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Innovating Electronic Worksheets for Students Using Project Based Flipped Classroom in Math Learning

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Abstrak
Rendahnya kualitas pembelajaran matematika disebabkan oleh kurangnya keterlibatan siswa dan kurangnya pemanfaatan teknologi dalam pembelajaran. Pemanfaatan teknologi dalam pembelajaran matematika dan partisipasi aktif siswa dalam proyek merupakan upaya untuk meningkatkan kualitas pembelajaran dengan harapan dapat meningkatkan kualitas proses dan hasil belajar siswa. Tujuan dari penelitian ini adalah membuat LKS elektronik menggunakan Project Berbasis *Flipped Classroom* (PjFC) yang valid dan praktis untuk siswa kelas X pada pembelajaran matematika. Jenis penelitian ini adalah penelitian dan pengembangan, berdasarkan model pengembangan yang dikemukakan oleh Plomp. Tahapan pengembangan model meliputi penelitian pendahuluan, tahap pembuatan prototipe untuk menilai validitas dan kepraktisan. Instrumen penelitian yang digunakan adalah evaluasi diri, angket validasi ahli dan *one-to-one*, kemudian pedoman wawancara untuk membantu memastikan keabsahan LKS elektronik, dan angket kelompok kecil serta pedoman wawancara untuk membantu mengkonfirmasi kepraktisan LKS elektronik kuesioner uji lapangan dan panduan wawancara. Berdasarkan penelitian dan analisis data dapat disimpulkan bahwa LKS elektronik yang menggunakan aplikasi *liveworksheets* dalam kategori sangat valid di kelas. Sedangkan persentase sebesar 95,89% tercapai pada kategori sangat praktis untuk kepraktisan penggunaan LKS elektronik oleh guru. Kategori sangat praktis memperoleh persentase nilai *one-to-one* sebesar 95,89%. Pada kategori sangat praktis, persentase nilai *small group* yang diperoleh sebesar 88,89%. Berdasarkan persentase di atas maka LKS elektronik menggunakan aplikasi *liveworksheets* pada pembelajaran matematika kelas X valid dan praktis.
Kata Kunci: LKS Elektronik; Project Berbasis *Flipped Classroom*; Pembelajaran Matematika.

Abstract
One of the reasons for the low quality of mathematics learning is the lack of students' involvement and the lack of use of technology in learning. The use of technology in mathematics learning and the active participation of students in projects is an attempt to improve the quality of learning in hopes of improving the quality of student processes and learning outcomes. The purpose of this study is to create electronics worksheet using Project-Based Flipped Classroom (PjFC) using valid and practical for grade X on mathematics learning. This type of research is research and development, based on the development model proposed by Plomp. Development model phases include the preliminary research, prototyping phase for judging validity and practicality. The research instrument used were self-evaluation, questionnaires of expert review and one-to-one, then interview guides to help confirm the validity of the electronic worksheet, and small group questionnaires and interview guides to help confirm the practicality of the electronic worksheet, field test questionnaire and interview guides. Based on the research and data analysis, it is possible to conclude that electronic worksheets employs

the live worksheet application in a very valid category in class. Meanwhile, a percentage of 95.89% was reached in the extremely practical category for the practicability of using electronic worksheets by teachers. The very practical category received a percentage of 95.89% for the students' one-to-one test scores. In the extremely practical category, the percentage attained for the small group test results was 88.89%. Based on the percentages above, electronic worksheets using the liveworksheets application on class X mathematics learning is legitimate and usable.

Keywords: Electronic Worksheets; Project Based Flipped Classroom; Math Learning.

I. INTRODUCTION

Education is an important aspect of an individual's life. Because education enables individuals to acquire and improve skills. In education, the atmosphere of the learning process drives educational success. The atmosphere of the learning process can positively develop the potential to have religious and spiritual strength, personality, intelligence and skills for oneself and one's environment (Fitriana, 2021). Learning, in general, is an interaction between a student and a teacher. Teachers distribute learning materials and students are encouraged to be active in class, develop creativity, and debate (Sriyanti, 2022).

One of the reasons for the low quality of mathematics learning is the lack of use of technology in learning (Mulyadi & Afriansyah, 2022). The use of technology in learning is an attempt to improve the quality of the learning process in hopes of improving the quality of student learning outcomes (Sriyanti, 2022). Advances in technology, information and communication are enabling various educational institutions to use e-learning systems to increase the effectiveness and flexibility of learning (Pane, 2017). In this case, technology needs to be integrated into the learning process, including teaching materials. One of the materials that can be converted to electronic form is student worksheets or so-called electronic worksheets. They are designed as electronic learning tools and contain interesting and systematic material to achieve expected competencies (Imansari, 2017; Nasrulloh et al., 2024). Based on our observations, we found that students were less creative, less critical thinkers, and less motivated to learn. Interviews with teachers revealed that during the learning process, teachers tried to use independent, curricular learning methods, but teachers struggled to create projects related to the material. There were limits to the production of technology-based learning media.

An effort to overcome this problem is the development of Android-based teaching materials in the form of electronic worksheets based on the Project Based Flipped Classroom. Electronic materials can be used independently, can be accessed anytime and anywhere, can be designed completely and systematically with special learning units, and the learning process is well networked (Rahayu, 2021; Hartono & Putra, 2022).

The applied problem-solving approach is research and development (Borg, 1989). Development research uses a trial-and-error approach to find new knowledge. Development research should provide practical and theoretical contributions. Finding innovative solutions to educational problems. The resulting product can offer users convenience, speed, and effectiveness. Research and development (R&D) is the process for developing and validating educational products. The steps in this process, commonly referred to as the R&D cycle, consist of literature review, product development, field testing, and modification according to what is learned in the field (Borg, as cited in Ramadoni, 2017). The research and development steps are as follows:

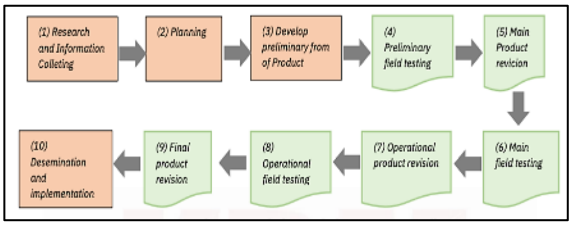

Figure 1. Borg & Gall R&D Steps

Based on the above, the characteristic of development is to conduct cyclical and repetitive research until a better product is created. Development research has an iterative nature to run several prototypes, as shown in the following figure (Plomp, 2013).

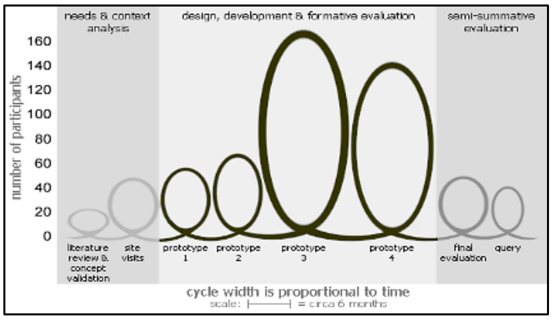

Figure 2. Plomp Development Phases

Based on the new Indonesian curriculum introduced in 2023, he argued that independent curriculum implementation in high school units, where project-based learning is strongly recommended, will help restore the quality of learning processes and outcomes. The Ministry of Education and Culture proposed in 2013 that the PjBL syntax in learning consists of six phases: 1) observing, 2) determining basic questions, 3) designing a project plan, 4) developing a project plan, 5) monitoring, 6) checking and evaluating results. To achieve project-based learning, many researchers try to combine it with the flipped classroom learning model.

The flipped classroom learning model is a learning phase in which the teacher presents concepts before class and does many exercises in class (Ramadoni & Mustofa, 2022). As stated more clearly in Reidsema (2017), the flipped classroom learning model is an activity in which students watch videos before class and engage in discussion activities in class. Many studies have shown that the flipped classroom learning model is successful in improving student learning outcomes (Adams, 2017; Lo, 2017; Zamorano, 2019; Chen, 2016).

On the other hand, many researchers face difficulties in implementing a flipped classroom learning model. I don't. The displayed videos are large and take a long time to download and view via social media (Kettle, 2013; Snyder, 2014; Schultz, 2014). Students can find it difficult to ask questions, and there are no platforms available to test students' comprehension before class (Bhagat, 2016). Pre-class activities are not continuous with in-class activities (Lai, 2016). Students do not have activity guides before and during class (Grypp, 2015; Smalhorn, 2017).

Several researchers have attempted to develop flipped classroom learning models such as: B. Project-based learning with flipped classroom (Agustina, 2021; Wen, 2017; Ekayana, 2022). The Project-Based Flipped Classroom (PjFC) combines project-based learning with the flipped classroom model. For your convenience, you can see it in the Figure 3.

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Figure 3. Basic Concepts of the Project Based Flipped Classroom Learning Model

These studies still focus on experimental studies that only test the developed learning models, and do not yet use a single platform that can support the process of learning models. On the other hand, no previous researchers have developed projects related to mathematical materials.

Electronics worksheets allow students to watch videos without downloading them. The electronic worksheet provides a video summary, question column, and writing section for practice exercises so students can watch the video in more detail. By using the platform during learning, students can be better guided and guided in all the activities they need to do both before and during class.

Apart from that, it is important to include activities in the form of working on projects related to mathematics. By working on a project, students are expected to actively participate in their learning. As more students engage in a variety of activities and participate directly in practice, their skills improve and lead to the achievement of expected learning goals. Based on the above description, researchers are interested in answering the above challenges by developing valid, practical and effective project-based flipped classroom electronic worksheets. The PjFC learning stages with electronic worksheet can be seen in the Figure 4.

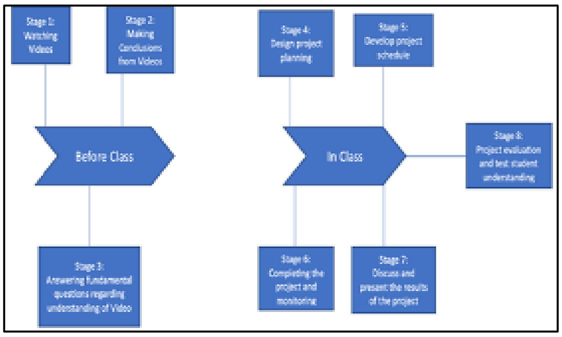

Figure 4. Electronic Worksheet using Project based Flipped Classroom Stages

Against this background, researchers would like to conduct a study titled "Innovating Electronic Worksheet for Students Using Project-Based Flipped Classroom in Mathematics Learning for Grade X".

Against the above background, the research questions of the study are listed, as follows: How to innovating electronic worksheet for students using project-based flipped classroom in math learning for grade X that is valid and practice?

II. METHOD

This kind of research is research and development. Research methods Research and development are research methods used to manufacture specific products and test the effectiveness of these products (Sugiyono, 2014). The subjects of this study were high school students in her X class, consisting of her six schools in Padang city. The development model used in this study is the development model proposed by Plomp (2013) which consists of 3 phases, namely the preliminary research, prototyping phase, and assessment phase.

Preliminary research is a stage that emphasizes content validity, this can be seen from the problem analysis and literature study. The second stage, namely the Prototyping phase, at this stage the development is more focused on consistency (construct validation), practicality gradually towards efficiency. This second stage can be reflected in the development of prototypes that are tested and revised based on formative evaluations. In the third stage, namely the assessment phase, the practicality and effectiveness of the products that have been tested before are seen, this aims to assess whether the user can use the product (practicality) and wishes to apply it as well as see the effectiveness of the product to use (effectiveness).

The flowchart of this research is a research process that will be passed by researchers. The description and steps that will be passed by the researcher are in the Figure 5.

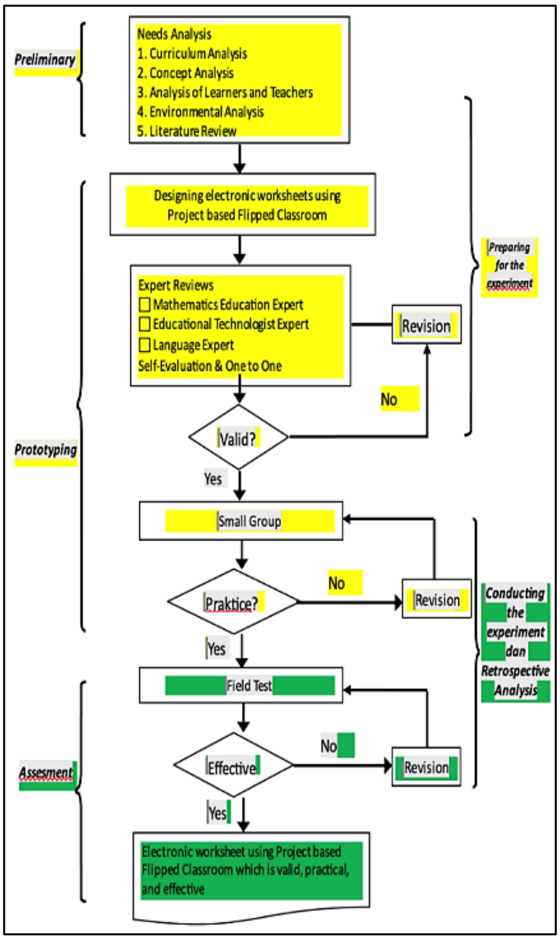

Figure 5. Research Flowchart

In this study, there are two types of data in this research, qualitative and quantitative. Qualitative data is data in the form of sentences, words or images. Quantitative data, on the other hand, is data in the form of numerical or quantitative data that is evaluated (scored). Quantitative data are therefore data that tend to be analyzed by means or statistical techniques. In this study, qualitative data were obtained from observations and interviews, and quantitative data were obtained from validation questionnaires, utility questionnaires, and efficacy questionnaires. The data collection tools used in this study are quenstionaire and interview guidance.

The data collection tools used in this study were pre-analysis, validity tool, practicality tool. 1) instruments in preliminary analysis, 2) instruments for testing validity (self-evaluation sheets, validation instruments, interview guidelines), 3) instruments for testing practicality (interview guidelines, observation sheets, student response questionnaires, teacher response questionnaires), 4) instruments for testing effectiveness (tests, interview guidelines, observation sheets, student response questionnaires, teacher response questionnaires).

Data analysis techniques in the development of electronic worksheet using Project-Based Learning (PjBL) are qualitative and quantitative. Qualitative data were obtained from validator criticisms and suggestions, and quantitative data were obtained from questionnaires given to experts, teachers, and students. Data analysis in the preliminary analysis phase uses descriptive techniques to describe the results of the preliminary analysis.

Analyzes of validity data were performed using Likert scales, after which means were retrieved and valid criteria for products were determined using validity tables. Analysis of utility data was performed in two ways. Qualitative data are analyzed using descriptive techniques and quantitative data are analyzed using Likert scales before averages are retrieved and utility tables are used to determine practical criteria for product decisions. it was done. Efficacy data analysis was analyzed by calculating student ratings, calculating average student overall ratings, and using efficacy tables to determine product efficacy criteria.

To determine whether electronic worksheets is valid, it is determined using the criteria developed by Dewi (2024), namely the very valid category with a value range of 81-100, the valid category with a range of 61-80, the quite valid category with a range of 41-60, the less valid category with a range of 21 -40, invalid category with a range of 0-20.

To find out practical electronic worksheets is determined using the following criteria: To find out practical electronic worksheets is determined through criteria developed by Dewi (2024), namely the very practical category with a value range of 81-100, the practical category with a range of 61-80, the quite practical category with range 41-60, the less practical category with the range 21-40, the impractical category with the range 0-20.

III. Result and Discussion

A. Validity

The validator assessment data is qualitatively and statistically reported and examined. The electronic worksheets validation sheet results were obtained utilizing a live worksheet for mathematicians and technology specialists. After validating with the experts, each mathematician and technology expert fills up the validation sheet. The percentage gained from the validation sheet results is shown in Table 1.

Table 1.
Mathematics Expert Validation

Assesment Aspects	Validator (%)			$\overline{x}$	Category
	1	2	3		
Content	88	88	82	86	Very Valid
Language	93,3	100	95	96,11	Very Valid
Presentation	95	85	94	91,33	Very Valid
Total	**92,1**	**91**	**90**	**91,15**	**Very Valid**

The validation value of the material expert on the content feasibility aspect was acquired at the end of 86% with a very valid category, as shown in Table 1. The validation results demonstrate that the contents of the electronic worksheets are adequate for the Project Based Learning model. With a very valid category, a final score of 96.11% was reached in the language aspect. The created electronic worksheets findings are in agreement with good and correct Indonesian language rules. With a very valid category, a final score of 91.33% was reached in the didactic or presenting element. The validation results suggest that the material in the electronic worksheets has been organized systematically.

Mathematicians' overall validation value from components of the electronic worksheets validation using the liveworksheet application in class X mathematics learning was 91.15%. This demonstrates that the electronic worksheets employs a highly effective liveworksheet application. electronic worksheets validation is seen through three lenses: content feasibility, language feasibility, didactics, and presentation. As a result, the contents of the electronic worksheets demonstrate the applicability of the Project Based Learning model, the use of language in the electronic worksheets is consistent with Indonesian language rules, making it easy to grasp, and the presentation of the electronic worksheets clear and systematic.

The percentage derived from the validation sheet results by the technical expert is shown in Table 2.

Table 2.
Technology Expert Validation

Assesment Aspects	Validator (%)			$\overline{x}$	Category
	1	2	3		
Graphics or Display	93,3	93,3	92	92,89	Very Valid
Ease of Use	90	100	100	96,67	Very Valid
Language	100	93,3	92	95,11	Very Valid
Total	**94,4**	**95,5**	**94**	**94,89**	**Very Valid**

The validation value of the technological expert on the graphical or display element was acquired at the end of 92.89% with a very valid category, as shown in Table 2. The validation results suggest that the electronic worksheets display can effectively convey information and that the electronic worksheets is both interesting and creative. The overall score for ease of use was 96.67% with a very valid category. The validation results suggest that the created electronic worksheets is portable, convenient to access, and simple to use. With a very valid category, a final score of 95.11% was reached in the language aspect. The created electronic worksheets findings are in agreement with good and correct Indonesian language rules.

The overall technology expert validation value derived from parts of the electronic worksheets validation using the liveworksheet application in class X mathematics learning was 94.89%. This demonstrates that the electronic worksheets employs a highly effective liveworksheet application. Electronic worksheets validation is seen from three perspectives: graphical or appearance elements, ease of use aspects, and linguistic feasibility. So, it can be inferred that the contents of the electronic worksheets demonstrate that the display on the electronic worksheets can transmit information effectively and that the electronic worksheets is highly interesting and creative, that the electronic worksheets developed is efficient to carry, easy to access, and simple to use, and that the use of language in the electronic worksheets is effective. The electronic worksheets is in conformity with Indonesian regulations.

B. Practicality

Two tests were conducted during the practicality stage: one-to-one and small group tests.

1) One-to-one

The electronic worksheets using the liveworksheet application in class X mathematics learning was tested on one mathematics instructor and three students for practicality and product development during the one-on-one test evaluation stage. Products that have been declared valid are distributed to mathematics teachers and students who have participated in class X mathematics learning and are then requested to attempt the electronic worksheets using the liveworksheet application before being given a practical questionnaire to complete.

Electronic worksheets using the live worksheet application, according to the teacher, is very fascinating and can be used by students. Table 3 shows the results of the one-on-one evaluations of mathematics teachers.

Table 3.
Shows The Outcomes of Mathematics Teacher Practicalities

Assesment Aspects	Teacher (%)			$\bar{x}$
	1	2	3	
Ease of use	93,3	100	100	97,78
efficiency	100	80	100	93,33
Attractiveness	100	100	92	97,33
Ease To Understand	95	90	88	91
Equivalence	100	100	100	100
Total	**97.67**	**94**	**96**	**95,89**

According to Table 3, the practicality of electronic worksheets utilizing the live worksheet application by mathematics teachers received a final score of 95.89% in the category of very practical and suitable for student use. Table 4 shows the outcomes of one-on-one evaluations for three students from each trial school.

Table 4.
Shows The Results of One-to-One Practicality Tests

Assesment Aspects	School (%)			$\bar{x}$
	1	2	3	
Instructions	84,4	91,1	97	90,85
efficiency	80	93,3	100	91,11
Attractiveness	93,3	90	97	93,44
Ease To Understand	80	81,6	88	83,22
Benefits	82,7	86,6	87	85,45
Total	**84,09**	**88,55**	**94**	**88,81**

According to Table 4, the practicality of electronic worksheets using the live worksheet application by students in the one-on-one test resulted in a final score of

84% in the highly practical group. This demonstrates that the electronic worksheets employs this very practical liveworksheet application with an average of 88.81%. This means that teachers can utilize the electronic worksheets as a learning medium for class X pupils.

2) Small Groups

After the teacher determined the electronic worksheets to be practical, the next small group trial intended to assess students' ability to use the electronic worksheets in class X mathematics learning using the liveworksheet application. The small group trial included nine students each school who had studied class X mathematics learning, with students carrying out the learning process as usual utilizing the developed electronic worksheets. Following that, the researcher delivered practicality questionnaires to students and requested them to complete them. Table 5 shows the results of the small group practicality test.

Table 5.
Results of Small Group Practicality

Assesment Aspects	School (%)			$\overline{x}$
	1	2	3	
Instructions	84	86,66	88	86,22
Efficiency	93,33	93,33	86	90,89
Attractiveness	91,90	89,62	92	91.17
Ease of Understanding	87,21	87,21	85	86,47
Benefits	86,70	93,33	89	89,68
Total	**88,63**	**90,03**	**88**	**88,89**

Table 5 shows that students got a final score of 88.89% in the extremely practical category for their practical outcomes of the electronic worksheets utilizing the liveworksheet application. This demonstrates that the electronic worksheets by learning mathematics for class X utilizing the liveworksheet application is very practical for usage in learning mathematics for class X at SMA Kota Padang.

C. Discussion

The electronic worksheets cover is on the first page. The cover is the first page that shows when you open the electronic worksheets. The cover features an image that is appropriate for the electronic worksheets, as well as a color that is appealing to readers. Figure 6 depicts the design of the cover page.

Figure 6. Electronic Worksheets Cover Pages

After that, if you scroll down the next page, a page with instructions for using electronic worksheets, instructions for using the live worksheet function, learning outcomes, and learning objectives will appear, as shown in Figure 7.

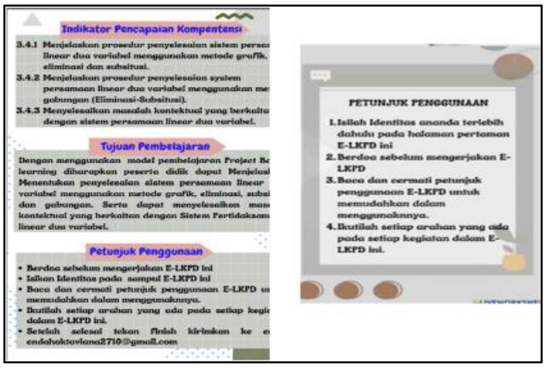

Figure 7. Electronic Worksheets Introduction Pages

When you slide it down, the electronic worksheets contents will emerge, namely learning activities with five phases, namely observing phenomena, basic inquiries, making project plans, preparing project schedules, and monitoring, as shown in Figure 8.

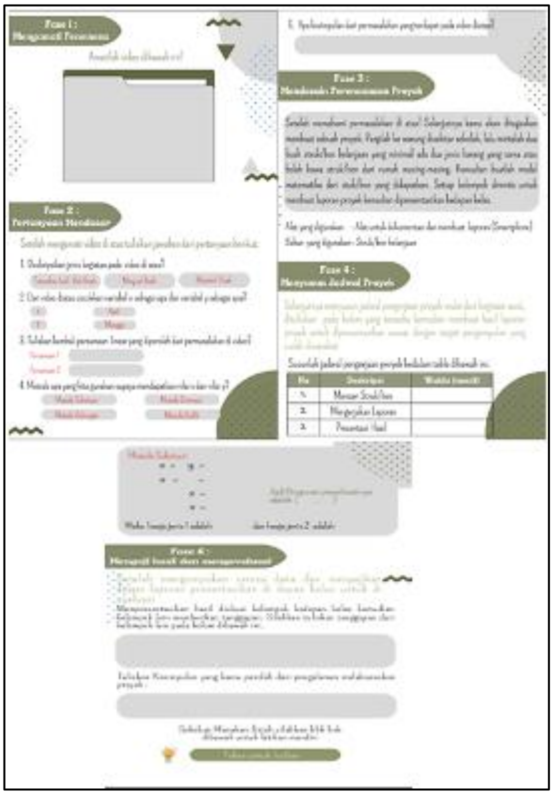

Figure 8. Electronic Worksheets Content Display for Linear Programming Topics

Next, if you slide it to the bottom of the page, the electronic worksheets contents will appear, including learning activities with videos, descriptions of the electronic worksheets work based on Project Based Learning (PjBL) syntax, and descriptions of the exercise work on completed projects, as shown in Figure 9 and 10.

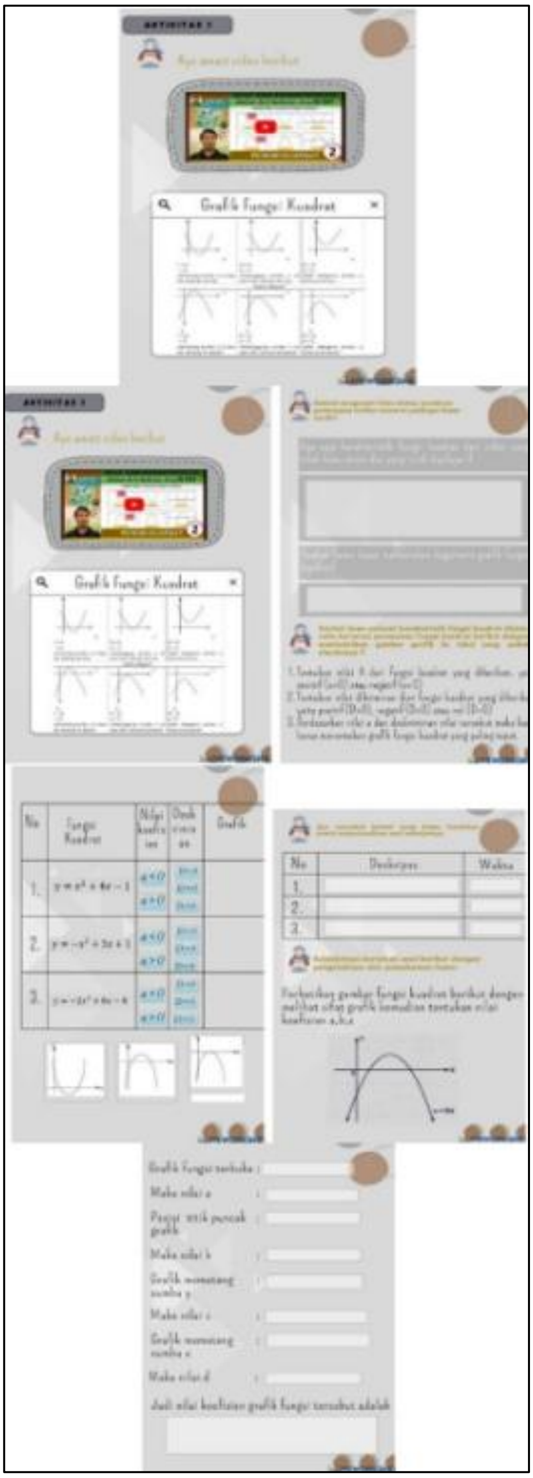

Figure 9. Electronic Worksheets Content Display for Quadratic Function Topics

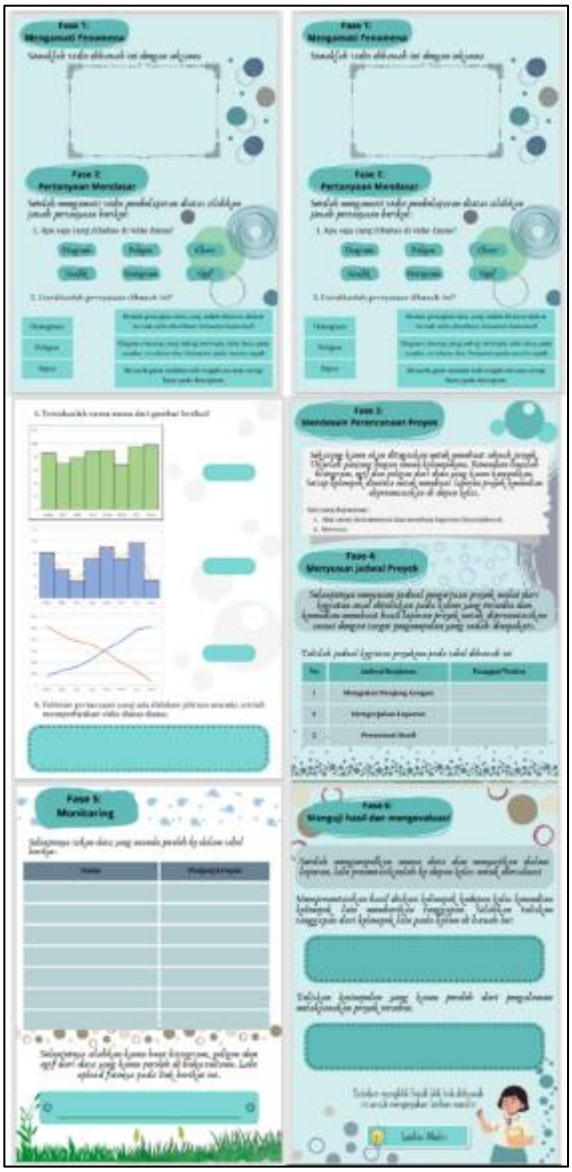

Figure 10. Electronic Worksheets Content Display for Statistic Topics

When you slide it down, the electronic worksheets cover with practice questions appears, as shown in Figure 11.

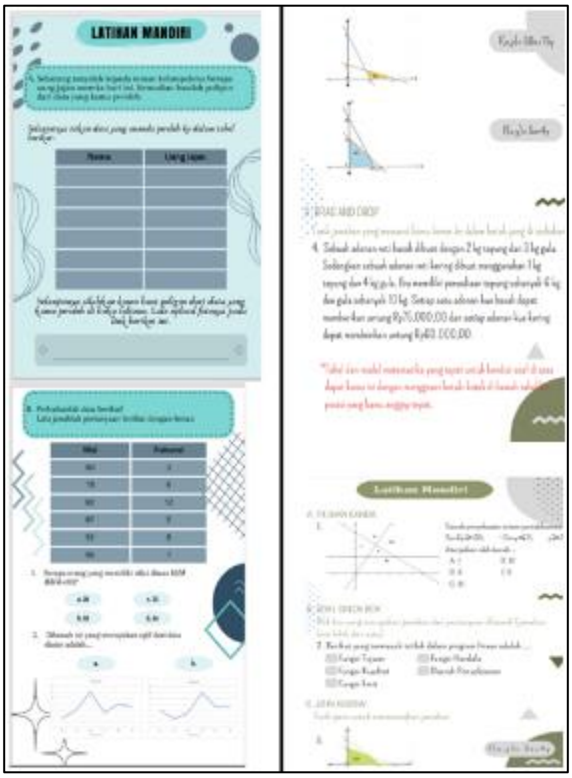

Figure 11. Electronic Worksheets Final Page

The first linear program project took the form of students walking around the field in opposite directions and calculating the time required. The second type of linear program project involves students determining how long it takes to pour water into a bottle (See Figure 12 and 13).

Figure 12. Students in Opposite Directions Circle the Ceremony Field

Figure 13. Determine The Amount of Time It Takes to Pour Water into a Bottle

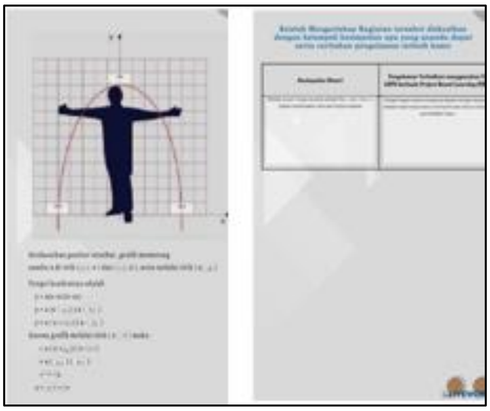

Figure 15. Measuring Height and Hand Span Project Report Display

The first type of quadratic function project activity is measuring the height and length of the hand span. It can be seen in the actions performed by students, as depicted in Figure 14. The electronic worksheets provides a worksheet in the form of a simple report for the project activities carried out to measure the length of the hands and height of these kids. Figure 15 shows project activities and simple reports completed by electronic worksheets students using the liveworksheet application.

Figure 14. Measuring Hand Height and Length

Throwing the ball into the basketball hoop is the second type of project activity on quadratic function material. Figure 16 depicts the project activities carried out by students to retrieve real data from throwing a basketball into the ring. Following that, students are instructed to write a report based on a video of a basketball throw performed by one of the group members. Students compute the height of the ball till the maximum point at which the ball enters the ring and then illustrate it on paper for the basic report. Figure 17 depicts the activities that these pupils engaged in.

Figure 16. Throwing a Ball into a Basketball Hoop as a Project Activity

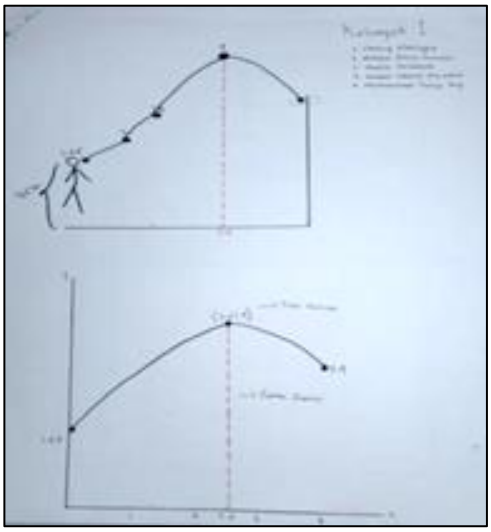

Figure 17. Project Report Results on Throwing Balls into Basketball Hoops

After gathering genuine data and creating drawings, the work is completed. Following that, students complete a worksheet in the form of a short report on the electronic worksheets live worksheet that has been provided. Figure 18 shows project activities and simple reports created by students in the electronic worksheets using the liveworksheet application.

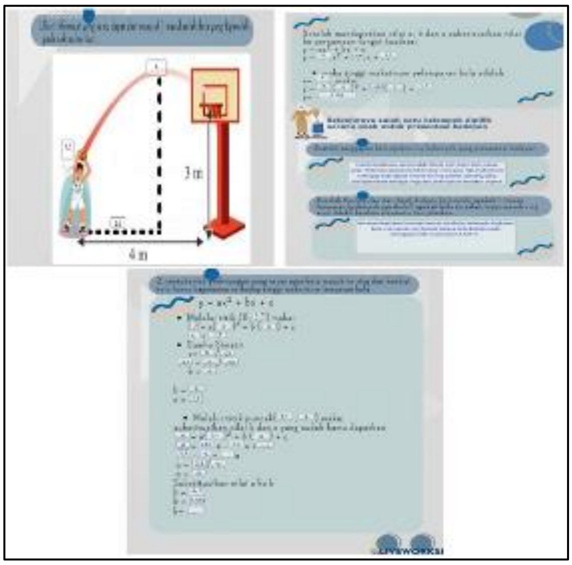

Figure 18. Report on Throwing a Ball into a Basketball Hoop Display

The first type of project work in statistics material is measuring the length of the student's arm, as indicated in the students' activities in Figure 19. Electronic worksheets provides worksheets in the form of simple reports in addition to the project activities carried out in this first statistics project. Figure 20 depicts the project activities and simple reports completed by students at electronic worksheets using the liveworksheet application.

Figure 19. Measuring Arm Length

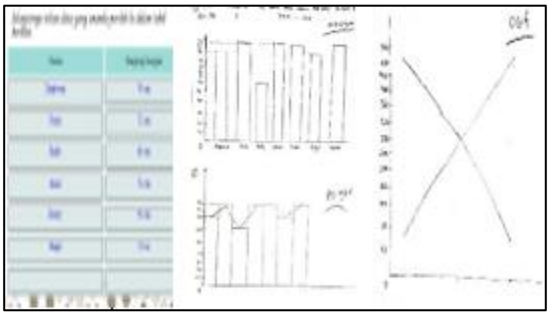

Figure 20. A Short Report on The Project for Measuring Arm Length is Displayed

The second type of project activity in statistical material is interviewing sellers in the school canteen about the names of the things being offered and their pricing, as indicated in the activities carried out by students in Figure 21. Electronic worksheets provides worksheets in the form of basic reports in addition to the project activities carried out in this second

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statistical material project. Figure 22 depicts the project activities and simple reports completed by students at electronic worksheets using the liveworksheet application.

Figure 21. Project Activity on Goods Selling Prices

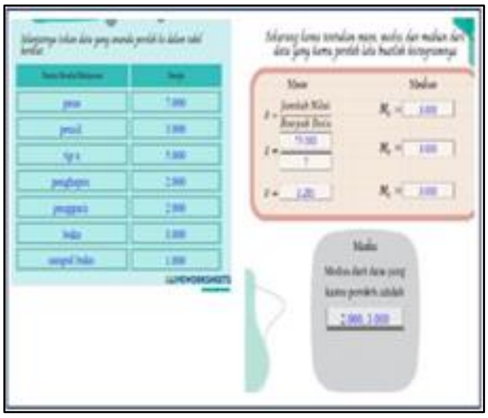

Figure 22. Project Report on Goods Selling Prices in the Canteen

The third type of project work in statistics material is measuring body height, as indicated in the activities performed by students in Figure 23. After completing project activities such as height measurement, students kept working on the electronic worksheets in the form of a basic report. Figure 24 depicts project activities and simple reports completed by electronic worksheets students using the liveworksheet application.

Figure 23. Height Measuring Project Activity

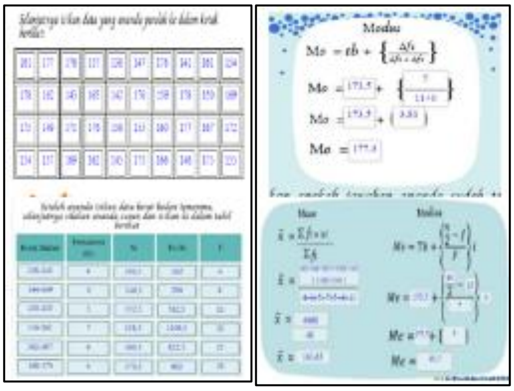

Figure 24. Height Measuring Project Report

The fourth form of project activity in statistics material, namely measuring body weight, can be seen in the activities carried out by students as shown in Figure 25. Students continue working on the electronic worksheets in the form of a short report after completing the project activity of measuring body weight. In Figure 26 below, you can observe project activities and simple reports created by students in the electronic worksheets using the liveworksheet application.

Figure 25. Project Activity on Body Weight Measurement

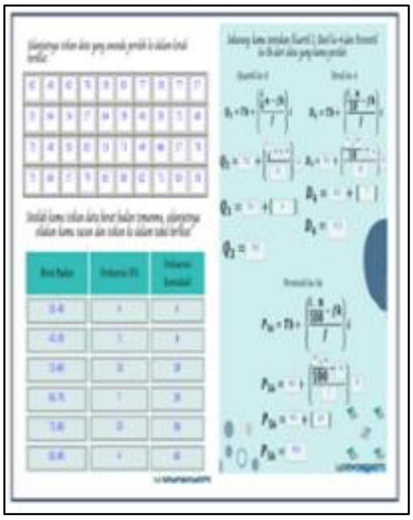

Figure 26. Project Report on Body Weight Measurement

The results of this study support previous studies that flipped classroom makes the PjBL take place more efficiently and effectively (Sholahuddin, 2021). They may enjoy group work and discussions, interaction with peers, and feel more comfortable asking questions, presenting, or solving problems; hence, they become more independent and active (Monaghan, 2019). Flipped classroom effectively helped students in mastering the knowledge and increased their ability to independently solve problems (Enfield, 2013; Zhang, 2021). PjBL-FC may cause more learning at higher concept application levels, general problem-solving, creative thinking, and collaboration (Love, 2015).

This learning made the process more enjoyable, interactive, and efficient. Besides, flipped classrooms increase motivation and allow students to learn in their way, specifically in understanding the concept being (Mustofa, 2022; Sukma, 2022; Ramadoni & Chien, 2023). Activities in project based flipped classrooms allow students to be more involved and active in learning by utilizing technology (Nerantzi, 2020). Project based flipped classrooms are provided with the opportunity to participate in real problem-solving and knowledge construction in authentic professional contexts (Guo, 2020). Electronic worksheets products in the following forms are being developed (See Table 6).

Table 6.
Electronic Worsheets Links in Class X Mathematics Learning

Topics	Link of Electronic worksheets
Linear Programming	Electronic worksheets 1 https://s.id/j5kGE Electronic worksheets 2 https://s.id/rX81 Electronic worksheets 3 https://s.id/TFPhT
Quadratic Function	Electronic worksheets 1 https://s.id/ed1ep Electronic worksheets 2 https://s.id/jnErE Electronic worksheets 3 https://s.id/KQikp
Statistics	Electronic worksheets 1 https://s.id/UMiXX Electronic worksheets 2 https://s.id/KSkEc Electronic worksheets 3 https://s.id/Q9OLU Electronic worksheets 4 https://s.id/uxvJG

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IV. Conclusion

Based on the research and data analysis, it is possible to conclude that electronic worksheets employs the live worksheet application in a very valid category in class. Meanwhile, a percentage of 95.89% was reached in the extremely practical category for the practicability of using electronic worksheets by teachers. The very practical category received a percentage of 95.89% for the students' one-to-one test scores. In the extremely practical category, the percentage attained for the small group test results was 88.89%. Based on the percentages above, electronic worksheets using the liveworksheets application on class X mathematics learning is legitimate and usable. In accordance with the Project Based study approach, electronic worksheets uses the live worksheets application in class X mathematics study.

Based on the results of this study, the use of electronic worksheets has proven to be very valid and practical in learning mathematics for class X by achieving a very high percentage in the practicality category, both in terms of teaching by teachers and testing by students. This innovation can improve the quality of mathematics learning through the Project-Based Flipped Classroom (PjFC) approach, which encourages active student involvement and optimal use of technology in the teaching and learning process.

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