Jurnal Pedagogi dan Pembelajaran
Volume 7, Number 3, Tahun 2024, pp. 570-579
P-ISSN: 2614-3909 E-ISSN: 2614-3895
Open Access: https://doi.org/10.23887/jp2.v7i3.83540

Integrating Scratch-assisted Project-based Learning Worksheets to Enhance Students' Mathematical Problem-Solving Skills and Dispositions

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ARTICLE INFO

Article history:
Received July 30, 2024
Accepted October 17, 2024
Available online October 25, 2024

Kata Kunci:
Project Based Learning, Scratch, *LKS, Teorema Pythagoras*

Keywords:
Project Based Learning, Scratch, Students Worksheets, Pythagoras Theorem

ABSTRAK

Rendahnya keterlibatan siswa dalam pembelajaran matematika terjadi karena generasi siswa saat ini merupakan generasi digital native. Sementara itu pembelajaran matematikanya masih menggunakan pendekatan abad ke-20 atau pembelajaran yang berpusat pada guru (teacher-centered)*. Penelitian ini bertujuan menghasilkan Lembar Kerja Siswa (LKS) berorientasi pada model* Project-Based Learning *(PjBL) berbantuan* Scratch *pada materi Teorema Pythagoras yang dapat meningkatkan kemampuan pemecahan masalah dan disposisi matematis siswa. Penelitian ini merupakan penelitian desain dengan menggunakan prosedur penelitian Plomp, yang terdiri dari tiga tahapan utama: preliminary* research, prototyping phase, dan assessment phase*. Subjek penelitian ini adalah satu orang dosen, dua orang guru, dan siswa kelas VIII SMP. Instrumen penelitian meliputi lembar validitas untuk menguji kevalidan LKS, lembar kepraktisan untuk menilai kepraktisan LKS, tes esai, lembar observasi, serta angket disposisi matematis untuk mengukur efektivitas LKS. Data dianalisis menggunakan teknik analisis deskriptif kuantitatif. Hasil penelitian menunjukkan bahwa LKS yang dikembangkan memenuhi kriteria sangat valid berdasarkan penilaian ahli, sangat praktis berdasarkan uji coba di kelas, dan cukup efektif dalam meningkatkan kemampuan pemecahan masalah serta disposisi matematis siswa. Temuan ini menunjukkan bahwa integrasi model PjBL berbantuan Scratch dapat menjadi inovasi pembelajaran yang relevan dengan karakteristik generasi digital native, sekaligus memberikan kontribusi terhadap pengembangan pembelajaran matematika yang lebih interaktif dan berorientasi pada siswa.*

ABSTRACT

The low level of student engagement in mathematics learning is attributed to the current generation of students being digital natives. While mathematics instruction still relies on 20th-century approaches or teacher-centered learning methods. This study aims to develop a Student Worksheet oriented toward a Project-Based Learning (PjBL) model supported by Scratch for teaching the Pythagorean Theorem, designed to enhance students' problem-solving abilities and mathematical dispositions. The research adopts a design-based research methodology following the Plomp model, which includes three main phases: preliminary research, prototyping, and assessment. The subjects of this study consisted of one lecturer, two teachers, and eighth-grade junior high school students. Research instruments included a validity sheet to assess the Student Worksheet's validity, a practicality sheet to evaluate its practicality, essay tests, observation sheets, and a mathematical disposition questionnaire to measure the Student Worksheet's effectiveness. Data were analyzed using descriptive quantitative analysis. The findings indicate that the developed Student Worksheet meets the criteria of being highly valid, as assessed by experts, highly practical based on classroom trials, and moderately effective in improving students' problem-solving skills and mathematical dispositions. These results demonstrate that integrating the Project-Based Learning model supported by Scratch offers an innovative instructional approach aligned with the characteristics of digital native learners, while also contributing to the advancement of interactive and student-centered mathematics education.

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1. INTRODUCTION

Education in this era is faced with the challenge of formulating concepts and learning objectives that equip students with 21st century competencies. One of the 21st century competencies is problem-solving skills. Braca in several previous studies explained that problem-solving skills are the heart of Mathematics (Sulistyaningsih et al., 2019; Hendriana & Sumarmo, 2014). According to Polya in several previous studies, there are several steps in problem solving, including: a) understanding the problem; b) planning problem solving; c) implementing the problem solving plan; d) reviewing the results of problem solving (Romli, 2016; Widyastuti, 2015). In this 21st century, students with good mathematical problem-solving skills are certain to be able to become individuals with high competitiveness. In relation to this, the mathematical problem-solving skills of Indonesian students need to be optimized again.

One of the reasons why it is necessary to improve the mathematical problem-solving abilities of Indonesian students is the PISA results. Based on the results of PISA 2022, the mathematics score of Indonesian students is 366 and this score is still far below the international average score of 472. The results of PISA 2022 show that 82% of Indonesian students aged 15 years do not understand mathematics (their scores are at level 2 or less, compared to levels 5 or 6 which are the best scores in PISA participating countries). In order for students to be motivated, the problems presented must be able to arouse students' curiosity and if students feel motivated, then students will be persistent in solving problems, diligent in working on them, flexible in using the knowledge they have, and confident in solving problems (Moslimah, 2023; Fauziyah & Kartono, 2017). Some of these attitudes are part of the indicators of mathematical disposition. According to Hendriana in several other studies, mathematical disposition is defined as an interest and appreciation of Mathematics which is shown by a tendency to think and act positively, which includes self-confidence, curiosity, perseverance, enthusiasm for learning, persistence in facing problems, flexibility, sharing with others, and the ability to reflect on mathematical activities (Logawe et al., 2021; Hajar & Sari, 2018).

Mathematical disposition is one of the goals that we want to achieve in learning mathematics (Fitria et al., 2021;Astalini et al., 2019). Currently, the mathematical disposition of Indonesian students shows less than optimal results and most Indonesian students experience boredom in learning mathematics. This is reinforced by the results of previous studies which state that most of the percentage of average scores of students' mathematical dispositions are in the low category (Indriyani, 2019; Akbar et al., 2018). The challenge often faced in mathematics learning today is the low level of student involvement in learning mathematics (Sinaga, 2024; Putri et al., 2019). Low student involvement results in literacy competencies (mastery of concepts) in mathematics and numeracy (problem-solving skills) that are still not optimal. This low student involvement occurs because the current generation of students is a digital native generation. Mathematics learning still uses 20th century mathematics learning or teacher-centered learning (Dewi et al., 2024; Fajriah & Asiskawati, 2015). This statement is in line with the research results which state that students do not pay attention to teachers when Mathematics learning is taking place (Putri et al., 2019; Amallia & Unaenah, 2018).This indicates that the mathematics learning carried out by teachers is not in accordance with the characteristics of current students.

Based on the description above, it is necessary to have learning innovations that can improve students' problem-solving abilities and mathematical dispositions by increasing student involvement in mathematics learning. One of the learning innovations that can be done is by using Student Worksheets (LKS). Currently, there are many LKS that can train students' problem-solving abilities and mathematical dispositions. Several previous studies have developed LKS to develop problem-solving abilities and train students' mathematical dispositions, but the resulting LKS still have several weaknesses (Lintang et al., 2023; Destania & Riwayati, 2021; Yulianingrum et al., 2020).

To overcome the weaknesses of the LKS in previous research, the LKS that will be developed needs to be combined with a learning model, namely the Project Based Learning (PjBL) model.The project-based learning model is an innovative learning model that makes students the center of learning (Ovartadara et al., 2022; Melinda & Zainil, 2020). The PjBL model is able to trigger students' enthusiasm for learning mathematics and result in students becoming more active in participating in learning, and indirectly has an impact on increasing motivation, interest in learning, critical thinking skills, collaboration between students, and students' creative thinking skills (Eriska et al., 2023; Hosnan, 2014).

Through project work activities in the PjBL model carried out collaboratively, students are stimulated to understand problems, analyze information, and find creative and effective solutions. Project work activities in this PjBL model can improve students' critical thinking skills and collaboration skills (Anggraeni et al., 2024; Khoiriyyah et al., 2022). In order for the LKS developed to be in accordance with the characteristics of digital native generation students, to be able to increase student involvement, stimulate students to carry out in-depth mathematical exploration, and enrich students' learning experiences, it is necessary to integrate technology or digital tools in mathematics learning, one of which is coding.

One of the softwarewhich can be used to teach coding, namely Scratch. Scratch is a block-based visual programming language intended for children aged 8 to 16, but can be used by people of all ages (Sholeh et al., 2022; Citarsa et al., 2021).Scratch chosen as the application used by students to create projects, because Scratch uses a visual-based block concept. Its visual nature makes it very easy for students to program because it is free from textual syntax that is sometimes meaningless to students. Involving students in constructing a project with coding in Scratch is believed to be able to optimize student engagement in learning mathematics. Constructionism expressed by Papert emphasizes that learning will be effective if students are active in creating or producing a physical work that can be presented in the real world as an artifact (Eliyanti, 2018; Yuriza & Srimuliati, 2017).In principle, this constructionism focuses more on learning-by-making, which means that students are given space to try to use their knowledge, both knowledge of teaching materials and computational thinking knowledge to construct something through trial and error. Therefore, student engagement is one of the causes of student success in building mathematical concepts.

There are research findings stating that, LKS oriented towards the PjBL model is able to effectively improve students' mathematical problem solving abilities (Fadli et al., 2024; Hikmiyah, 2021). The results of further research revealed that Scratch-assisted LKS is very good for use in learning Mathematics and the use of Scratch-assisted learning media has an effect on students' mathematical understanding abilities. (Ningrum & Novtiar, 2023; Nurhasanah et al., 2023). The use of LKS is also able to improve problem solving skills and is able to improve students' mathematical disposition (Lintang et al., 2023; Wanabuliandari, 2016). There are two previous studies with the results that the use of Scratch-assisted learning media is able to optimize problem-solving abilities and mathematical understanding student (Ningrum et al., 2023;Ningrum & Novtiar, 2023).

Based on several research results, it can be said that LKS and Scratch are effective teaching materials used to improve students' academic achievement in mathematics learning which has an impact on improving students' problem-solving abilities and mathematical dispositions. It's just that in previous studies, there has been no study related to LKS oriented to the PjBL model assisted by Scratch on the Pythagorean Theorem material which aims to improve students' problem-solving abilities and mathematical dispositions. Therefore,This study aims to produce Student Worksheets (LKS) oriented to the Project-Based Learning (PjBL) model assisted by Scratch on the Pythagorean Theorem material which can improve students' problem-solving abilities and mathematical dispositions. The results of this study are expected toimprove students' problem solving abilities and mathematical dispositions.

2. METHOD

The development research conducted aims to develop a PjBL model-oriented LKS assisted by Scratch on the Pythagorean Theorem material to improve students' problem-solving abilities and mathematical dispositions. The subjects of this study were students of class VIII of SMP Negeri 1 Kuta Utara who played a role in obtaining data related to the practicality and effectiveness of the developed LKS and the mathematics teacher of class VIII of SMP Negeri 1 Kuta Utara who played a role in obtaining data related to the practicality of the developed LKS. The development of this LKS uses the Plomp development model with stages including: preliminary research, prototyping, and assessment (Febrina et al., 2022; Suharta, 2018).

The preliminary research stage focuses on needs analysis and mathematics learning analysis in the classroom. Some activities carried out at this stage include: conducting observations on the implementation of learning in the classroom, conducting interviews with grade VIII mathematics teachers and several grade VIII students regarding the situation and obstacles experienced during the learning process, and conducting document analysis, namely related to the results of learning mathematics in grade VIII and reviewing learning tools used in the mathematics learning process in the classroom. The prototyping stage focuses on product design. Some activities carried out at this stage include: validating the developed LKS (prototype I) by the validator, conducting limited trials related to prototype II that has been produced, and conducting field trials I related to prototype III that has been produced. The assessment stage focuses on optimizing the quality of the developed LKS (prototype IV), so that from this stage the final product is obtained.

The research data were collected using observation and interview methods, questionnaires, and tests. The research instruments used in this study consisted of: (1) to measure the validity of the LKS, a validation sheet filled out by the validator was used; (2) to measure the practicality of the LKS, an LKS implementation sheet, teacher response questionnaire, and student response questionnaire were used; (3) to measure the effectiveness of the LKS, a mathematical problem-solving ability test (pre-test-post-test), a mathematical disposition observation sheet, and a mathematical disposition questionnaire were used.

The data analysis technique for testing the validity of the LKS is carried out with the following steps: (1) determining the average score obtained from each validator; (2) adding up the average score obtained from each expert, then determining the overall average score; (3) converting the overall average score into a qualitative value. The analysis of the practicality of the LKS is carried out with the following steps: (1) determining the average score of the student response questionnaire to the LKS and the average score of the teacher response questionnaire to the LKS; (2) converting the average score of the student response questionnaire and the average score of the teacher response questionnaire into a qualitative value. The implementation of LKS is analyzed by determining the average total score of each observer, then determining the average of both observers, and converting it into a qualitative value. The analysis technique to measure the effectiveness of LKS is carried out with the following steps: (1) testing the normality of research data; (2) conducting a hypothesis test with a paired sample t-test; (3) conducting an N-Gain test to determine the extent of the increase in students' problem-solving abilities and mathematical dispositions.

3. RESULT AND DISCUSSION

Result

This development research was conducted to produce a PjBL model-oriented LKS assisted by Scratch on the Pythagorean Theorem material that meets the criteria of being valid, practical, and effective. This research uses the Plomp development model whose stages include: preliminary research, prototyping, and assessment. The results of the preliminary research stage show several results. First, the learning process is not yet fully centered on students (student centered). Second, there is still a lack oflearning textbooks, LKS, and questions that can train problem-solving skills and increase students' interest in learning mathematics which has an impact on students' mathematical disposition. Third,Students tend to be passive and less involved in the learning process, and students are less motivated. Fourth, most students experience confusion and have to not continue solving HOTS math problems. Fifth, teachers rarely use software in teaching math. Sixth, students' daily summative test results are relatively low. Seventh,teachers have never applied the PjBL model in mathematics learning whose final product is done using software, one of which is Scratch. The results of the next stage (prototyping) are related to product development. The results of this stage are producing a prototype I, namely a PjBL model-oriented LKS assisted by Scratch on the Pythagorean Theorem material. This prototype I is then validated by the validator. In addition to the LKS, this stage also produces several supporting instruments that are used to test the validity, practicality, and effectiveness of the products made. Prototype I and the instruments that have been made are then validated by the validator. The validators in this study consisted of one lecturer from the Postgraduate Program of Ganesha University of Education and one teacher from SMP Negeri 2 Kuta Utara. Validity testing was carried out in order to obtain an initial prototype that was ready to be tested in a limited trial. The validation results of the developed LKS can be presented in Table 1.

Table 1. The Summary of LKS Validation Results

Validators	Average Score	Average Total Score	Category
Validator I	3.64	3.75	Very Valid
Validator II	3.86		

Based on the assessment of the validators on Table 1, then the average score is 3.75 which shows that the developed LKS is classified as very valid. It can be seen that from all aspects of validation measured, the developed LKS has met the very valid category which means that the LKS is very feasible to be implemented.The product trial process was carried out in three stages, namely limited trial, field trial I, and field trial II. The limited trial was carried out in class VIII F involving 30 students with various abilities. During this trial, 2 observers were also involved, namely the teacher who teaches mathematics in class VIII F of SMP Negeri 1 Kuta Utara and the researcher. From this limited trial, data was obtained related to the observation of the implementation of LKS (prototype II) which can be presented in Table 2.

Table 2. The Summary of LKS Implementation Sheet Score Results in Limited Trial

Meeting	Average Observer Score		Total	Average Total Score Each Meeting	Criteria
	Observer I	Observer II			
1	3.50	3.63	7.13	3.56	Practical
2	4.00	4.13	8.13	4.06	Practical
3	4.25	4.50	8.75	4.38	Very Practical
Overall Score Average				**4**	**Practical**

During the limited trial, student response questionnaires and teacher response questionnaires were also distributed. The results of the student response questionnaire and teacher response questionnaire after being analyzed and converted into practicality criteria respectively, namely 3.84 with the practical category and 4.3 with the very practical category. After prototype II was revised based on the results of the limited trial, it produced prototype III which will be tested again. This prototype III trial is called field trial I. This field trial I was carried out involving 32 students from class VIII H of SMP Negeri 1 Kuta Utara. During this trial, 2 observers were also involved, namely the teacher who teaches mathematics in class VIII H of SMP Negeri 1 Kuta Utara and the researcher. From this field trial I, data was obtained related to the implementation of LKS (prototype III) which can be presented on Table 3.

Table 3. The Summary of the Results of the LKS Implementation Sheet Scores in Field Trial I

Meeting	Average Observer Score		Total	Average Total Score Each Meeting	Criteria
	Observer I	Observer II			
1	3.63	3.63	7.25	3.63	Practical
2	4.00	3.88	7.88	3.94	Practical
3	4.13	4.13	8.25	4.13	Practical
4	4.13	4.25	8.38	4.19	Practical
5	4.25	4.38	8.63	4.31	Very Practical
6	4.38	4.38	8.75	4.38	Very Practical
Overall Score Average				**4.09**	**Practical**

During the first field trial, student response questionnaires and teacher response questionnaires were also distributed. The results of the student response questionnaire and teacher response questionnaire after being analyzed and converted into practicality criteria were respectively 4.45 with a very practical category and 4.50 with a very practical category. The effectiveness of the LKS in this first field trial was obtained from mathematical problem-solving ability test data consisting of pre-test and post-test as well as mathematical disposition observation data and mathematical disposition questionnaires. The effectiveness of this LKS is known from the results of the N-Gain test. Before the N-Gain test was carried out, the data was first tested for normality. Based on the results of the normality test, it was found that all data were normally distributed. To determine whether or not there was a significant effect on the differences in treatment given in field trial I, a paired sample t-test was conducted. The results of the paired sample t-test for the mathematical problem solving ability and mathematical disposition test data both obtained a significance value of 0.000, which means that there was a significant effect on the differences in treatment given in field trial I, namely before and after the use of LKS in learning.

Next, the N-Gain test was conducted and the average Gain-Score for the mathematical problem solving ability test was 0.62 with the criteria being quite effective and the percentage increase was 57%. Meanwhile, the average Gain-Score for the observation of mathematical disposition was 0.65 with the criteria being quite effective and the percentage increase was 70%.For mathematical disposition, in addition to the observation method, a mathematical disposition questionnaire was also distributed to ensure the level of students' mathematical disposition after being given treatment using the developed LKS. The average score of the students' mathematical disposition questionnaire was 81.74 with very high criteria. After prototype III was revised based on the results of field trial I, it produced prototype IV which will be tested again. This prototype IV trial is called field trial II or the assessment stage which is the last stage in the development stage of LKS in this study. Field trial II was carried out involving 34 students from class VIII J of SMP Negeri 1 Kuta Utara. During this trial, 2 observers were also involved, namely the teacher who teaches mathematics in class VIII J of SMP Negeri 1 Kuta Utara and the researcher. From this field trial II, data was obtained related to the implementation of LKS (prototype IV) which can be seen in Table 4.

Table 4. The Summary of the Results of the LKS Implementation Sheet Scores in Field Trial II

Meeting	Average Observer Score		Total	Average Total Score Each Meeting	Criteria
	Observer I	Observer II			
1	4.00	4.13	8.13	4.06	Practical
2	4.13	4.13	8.25	4.13	Practical
3	4.25	4.25	8.50	4.25	Very Practical
4	4.38	4.25	8.63	4.31	Very Practical
5	4.38	4.38	8.75	4.38	Very Practical
6	4.50	4.38	8.88	4.44	Very Practical
Overall Score Average				**4.26**	**Very Practical**

During the second field trial, student response questionnaires and teacher response questionnaires were also distributed. The results of the student response questionnaire and teacher response questionnaire after being analyzed and converted into practicality criteria were respectively 4.51 with a very practical category and 4.80 with a very practical category. The effectiveness of the LKS in this second field trial was obtained from mathematical problem-solving ability test data consisting of pre-test and post-test as well as mathematical disposition observation data and mathematical disposition questionnaires. The effectiveness of this LKS is known from the results of the N-Gain test. Before the N-Gain test was carried out, the data was first tested for normality. From the results of the normality test, it was found that all data were normally distributed. To determine whether or not there was a significant effect on the differences in treatment given in the second field trial, a paired sample t-test was carried out.

The results of the paired sample t-test for the mathematical problem solving ability and mathematical disposition test data both obtained a significance value of 0.000, which indicates a significant effect between the treatment before and after the use of LKS in learning. Furthermore, the N-Gain test was carried out and the average Gain-Score for the mathematical problem solving ability test was 0.69 with the criteria being quite effective and the percentage increase was 68%. The average Gain-Score for the observation of mathematical disposition was 0.73 with the criteria being quite effective and the percentage increase was 93%.For mathematical disposition, in addition to the observation method, a mathematical disposition questionnaire was also distributed to ensure the level of students' mathematical disposition after being given treatment using the developed LKS. The average score of the students' mathematical disposition questionnaire was 81.74 with very high criteria..

From a series of trials conducted, the average validity score of the developed LKS was 3.75 with a very valid category and the average practicality score of the developed LKS was 4.31 with a very practical category. Meanwhile, the level of effectiveness of the developed LKS was seen from the average Gain-Score total of the mathematical problem solving ability test, which was 0.66 with a fairly effective criterion and an increase percentage of 62%. The average Gain-Score total observation of mathematical disposition was 0.69 with a fairly effective criterion and an increase percentage of 81%. The average total score of students' mathematical disposition obtained from the distribution of the mathematical disposition questionnaire was 83.02 with a very high criterion.

Discussion

Based on the research results, the PjBL model-oriented LKS assisted by Scratch on the Pythagorean Theorem material has met the criteria of being valid, practical, and effective. The characteristics are: from the PjBL model-oriented LKS assisted by Scratch on the Pythagorean Theorem material, namely the LKS contains computational thinking activities with Scratch and contains project work activities that are completed with the PjBL phase using Scratch. As a comparison with previous studies, there are several previous studies that have developed PjBL model-oriented LKS, but there are several weaknesses in the results of these studies such as not integrating technology and there are studies that have integrated technology but still limit students in experimenting or exploring (Ating et al., 2023; Saputri et al., 2022; Hikmiyah, 2021). The results of this study are in line with previous studies which revealed that learning mathematics using PjBL-STEM has an influence on improving students' problem-solving and mathematical problem-solving abilities (Priyani, 2024; Priatna et al., 2022). The increase in mathematical problem solving skills is because during the learning process, students are given the opportunity to be actively involved in solving problems on the activity sheets provided and in completing projects in each group. Previous research also shows that the PjBL model also has an effect on students' mathematical dispositions (Hasibuan et al., 2022; Ritawati, 2019). The results of previous research revealed that the use of the PjBL model showed an increase in student interest in learning Mathematics (Eriza & Hadi, 2023; Sunita et al., 2019). PjBL encourages students to solve complex problems in the form of projects and find creative solutions to the project through learning activities that involve group work, where students must collaborate and communicate in completing the project they want to complete. Through this learning activity, students feel meaningful mathematics learning and this affects the development of students' mathematical dispositions.

The developed LKS is oriented towards the PjBL model, so that students certainly create a project from the problems presented in the LKS. The work on this student project is completed using a simple programming language, namely Scratch.Scratchusing the concept of visual-based blocks. Its visual nature makes it very easy for students to program because it is free from textual syntax that is sometimes meaningless to students. Scratch continues to develop as a platform to optimize student understanding, problem-solving skills, motivate students to be active, besides that scratch also helps students to be able to develop critical, algorithmic, and creative thinking skills, and is able to increase student enthusiasm in learning through interesting and fun visual programming activities (Fitriani & Yahfizham, 2024; Assulamy et al., 2023).

The combination of PjBL with Scratch aims to increase student engagement(student engagement) which has an impact on optimizing students' problem-solving abilities and mathematical dispositions. Previous research revealed that students who are truly engaged in the learning process have the behavior of always being diligent, active, never giving up, and responsible in following the mathematics learning process which will later affect the increase in students' academic achievement and optimizing students' mathematical problem-solving abilities. In addition, other research also states that mathematical disposition has a strong and significant positive relationship with students' mathematical problem-solving abilities (Rezita & Rahmat, 2022; Sa'adah & Ariati, 2020).This confirms that students who are truly engaged in the mathematics learning process are also certain to have a high mathematical disposition.

After the developed LKS is declared valid, practical, and efficient, it is necessary to create a flow of providing learning experiences to students when the learning process uses LKS oriented to the PjBL model assisted by Scratch. Learning trajectory is a path or process of providing experiences to students in order to achieve a change through the interaction of stimulus and response. In general, the learning trajectory for learning the Pythagorean Theorem when using LKS oriented to the PjBL model assisted by Scratch is divided into three activities: (1) identifying the concept of the Pythagorean Theorem using LKS oriented to the PjBL model assisted by Scratch, (2) understanding the concept of the Pythagorean Theorem through project completion activities on the LKS using Scratch, and (3) understanding the Pythagorean Theorem formulas and their application to solve more complex mathematical problems.

The activity is then hypothesized into HLT which then obtains a more detailed learning trajectory and is divided into four stages, including: (a) Informal Stage (Real World Situations), consisting of activities introducing the Pythagorean Theorem through case studies or relevant problems; (b) Model of Stage, consisting of activities understanding the basic concepts of Scratch programming which will later be used in constructing projects contained in the LKS; (c) Model for Stage, consisting of activities completing projects on the LKS through project completion activities using Scratch; (d) Formal Knowledge Stage, consisting of activities writing the Pythagorean formula used to determine the length of the sides of a right triangle and writing the natural number pattern which is a Pythagorean Triple. Integration of the Scratch-assisted PjBL model can be a learning innovation that is relevant to the characteristics of the younger generation digital native, while contributing to the development of more interactive and student-oriented mathematics learning. Innovation of Student Worksheets (LKS) based on the Project-Based Learning (PjBL) model with the help of Scratch has implications for increasing student involvement in Mathematics learning. The limitation of this study lies in the subjects that are limited to grade VIII students in one school only. Further research can determine broader subjects so that the research results can be maximized.

4. CONCLUSION

The innovation of Scratch-assisted PjBL-oriented LKS developed with the Plomp development model has a very valid validity value and a very practical practical value. Meanwhile, the level of effectiveness of the developed LKS is quite effective in improving students' problem-solving abilities and mathematical dispositions. Characteristicsfrom the Scratch-assisted PjBL model-oriented LKS, namely, the LKS contains computational thinking activities with Scratch and contains project work activities that are completed with the PjBL phase using Scratch.The learning path for the Pythagorean Theorem in the LKS developed here includes:(a) identifying the concept of the Pythagorean Theorem, (b) understanding the concept of the Pythagorean Theorem through project completion, (c) understanding related to the Pythagorean Theorem formulas and their applications.

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