Development of Digital Student Worksheets Based on Inquiry Training Assisted by Live Worksheet

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Abstract. The objective of this study was to assess the effectiveness and practicality of digital student worksheets based on Inquiry Training Assisted by Live Worksheets. The research falls under the category of research and development (R&D), following the ADDIE development model. The study involved fifth-grade students from State Elementary School 091473 Plus Tiga Balata, with two classes totaling 54 students. Class V.2 served as the control group with 27 students, while class V.4 functioned as the experimental group with another 27 students. After analyzing the research data and conducting discussions, it can be concluded that the digital student worksheets, assisted by Live Worksheets, are both valid and suitable for use in educational settings. Moreover, there was a noticeable improvement in student learning outcomes, falling within the mid-level classification. Furthermore, the product development process received an average rating of 4.7 points from the supervisory evaluations during each trial. The results indicate a 94% satisfaction rate, demonstrating the practicality of the developed tool. In summary, the digital student worksheets based on Live Worksheet Assisted Inquiry Training proved effective and practical for enhancing learning outcomes in the context of this study.

Keywords: Worksheet, Digital Worksheet, Inquiry Training, Live Worksheet

1 Introduction

Learning is a process of interaction among students, between students and teachers, and between students and learning resources within a learning environment. Sugihartono define learning as a process of acquiring knowledge and experiences in the form of changes in behavior and relatively permanent or lasting reaction capabilities due to the interaction of individuals with their environment [1]. Heldrianto states that a person gains knowledge and skills through education, which is an activity aimed at enhancing a person's general knowledge, including improving theoretical understanding and practical skills. Education involves making decisions and seeking solutions to problems related to activities in achieving goals, whether related to educational matters or daily life [2].

In an era defined by the relentless march of knowledge and technology, the teaching and learning process has experienced a remarkable evolution. The traditional model of education, where a teacher's presence dominated the classroom, has given way to a more dynamic and technologically-driven approach. This shift is a response to the growing recognition that effective education must leverage the full spectrum of available tools and resources.

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In the Curriculum Development Guidelines of 2013, it is stated that elementary school-level science education is conducted thematically. The teaching and learning process is developed as an integrative science subject rather than individual disciplines standing independently. It is oriented towards applied education, the development of thinking abilities, learning skills, curiosity, and the cultivation of attitudes of care and responsibility towards the natural and social environment [3].

In line with Trianto, who states that Science is a systematic collection of theories, its general application is limited to natural phenomena [4]. It originates and develops through scientific methods such as observation and experimentation while also demanding a scientific attitude like curiosity, openness, honesty, etc.

This means that students are expected not only to pay attention to and read what the teacher presents but also to engage in experiments or practical activities. This is to ensure that students acquire skills in the scientific process and enhance their critical thinking abilities.

The portrayal of learning in the 5th grade at State Elementary School 091473 Plus Tiga Balata indicated a preference for passive learning. The previous teaching approach involved guiding the learning process through Zoom meetings, where students primarily listened to teacher explanations. They were assigned worksheets distributed by the teacher through class WhatsApp groups, and subsequently, students completed these worksheets on double folio paper. This approach seemed to lack active student engagement and independent problem-solving opportunities.

In the context of a recent learning evaluation in the 5th grade at State Elementary School 091473 Plus Tiga Balata, it became evident that the prevailing approach leaned towards passive learning. In this model, the traditional teacher-centered paradigm still held sway. During the pandemic, remote instruction was primarily delivered via Zoom meetings, where students often found themselves in the role of passive recipients, absorbing teacher explanations and directives. Subsequently, they were assigned worksheets via class WhatsApp groups, and the learning process culminated in students diligently filling out these worksheets on double folio paper.

This observation is also supported by the average daily test scores data for covering over the past 2 years, as shown in Table 1 below:

Table 1. Average Daily Test Scores for Academic Years 2019/2020 & 2020/2021

No	Academic Year	Number of Students	Average Daily Test Score
1	2019/2020	110	57
2	2020/2021	107	60

Based on the problem mentioned above background, it is crucial to find an effective and enjoyable solution to enhance student learning. One instructional resource that can be employed as a support in teaching is the use of instructional worksheets. Student worksheet offers several benefits, including its integration as a teaching tool through various instructional models, such as the Inquiry Training model.

According to Trianto, student worksheets can take the form of exercise guides for developing cognitive aspects as well as guides for the development of all learning aspects, in the form of experiment or demonstration guides. In delivering a learning topic, student worksheet often becomes one of teacher's commonly used teaching resources [5].

In the era of integrating ICT (Information and Communication Technology) as it is today, student worksheets no longer exist solely in conventional form but also in electronic format. Consequently, all fields are expected to adapt by utilizing all available resources. One of these adaptations involves creating electronic student worksheets using available internet-based applications, such as Live Worksheet.

In Yuniastuti et al.'s book, the Live Worksheet application is described as a tool provided by Google's search engine for free [6]. This application assists teachers in transforming traditional worksheets into interactive online exercises while automatically correcting students' responses. Additionally, students can work on worksheets online and submit their answers to the teacher electronically. The advantages of this application for students include its interactivity and motivation, while for teachers, it helps save time and paper resources.

Several studies also support that using digital student worksheet can enhance student learning outcomes. The development of Interactive student worksheets based on Live Worksheet to Improve Elementary School Social Studies Learning Outcomes, conducted by Ikhlashul et al. in 2022, achieved validation results from content experts at 91% and media experts at 90%, both categorically considered highly valid [7].

The results of student response questionnaires in the small group trial and field trial yielded scores of 84% and 90%, respectively, both categorized as highly practical. The effectiveness of the product in improving student learning outcomes was evaluated based on the average N-Gain scores of students in both the small group trial and field trial, which amounted to 0.71, indicating a high level of improvement. This demonstrates that the Interactive student worksheets product based on Live Worksheet is valid, practical, and effective.

Furthermore, the study conducted by Prabowo in 2021 on using Live-worksheet with a Web-Based Application to Improve Student Learning Outcomes revealed that the research findings indicated the effectiveness of this approach. In the pre-cycle, the classical mastery level of students was 52.7%, with an average learning outcome of 69.7. In the first cycle, the classical mastery level improved to 72.2%, with an average learning outcome of 76.6. Lastly, in the second cycle, the classical mastery level further increased to 86.1%, and the average learning outcome improved to 82.8.

Given the current situation and supported by research findings, it is highly appropriate to develop a digital student worksheet with the assistance of the Live Worksheet application. Furthermore, this electronic student worksheets is interactive, motivating for students, and contains the expected learning content aimed at enhancing student engagement and learning outcomes.

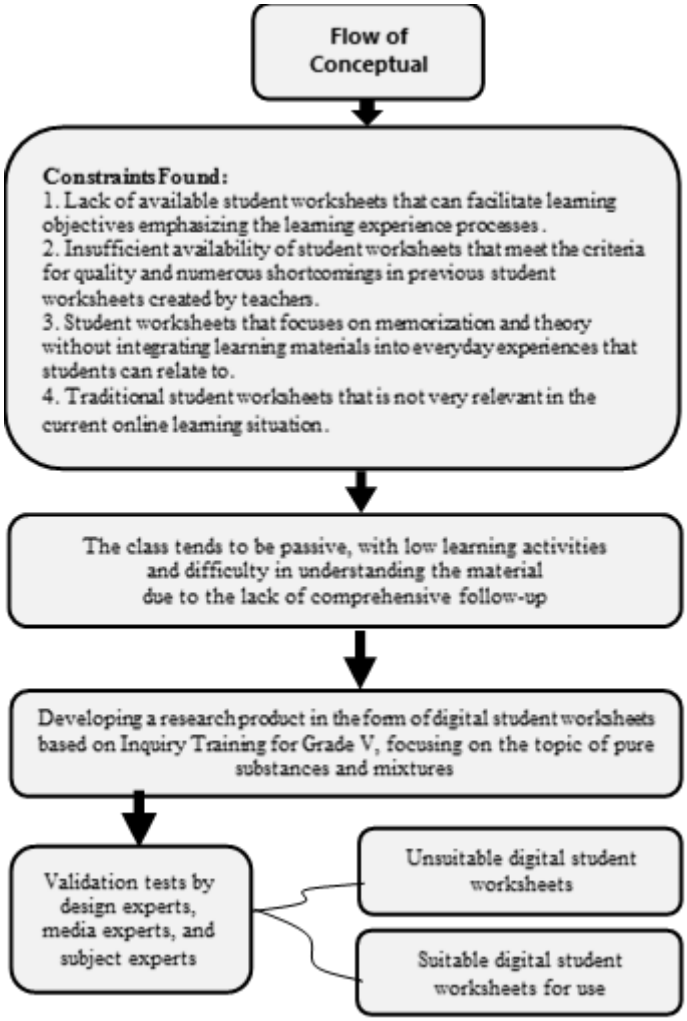

Fig. 1 Conceptual framework

The research has three primary objectives: to validate Inquiry Training-Based digital student worksheets with Live Worksheet assistance through expert evaluation, to determine if the learning outcomes of the group using these worksheets surpass the Minimum Mastery Criteria, and to assess the practicality of implementing them in an educational context. These objectives collectively aim to evaluate the effectiveness and feasibility of integrating technology-enhanced, inquiry-based learning methods into modern education.

2 Methodology

This research was of the development type, specifically using the Research and Development approach, which referred to the ADDIE development model. The development model used was as follows:

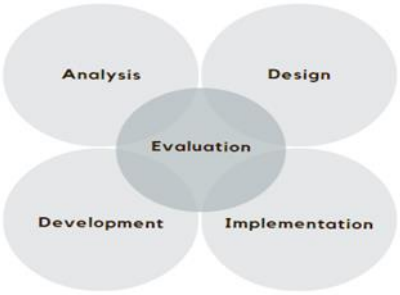

Fig. 2 Stages of the ADDIE model

The subjects of this study were 5th-grade students of SD N 091473 Plus Tiga Balata, comprising 52 students in total, divided into two classes. Class V.2 served as the control group with 27 students, while class V.4 was the experimental group consisting of 27 students. The object of this study was the Inquiry Training-Based digital student worksheets on Theme 9, "Objects Around Us," Subtheme 1, "Individual Objects and Mixtures," specifically focusing on the topic of Individual Substances and Mixtures. The data collection techniques and tools used in this research included expert validation questionnaires, questionnaires for teacher and student responses, as well as assessments of student learning outcomes. Data analysis aimed to process the data to ensure the research's validity. Before hypothesis testing, preliminary data analyses were conducted, including assessing data normality and homogeneity. Once it was established that the research data met the normal distribution and homogeneity criteria, the subsequent step involved hypothesis testing. Statistical tests were used to determine whether the hypotheses could be accepted or rejected, specifically the independent sample t-test and N Gain. Based on the indicators mentioned earlier, it can be understood that students could be considered to have an improved conceptual understanding if their scores were ≥ 0.3. After conducting the N Gain test, the pretest and posttest scores were analyzed to ascertain any significant improvements.

3 Results And Discussion

3.1 Analysis Phase

In the analysis, there are five stages, namely needs analysis, instructional tool analysis, potential analysis, material and curriculum analysis, and instructional approach analysis. Based on the needs analysis results, it is found that teachers are not yet familiar with digital student worksheets based on Inquiry Training assisted by Live Worksheets. Students still require and search for alternative learning sources beyond textbooks to comprehend the lessons. Additionally, no instructional aids or learning media have been utilized during teaching, resulting in students' difficulties understanding the subject matter. These analysis

outcomes indicate the necessity for developing digital student worksheets as an essential instructional tool to be implemented at State Elementary School 091473 Plus Tiga Balata.

Based on the observation results related to instructional tool analysis, the student worksheets available at State Elementary School 091473 is still simple and lacks engagement. However, effective student worksheets should be capable of stimulating and assisting students in understanding the subject matter. This notion aligns with Artina & Sri (2015), who stated that student worksheets, in the form of worksheets, aims to stimulate and assist learners in their learning activities to achieve mastery in understanding, skills, and/or attitudes [8].

Based on the analysis, the available student worksheets is insufficient in stimulating students' comprehension of the learning material. Therefore, the development of engaging and stimulating student worksheets becomes highly crucial. Consequently, the digital student worksheets to be developed by the researchers is well-suited to address this issue. This perspective aligns with previous research conducted by Putriyana et al. and Umriani, which explained that digital student worksheets serve as a student guide to facilitate a better understanding of learning materials in electronic format. Its application can encompass desktop computers, notebooks, smartphones, and cell phones [9], [10].

Based on the observation results of the environmental analysis, State Elementary School 091473 Plus Tiga Balata is located in one of the neighborhoods within the Jorlang Hataran Sub-district, Simalungun Regency, North Sumatra. Despite the school's distance from the capital city of Medan, the Tiga Balata area has a geographic advantage as it doesn't face challenges in electricity and internet access. Hence, the development and utilization of digital student worksheets as an instructional tool are feasible in this context, given that its usage requires communication devices and internet connectivity.

Curriculum analysis is essential to determine the curriculum implemented by the school where the research will be conducted. State Elementary School 091473 Plus Tiga Balata follows the Curriculum 2013. Curriculum 2013 emphasizes schools' optimization of all available resources in their surroundings to aid in achieving educational goals. The chosen subject matter for this study is substances and mixtures. The selection of this topic is aimed at understanding and determining content and approaches that align with the Core Competencies and Basic Competencies outlined in the curriculum.

3.2 Design Phase

In this phase, the initial design of the digital student worksheets is developed, and research instruments are created. This stage is divided into several steps as follows:

1. Collecting references and elements/components within the digital student worksheet.

Fig. 3 Flowchart of Digital Worksheet

2. Creating a Storyboard

A storyboard is a visual representation used to create instructional media to facilitate the process of producing a product. Below is a description of the developed media:

3.3 Development Phase

In the phase of developing the digital student worksheets to be created by the researcher, the researcher undertakes several steps as follows:

1) Crafting a suitable title for the digital student worksheets that aligns with the core competencies, basic competencies, indicators, and learning objectives

Fig. 4 Cover and Core Competencies Digital Worksheet

2) Crafting introductory activities as an introduction to the main activities of each indicator, organizing core material points as supporting information and reinforcement for the activities conducted
3) Creating a detailed list of student activities based on the intended learning objectives to be achieved
4) Integrating supportive elements (such as images) that align with the content of the activities and materials
5) Creating a conclusion diagram of activities that will be filled in by the students
6) Designing the digital student worksheets into a complete digital student worksheet

The visuals above represent visualizations of the media created by the researcher. The produced product is then validated by an expert media validator, a subject matter expert, a learning design expert, and students. Validation for the utilized student worksheets is assessed based on the consensus reached by the three respective expert evaluators and teacher assessments of the developed Inquiry Training-based student worksheets.

- Subject Expert

Based on the calculations above, overall material aspects received an average score of 5.00, indicating a " Very Appropriate " rating falling within the range of 4.17 – 5.00.

- Media Expert

Based on the calculations above, overall, the media aspect scored an average of 4.58, with the criteria " Very Appropriate, "falling within the range of 4.17 – 5.00.

- Design Expert

Based on the calculations, overall, the design aspect scored an average of 4.83, with the criteria "Very Appropriate," falling within the range of 4.17 – 5.00.

3.4 Implementation Phase

Learning module that has been deemed appropriate by subject matter experts, language experts, and design experts can then be implemented with student responses towards the developed product.

Based on the recapitulation of student response questionnaires that have been conducted, assessments from 27 students on 10 response-related items regarding the developed product yielded an average score of 4.7 with a percentage:

$$PRS = \frac{\sum A}{\sum B} \times 100\% \qquad = \frac{47}{50} \text{ x } 100\% = 94\%$$

To ensure the achievement of learning objectives as evaluated from the learners' reactions, if the number of learners providing a positive response is greater than or similar to 80% of the total points observed for each trial, and the obtained result is 94%, the developed tool is claimed to be practical.

3.5 Evaluation Phase

Moving on to the evaluation phase, the effectiveness of the developed instructional media will be tested through student learning assessments, which will be evaluated using pre-tests and post-tests and then compared with the control group.

Table 2. Hypothesis Testing Based on Post-Test Results

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Posts	Equal variances assumed	194	661	2.799	452	**.007**	10.628	3.797	.993	8.263
	Equal variances not assumed			2.810	47.379	**.007**	10.628	3.782	.021	8.235

Based on the Sig. (2-tailed) value of 0.007, which is less than 0.05, indicates that there is a significant difference in learning outcomes between the Experimental Class and the Control Class based on the post-test scores obtained by the students.

Table 3. Hypothesis Testing Based on N-Gain Values

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
NGain	Equal variances assumed	3.978	.000	.897	52	**.000**	.402	.068	.265	.539

	Equal variances not assumed	.382	26.977	**.000**	.402	.063	.273	.531

4 Conclusion

Based on the data from the research results and discussions that have been presented, the following conclusions can be drawn:

1. Based on the Subject Expert Validation Team recapitulation, an overall average score of 5 was obtained. The learning design experts obtained an overall average score of 4.83, and the media experts obtained an overall average score of 4.58. Therefore, based on the calculated average validation score of 4.8, falling within the range of 4.17 – 5.00, it can be stated that digital student worksheets Based on Inquiry Training Assisted by Live Worksheet fall under the category of "Very Appropriate."
2. Based on the average results obtained for N-Gain in the Experimental Group, a score of 0.57 was achieved. This indicates a moderate level of improvement in student learning outcomes. Meanwhile, based on the average results obtained in the control group, an N-Gain score of 0.14 was obtained, signifying a low level of improvement in student learning outcomes. Thus, it can be concluded that there is an improvement in learning outcomes when using the student worksheets based on Inquiry Training Assisted by Live Worksheet.
3. Based on the recapitulation of student and teacher response questionnaires that have been conducted, assessments were made on 10 response items related to the developed product. An average assessment score of 4.7 was obtained. Therefore, the developed tool is claimed to be practical.

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