add live-worksheet function feature


</td>
<td>Accepted, the use of the liveworksheet feature is added including the join feature.


</td>
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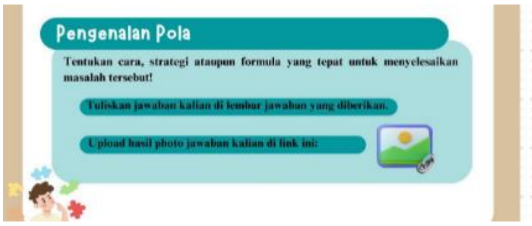
<tr>
<td>The use of paper based in liveworksheet does not show the role of the liveworksheet, it would be better if all of them added live worksheet.


</td>
<td>SLW no longer uses paper based, it is replaced by using elements on liveworksheets.</td>
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	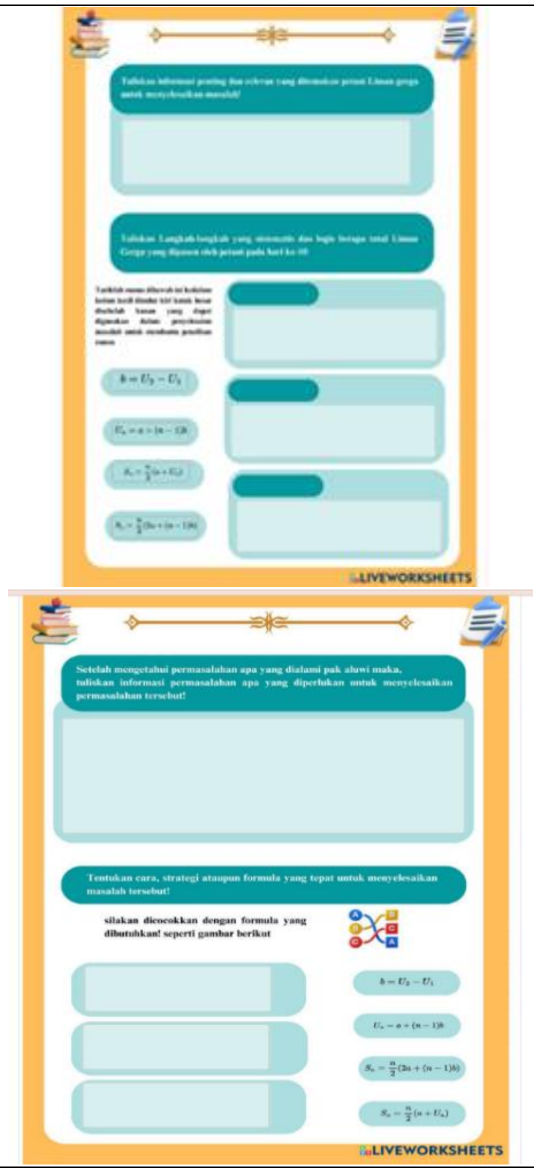
Add short reflective answers from students.	Accepted, added a short section for reflection for students. 

One to One

In addition to conducting expert reviews, Prototype I of the Student Live Worksheet (SLW) was tested on three students to further assess its validity. The students involved in this stage were selected from SMK Muhammadiyah Pagaralam based on teacher recommendations and participated voluntarily. During this limited trial, students were provided with SLW materials for the first meeting and SLW for the second meeting to solve the presented problems. The researcher also investigated the challenges faced by the students during the activity and provided a feedback form to collect their comments regarding the SLW.

During the implementation, several difficulties were identified. Students reported that some instructions were unclear, making it difficult to understand the tasks. Certain vocabulary used in the SLW was considered too complex for their level, and some illustrations were found to be irrelevant or not aligned with the context of the problems, leading to confusion. Additionally, limited internet connectivity hindered the use of the online Liveworksheet platform. In response to these challenges, students suggested improvements such as clearer instructions, simpler and more familiar vocabulary, more contextual and supportive illustrations, and better internet access to support the use of SLW. Based on this feedback, the researcher revised the SLW by refining the instructional text, simplifying complex terms, replacing inappropriate visuals with more relevant ones aligned with students' learning styles, and ensuring that internet access was adequate to support smooth implementation.

Small Group

Following the revisions made in the previous stage, the developed prototype advanced to Prototype II and was subjected to a small-group trial involving three groups, each consisting of two students representing different ability levels: low, medium, and high. This trial was conducted with participants distinct from the primary research subjects, aiming to assess the practicality of the developed Student Live Worksheet (SLW). In the implementation process, students were provided with the SLW in the first meeting and the SLW the second meeting to engage with the problems designed in accordance with the learning objectives. Furthermore, the researcher identified the challenges experienced by the students during the activity and facilitated the provision of feedback and suggestions via the Liveworksheet platform. The practicality of the SLW was evaluated through both small-group and limited-scale trials using student practicality questionnaires. The results of the questionnaire analysis indicated that the SLW achieved a mean score of 89.58%, categorizing it as very practical as presented in Table 2. These findings substantiate the conclusion that the SLW developed in this study satisfies the criteria for practical implementation in classroom learning contexts. Observations from the trial revealed that the majority of students were able to comprehend and complete the learning activities embedded within the SLW. However, several technical and pedagogical challenges were encountered. Students reported that although the SLW contributed positively to their understanding of the subject matter, limited internet access posed a constraint during online engagement. Accordingly, students recommended the development of an offline version of the SLW to enhance accessibility in areas with inadequate connectivity. Based on the feedback collected, it can be concluded that students responded positively to the SLW and provided constructive input that will inform further refinement of the learning tool prior to broader implementation.

Field Test

At this implementation stage, the aim is to see the potential effects of the SLW that has been developed. The potential effects observed can be seen from the time of working on the SLW which was then given test questions and interviews were conducted with the subjects that had been selected from the students of

SMK Muhammadiyah Pagaralam totaling 32 people. During the learning activities in the classroom using SLW, 2 meetings were held. Students were divided into groups of 4 people to make it easier for them to discuss working on problem-solving questions. Before working on the SLW, students were given material first and then they were asked to work on the problems contained in the SLW.

In the first and second meetings, the researcher gave the SLW liveworksheet barcode based on Computational Thinking skill meeting 1 to the students so that they could access it using their mobile phones through their respective browsers. The SLW meeting 1 contains non-routine problems on the material of arithmetic sequences and series about the context of the gerga lime fruit, which is the iconic fruit of Pagaralam so that students can more easily imagine the context. In the SLW there are also questions that lead to computational thinking indicators with the aim of supporting students to get used to using computational thinking skills. After all students have successfully accessed the barcode given and have opened the SLW meeting one, the teacher explains the sections on the SLW starting from the cover display then on the next page the teacher asks students to read the instructions for use contained in the SLW to make it easier for students to use the SLW given.

The teacher encourages students to read and pay attention to the learning achievements and learning objectives on the next page. Then the teacher directs students to watch the illustration video before reading the problem so that they are helped to understand what the problem is in the SLW. After watching the video, students are immediately directed to read and understand the problems below, then students are asked to answer the questions provided from number 1 to the last number. When working on the SLW, the teacher approaches each group one by one to see if there are any difficulties experienced by students. After all groups have finished answering the SLW, the researcher offers them the opportunity to ask if there is anything that needs to be asked about the learning that was just done. The teacher gives the opportunity to groups who want to present their answers while checking the answers with other groups.

Evaluation Stage

At this stage is the final stage of the ADDIE model, namely evaluation. Evaluation aims to determine the success of research and development. When working on SLW, students wait for teacher directions to move from one slide to the next, even though students can use SLW independently without having to wait for teacher directions to move to the next page. Obstacles were also found where students immediately answered questions on their worksheets because they were not used to using electronic LKPD. At this stage, the prototype 4 produced can be seen in Figure 2.

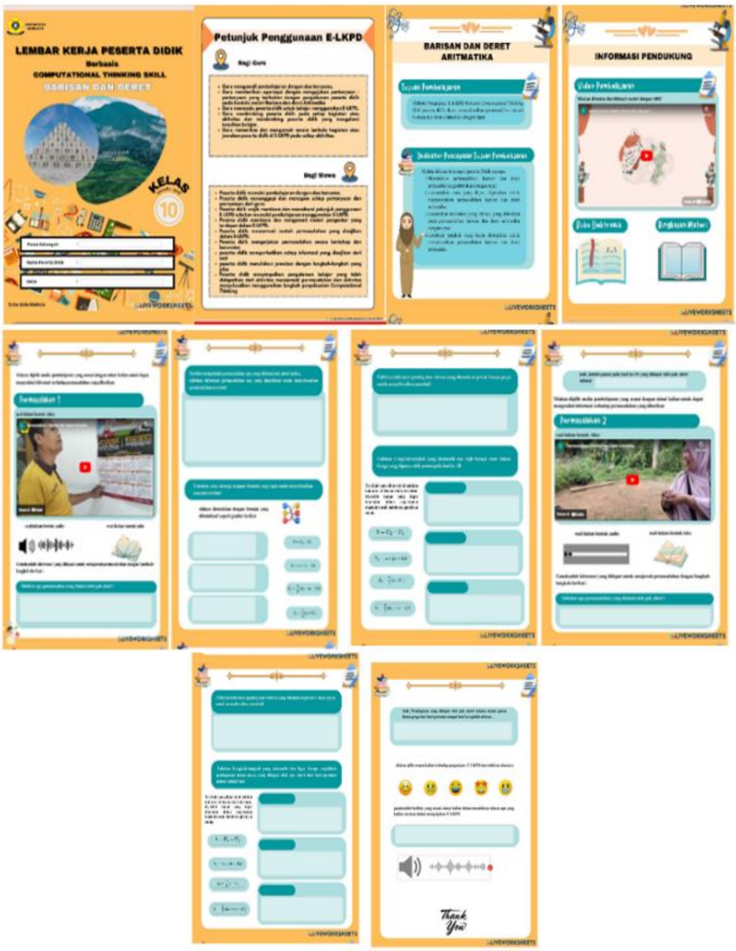

Figure 2. Prototype 4

Discussion

This study aims to produce SLW to support computational thinking skills in sequence and series material that is valid and practical and has a potential effect on students' computational thinking skills. The development of this product uses the ADDIE model, namely analysis, design, development, implementation and evaluation. The validity of the developed SLW is seen from the results of the validation of the researcher with three validators. There is a suggestion from the validator to reduce the number of problems to one problem in each SLW which the researcher originally made two problems in each SLW and then there is also a suggestion to delete questions that have the same meaning so that students do not waste time working on them. In line with what was found by (Wati & Nurcahyo, 2023) that lack of time can cause students who are able to work on the questions to not finish.

Then there is also a suggestion to change the words in the questions into words that are more commonly heard by students as stated by (Khatimah & Asdarina, 2020) using simple or easy-to-understand language for students can help overcome difficulties in understanding the material. After being corrected, re-validation was carried out on the four validators and the average percentage of validity was obtained at 84.28% with quite valid criteria for construct, language and content. The developed SLW has not yet obtained the maximum percentage because in terms of appearance and language, the SLW still needs to be improved. The developed

SLW obtained valid criteria because the E LKPD contains content, context and language that can be used to support students' computational thinking skills. This is in line with what Khasanah and Agung (2019) said that validity itself can be seen from determining the quality of the product from the learning devices made as seen from the existing material. After obtaining a valid SLW, the researchers then looked at the practicality of the developed SLW. Its practicality can be seen from the trial at the small group stage.

When using SLW, students were seen discussing and asking a lot and were enthusiastic about using the SLW provided. In line with (Kristiani et al., 2021) who said that video-based can make students more interested in learning. Students stated that the design of SLW is very interesting and SLW when used is quite easy to understand and can make students more interested in learning mathematics as seen from the interview results. As expressed by (Milala et al., 2021) the condition of the learning media that has been developed by users-students and teachers-so that learning becomes meaningful, interesting, fun, and useful for students and fosters creativity in learning is called practicality. In the SLW that has been developed, it has fulfilled the characteristics of self-instruction, namely students can use this SLW independently without being assisted by others, which can be seen when using SLW, students successfully complete both SLWs and also in SLW, a video tutorial on use has been provided which contains an explanation of use so that. In line (Wulandari et al., 2021) with that videos can make it easier for students to understand what is being taught. Then the next characteristic is stand alone or stand alone where this SLW can be completed without requiring other media teaching materials because in the SLW has also been given material in the form of number lines that students can try to understand the problem so that this SLW also has self-contained characteristics. In line with (Sari et al., 2020) that a good LKPD is an LKPD that does not depend on other teaching materials and describes the entire learning process. In this SLW, it has also followed the development of science and technology where this SLW can be accessed on all electronic devices that can access the internet and students can also directly provide answers online without having to submit them to their respective teachers so that they meet adaptive characteristics. Along with the very rapid development of technology, the teaching materials used must be able to follow the development of this technology (Hariyati & Rachmadyanti, 2022).

The SLW that was developed also meets user-friendly characteristics because it has an attractive color display for grade VII students with a display of outer space and clouds with dark blue nuances making students more enthusiastic about working on the E LKPD and there are videos that make them even more interested and can be accessed using their cellphones so that they can comfortably work on it. In line with Widiyani and Pramudiani (2021) the unique appearance of LKPD can attract attention so that it makes it easier for students to understand the material. The use of good and attractive colors makes students feel happy learning using LKPD (Juniarti et al., 2021). So that the E LKPD that is developed meets the five characteristics according to Puspitasari (2019) and Magdalena (2021), namely self-instructional, self-contained, stand alone, adaptive and user friendly.

The learning process for students is carried out using the form of differentiation implemented in the SLW focuses on process differentiation, where students are provided with the flexibility to choose methods for exploring and solving the problems presented. This approach allows learners to engage with the material in a way that aligns with their individual learning styles and paces, thereby enhancing their understanding and overall learning experience, not only that, students are invited to collect information and answer questions that have been given. By understanding the problem, it makes it easier for students to develop strategies used to get solutions. (Sabarikun & Heru Purnomo, 2023). Stating that in differentiating learning, teachers can modify the five elements of learning activities, namely learning materials, processes, products, environments, and evaluations. Mathematics learning with differentiated learning is very effective, because students understand better, it is more interesting because it uses SLW that is in accordance with the readiness of each student. (Febriana et al., 2023).

In addition to analyzing student test results, the researchers also analyzed six representative interviews with research subjects, namely 2 subjects with high AT and NR categories, 2 subjects with medium MD and MA categories and 2 subjects with low N and EA categories. Based on the meetings that have been held, the test subjects stated that by utilizing SLW students get help to solve problems. From the interview results it can also be seen that this SLW is very helpful for students to solve problems and supports computational thinking skills even though some of them still lack time to answer. As conveyed by Putri (2018) that solutions to non-routine problems cannot be found immediately because the problems are more complicated than routine problems.

Implication of Research

The findings of this study imply that the developed Student Live Worksheet (SLW) holds strong potential as an effective instructional tool for enhancing students' computational thinking skills, particularly in the topic of sequences and series for seventh-grade students. The SLW not only presents visually engaging and digitally accessible content, but it is also specifically designed to support differentiated instruction through interactive problem-solving processes. This approach allows students with varying levels of ability to actively participate in learning activities, as they are encouraged to develop problem-solving strategies tailored to their individual readiness and learning styles. The practical implications of using the SLW are evident from the positive responses provided by students during both the small group and limited trials, in which most students reported improved conceptual understanding and increased motivation to complete the tasks. Therefore, the SLW developed in this study is not only relevant for use in the classroom where the research was conducted, but it also has the potential to be adopted more broadly as part of curriculum innovation efforts aimed at fostering higher-order thinking skills, particularly in mathematics education in the digital era.

Limitation

However, this study is not without limitations. First, the implementation was limited to a small number of students within a specific educational context, which may affect the generalizability of the findings. Second, the use of digital platforms such as Liveworksheet requires stable internet connectivity, which became a challenge for some students during the trials. This indicates the need for an offline version of the SLW to ensure accessibility for all students, regardless of their technological infrastructure. Additionally, the development and testing phases focused primarily on the topic of sequences and series; thus, further research is recommended to explore the effectiveness of this approach across other mathematical topics and in diverse learning environments.

CONCLUSION

Based on the results obtained, it can be concluded that this study successfully produced two Student Learning Worksheets (SLWs) on the topic of arithmetic sequences and series, which fall under the "fairly valid" category with a validity score of 84.28%. This indicates that the SLWs can be used with some revisions to improve their quality. In addition, the SLWs also meet the practicality criteria, obtaining a practicality score of 89.58%, which places them in the "very practical" category. These findings demonstrate that the SLWs are not only feasible for classroom implementation but are also effective in supporting student engagement.

The developed SLWs exhibit several essential characteristics, including self-instructional design that allows students to study independently, self-explanatory content that minimizes the need for teacher intervention, communicative and interactive features that facilitate engagement, and additional support through tutorials and collaborative study groups. These characteristics make the SLWs especially valuable in promoting student-centered learning.

Furthermore, the integration of various digital features within the SLWs provides opportunities for students to practice and strengthen their computational thinking skills. By presenting differentiated and contextualized learning tasks, the SLWs cater to students' diverse readiness levels and learning preferences, thus supporting more meaningful and personalized learning experiences. These advantages suggest that the SLWs developed in this study can serve as an effective instructional tool, not only in the specific context of this research but also in broader educational settings aiming to enhance higher-order thinking skills in mathematics.

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