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DEVELOPMENT OF STUDENT ACTIVITY SHEETS (SAS) ORIENTED ON PROJECT BASED LEARNING (PJBL) TO IMPROVE STUDENTS' CREATIVE THINKING SKILLS ON GREEN CHEMISTRY MATERIAL

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Abstract

The purpose of this study was to produce student activity sheets (SAS) of project based learning to improve student's creative thinking skills. This research used the Research and Development (R&D) method. with a 4D model, which includes the definition stage, design stage, development stage, and dissemination stage, but in this study, it was limited into the development stage. In this study, limited trials were conducted on 34 tenth grade high school students who had previously studied green chemistry material. The feasibility of the student activity sheets was reviewed in terms of validity, practicality, and effectiveness. The validity aspect obtained a mode of 4 with a good category. The practicality aspect, which was observed from the student response questionnaire, student activities, and implementation, obtained percentages of 96,9%, 95,5%, and 100%, respectively. The effectiveness aspect was reviewed from the improvement in students' creative thinking skills, the results of the improvement of creative thinking skills are stated with an average n-gain score of $\geq$ 0,7 in the high category. These results were also supported by the Wilcoxon test, which obtained a significance of 0,000 < 0,05. Based on its validity, practicality, and effectiveness, the student activity sheets (SAS) developed is suitable for use as a learning media.

Key words: student activity sheet, creative thinking, project based learning, green chemistry

INTRODUCTION

Learning plays a central role in the educational process. In Indonesia, education is rationally defined as a deliberate and systematic effort to create a learning environment and mechanism in which students actively develop their abilities. In this way, students can develop spiritual and religious strength, self-control, intellectual and moral excellence, and competencies that are useful for themselves and their social environment [1].

The skills mastered by students in 21st-century learning are not limited to reading and memorization, as is often the case in most schools in Indonesia. The 21st-century skills that young people must possess include the 4Cs creativity, critical thinking, communication, and collaboration [2]. The 4Cs play an important role because they encourage students to actively participate in group work, solve problems, and increase tolerance towards differences among peers. In addition, these skills also train critical and creative thinking abilities to overcome challenges related to various aspects of daily life [3]. However, several studies state that the creative thinking skills of Indonesian students are still low [4], [5], [6]. This statement is supported by data obtained by Putri and Alberida [7] from 68 students showing that the creative thinking skills of 48.2% were very low, 27.4% were low, 12.9% were moderate, 6.7% were high and 4.7% were very high. Therefore, the application of learning models is very important in the learning process. Project based learning (PjBL) is one model that can be implemented for learning activities [8].

The PjBL model is a type of approach in which the products result from project outcomes, so that problems can be solved and the concepts discovered can be applied in solving those problems. This model places educators as facilitators for students by providing opportunity to create ideas or concepts [9]. By implementation of the PjBL model, students play an active role in the learning process. The steps of the PjBL model include determining fundamental questions, plan of procedure for project, creat a schedule, action the project with the facitily and monitorine, reporting and evaluate process and outcome of the project learning outcomes [10]. The implementation of PjBL model will create proactive and creative learning [11]. Therefore, the project based learning model supports one of the 21st-century thinking skills, namely creativity. Research conducted by Kurnia and Ulianas [12] shows that student creativity increases with the implementation of the PjBL model.

The results of a preliminary research questionnaire conducted in grade X at a public school in Gresik showed that 86,1% of of students that the learning process was still carried out using the direct intruction method. As a result, student creativity was still relatively low. This is caused by a learning process that is still teacher centered, which makes students passive and dependent on the teacher. Therefore, efforts to increase student creativity are needed to support students in learning activities. One of these efforts is the use of student activity sheets (SAS).

The SAS serves as a guide for learning so that students find it easier to carry out learning activities [12]. The student activity sheet includes guidelines for practical work, experiments that can be done at home, discussion materials, as well as practice questions and other instructions that can motivate students to be actively involved in the learning process. The student activity sheet helps students explore and understand these concepts [13]. However, based on the results of interviews with teachers at public high school in Gresik, the SAS that have been used do not facilitate students according to their needs as an implementation of differentiated learning in the independent curriculum. The SAS used only contain cognitive materials and questions that need to be completed by students individually or in groups. Tulung [14] in his research stated that providing varied learning resources can foster student interest and motivation. The learning resources used can be PjBL oriented SAS. His research mentioned that PjBL oriented SAS received an 87% response rate in the acceptable category. Therefore, it is necessary to develop activity sheets tailored to the needs of students and activity steps that are adapted to the PjBL syntax.

The stages of activities in SAS are structured according to the steps of the PjBL learning model. The activity begins with determining fundamental questions through the presentation of a problem or project context in SAS to arouse students' curiosity. Next, in the analytical stage, participants are directed to design a planning project by identifying concepts, tools and materials, and necessary work steps. The next stage is the preparation of a project schedule, which helps students organize time and divide tasks systematically. In the project implementation stage, educators monitor the activity and development of the project through structured activities in SAS. Next, in the synthetic stage, participants are tested to test the project results and integrate findings to produce a product. The final stage is the evaluation of learning outcomes, which includes reflection on the project process and understanding of the concepts learned. With the alignment of SAS stages and PjBL syntax, learning becomes more focused, meaningful, and supports the development of student creativity. The development of a learning tool such as SAS must have criteria so that they are suitable for use. According to Plomp and Nieveen [15], suitability is measured in terms of validity, practicality, and effectiveness.

Chemistry is a branch of natural science that is part of the independent curriculum in phases E and F. These two phases are learning outcomes for senior high school/equivalent levels, with phase E for grade 10 and phase F for grades 11 and 12 [16]. One of the new materials in chemistry in the independent curriculum is green chemistry. Green chemistry is an approach that aims to address environmental issues through the control of chemicals produced and through improvements in the processes and stages of reactions used. This material aims to enable students to understand and apply the principles of green chemistry in an effort to minimize the negative impact of chemicals on the surrounding environment [17]. However, from the results of preliminary research conducted 75% of students had never done a project on green chemistry, so they didn't really understand how to apply green chemistry principles.

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Based on the background described, it is necessary to develop a student activity sheet (SAS) oriented on project based learning to improve students' creative thinking skills on green chemistry material. This study aims to determine the feasibility of the student activity sheet in improving students' creative thinking skills in green chemistry material.

METHOD

The type of research used is Research and Development. Research and development is a research method used to produce a product and test the effectiveness of a particular product [18]. This research refers to Thiagarajan's 4D model, which consists of four main stages, namely the definition stage, the design stage, the development stage, and the dissemination stage [19]. However, in this study, it is limited to the development stage.

This study was conducted in a public school in Gresik with 34 students. The research data obtained from the development of SAS was based on the results of review, validation, and trial data. The instruments used were review sheets, validation sheets, student observation sheets, learning implementation sheets, response questionnaires, and creative thinking skills test questions.

The validity of the SAS was obtained through review and validation data conducted by experts. The review activity was carried out by providing suggestions and comments on the SAS developed by the researchers. Meanwhile, the validation data was collected and then analyzed descriptively and quantitatively using a Likert scale assessment, as shown in Table 1.

Table 1. Scale of Likert

Score	Criteria
1	Not good
2	Less good
3	Fair
4	Good
5	Very good

[20]

If the assessed aspect has a mode of ≥ 4 with a category of good to very good, then the student activity sheet is interpreted as valid for use in the learning process.

The practicality of the student activity sheet developed can be seen from the responses and activities of the students, as well as the implementation of each syntax of the learning model. Student response data was obtained after conducting a limited trial and evaluated using the Likert scale presented in Table 2 below.

Table 2. Likert Scale Score Response Questionnaire

Assessment	Criteria
Strongly disagree	1
Disagree	2
Undecided	3
Agree	4
Strongly agree	5

[18]

The data was then processed using the following formula:

$$\text{Percentage} = \frac{\text{Score obtained}}{\text{Maximum score}} \times 100\%$$

The results of the analysis of student response data were used to determine student responses on the SAS, which were interpreted according to the criteria shown in Table 3.

Table 3. Practicality Criteria

Percentage (%)	Criteria
0-20	Not good
21-40	Less good
41-60	Fair
61-80	Good
81-100	Very good

[18]

If the percentage of student response questionnaires is ≥ 61% with a rating of good to very good, then the student activity sheet is interpreted as being practical for use in learning.

Data from observations of student activities can be analyzed using the following formula:

$$\% = \frac{\sum frequency\ of\ student\ activity\ that\ appears}{\sum frequency\ of\ overall\ activity} \times 100\%$$

If the percentage of relevant activities is ≥ 61% of the percentage of irrelevant student activities, then the developed student activity sheet is declared practical.

The data on the results of the implementation observation were obtained from the Likert scale scores as shown in Table 1. Then, the percentage of the data obtained was calculated using the following formula.

$$\text{Percentage} = \frac{\text{Score obtained}}{\text{Maximum score}} \times 100\%$$

The percentage results obtained are then interpreted according to the categories shown in Table 3. If the learning implementation percentage is ≥ 61% with a category of good to very good, then the SAS are interpreted as being practical for use in the learning process.

The effectiveness data from the pretest and posttest results were analyzed using the Shapiro Wilk normality test with a significance level of 0,05 to determine whether the data were normally distributed or not. Then, a hypothesis test was conducted. If the data was normally distributed, a paired sample t-test was performed; if the data was not normally distributed, a Wilcoxon test was performed. Next, an N-gain test was used to see the increase in students' creative thinking skills using the following formula:

$$\text{N-Gain (g)} = \frac{\text{Posttest score} - \text{Pretest Score}}{\text{Maximum score} - \text{Pretest Score}}$$

The N-gain score obtained is interpreted as follows:

Table 4. Criteria of N-Gain Score

N-Gain (g) Score	Criteria
g ≥ 0,7	High
0,7 > g ≥ 0,3	Medium
g < 0,3	Low

[21]

Based on the above analysis, SAS are considered effective if the increase in pretest and posttest scores reaches an N-Gain score ≥ 0,3, which is classified as moderate to high.

RESULTS AND DISCUSSION

The research conducted aimed to determine the feasibility of the SAS developed to improve creative thinking skills. The feasibility criteria in this study were reviewed from three aspects, namely validity, practicality, and effectiveness. The aspect of validity was reviewed from the results of the validation sheet assessment, which consisted of content validity and construct validity. The practicality aspect was assessed based on the results of a response questionnaire filled out by students, student activity observation sheets, and learning implementation observation sheets. The effectiveness aspect was determined from the results of pretests and posttests. The discussion in this study contains all research results and their analysis, which includes the results of the review and validation of SAS, data on student activities and responses, learning implementation, and the results of creative thinking skills tests.

Stage of Define

The definition stage is carried out to determine the requirements for learning that will be used and to collect relevant data for the development of SAS. The steps in this stage are described as follows.

The initial analysis aims to identify fundamental problems encountered when learning chemistry in high school, which will form the basis for developing specific tools. This analysis produces alternative solutions to problems that help determine the selection of learning tools to be developed. The fundamental problems were identified through a pretest questionnaire completed by the students. The findings revealed that 86,1% of students that teachers still used the direct intruction method to deliver material; 75% of students that they had never worked on a project during green chemistry lessons; and 75% of students that the learning resources used in lessons were in the form of power point presentations. The observation results showed that the curriculum used was the independent curriculum, which was designed to develop thinking skills, one of which was creative thinking, but during the learning process, there was still a lack of improvement in students' creative thinking skills.

The student activity sheet (SAS) is a learning tool that helps students understand chemistry. The use of SAS, supported by the project based learning model, can improve creative thinking skills and encourage students' ability to solve real life problems. Furthermore, the PjBL model makes learning student centered, with the teacher acting as a facilitator, guiding and directing the learning process [12].

The analysis of students aimed to identify student characteristics in supporting the development of media or tools according to student needs [19]. Students in senior high school are around 16-17 years old. According to Piaget's

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cognitive development theory, students have entered the formal operational stage, where they are capable of abstract, logical, and idealistic thinking [22]. With that, students in the classroom are expected to have the ability to generate new and original ideas, solve problems from various perspectives, and develop new ideas with the ideas of others.

Concept analysis serves to identify the main concepts of the material to be studied, then connect the concepts and realize them in the form of a concept map. The concept map used in this study is related to green chemistry material.

Task analysis aims to determine the tasks that students must complete in learning activities. The tasks compiled in the student activity sheet aim to improve students' creative thinking skills in accordance with the syntax of project based learning. Students must complete the tasks in the student activity sheet, starting from making basic statements, making project plans, making project schedules, monitoring or implementing projects, showing project results by presenting in front of the class, and evaluating their experiences during the project.

The formulation of learning objectives is based on the task analysis and concept analysis that have been made previously. Learning objectives are formulated based on the learning outcomes written in the E phase chemistry subject of the independent curriculum [16]. Daryanto [23] states that the learning objectives formulated must use measurable verbs so that the desired learning activities can be achieved clearly. Learning objectives are also needed to develop questions for creative thinking tests. In formulating learning objectives, they are also aligned with the learning model used.

Stage of Design

The design stage was created to produce preliminary designs for project based learning activity sheets for students to improve their creative thinking skills in green chemistry. Several things that need to be done in the design stage are media selection, format selection, and initial device design. Media selection is very important in supporting learning activities to meet learning objectives. Kurnia and Ulianas [12] showed that LAPD using the PjBL model on green chemistry material has been tested as a valid and practical learning medium. The selection of the format in LAPD is adjusted to the creative thinking components and syntax of the project based learning model as well as the curriculum used, namely the independent curriculum. The initial device design stage is adjusted to the predetermined format with the project-based learning model to help improve students' creative thinking skills in green chemistry material. LAPD is designed in the canva application and will later be printed in A4 size. At this stage, three SAS were designed. The first student activity sheet involves making hand sanitizer, the second involves making liquid organic fertilizer, and the third involves making herbal drinks.

Figure 1. Cover for SAS (a) Main Cover (b) Cover of Project 1 (c) Cover of Project 2 (d) Cover of Project 3

The cover of the student activity sheet provides an overview of its contents. The cover includes the title of the student activity sheet, illustrations or supporting images, a column for student identification, and the names of the author and supervising lecturer. Meanwhile, the design of the student activity sheet includes an introduction, table of contents, student activity sheet identity, learning objectives, instructions for use, concept map, learning outcomes, and learning objectives, as well as examples of problem presentation to train creative thinking, stages of the project based learning model, and tasks that must be completed by students.

Stage of Develop

The purpose of the develop stage is to produce a final draft of the student activity sheet that has been developed. The steps in the development stage consist of 1) review by the supervising lecturer, 2) validation by two lecturers from the chemistry education undergraduate program and one chemistry teacher, 3) limited testing. In the process of developing a product, validation is carried out by expert testing, and limited testing must be carried out so that the resulting product is useful for improving the quality of learning [24].

Validity

The validation sheet contains two aspects that are assessed, namely content validity and construct validity. Content validity consists of the completeness, accuracy, and suitability of the student activity sheet with the project based learning model used and indicators of creative thinking skills. Construct validation includes language, graphics, and presentation.

The validation results from the three validators showed that the project based learning oriented SAS developed obtained a mode of 4 in both content and construct criteria, with a category of good.

The aspects reviewed in content validity included the suitability of the SAS with the material, the suitability of the material with the PjBL components, the suitability of the material with the PjBL model, the suitability of the SAS with the creative thinking skills aspect, and the suitability of the PjBL syntax with the creative thinking skills aspect.

The construct validity related to the SAS developed was reviewed from the aspects of the suitability of the SAS with linguistic criteria, the suitability of the SAS with criteria related to presentation, and the suitability of the SAS related to graphics.

The results of the SAS validation developed in the description above show that the content validity and construct validity obtained a mode of 4 with a good category so that the LAPD was interpreted as valid and feasible when tested on a limited basis.

There are other tools and instruments such as teaching modules, student response questionnaires, learning implementation observation sheets, student activity observation sheets, and pretest and posttest sheets for creative thinking skills, which were also validated by three validators. These tools were used to support the implementation and feasibility of the developed SAS. The results of the validation of the research tools and instruments used were in the good category with a mode of 4, so that these tools and instruments could be used in limited trials. After making improvements and revisions in accordance with the suggestions and comments from the validators, the tools and instruments could be implemented in limited trials. So that the results of the validation of the research devices and instruments used are known to be in the good category with mode 4, so that the devices and instruments are valid and can be used in limited trials [25].

Limited Trial

Limited trials were conducted after the review and validation stages. Limited trials were conducted on August 12 and August with 34 students participating.

The limited trial was conducted to determine the practicality of the SAS developed based on the results of the student response questionnaire and supported by the results of student activities and learning implementation, as well as to determine the effectiveness of the SAS based on the pretest and posttest of students' creative thinking skills.

The first meeting was held on Tuesday, August 12, 2025, beginning with the students taking a pretest on creative thinking skills, followed by a trial of the SAS for projects 1, 2, and 3. The trial of the SAS in the first meeting was carried out up to phase 3. There were 34 students in one class, divided into 6 groups, with groups 1 and 2 working on the SAS for project 1 on making

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hand sanitizer, groups 3 and 4 working on the SAS for project 2 on making liquid organic fertilizer, and groups 5 and 6 working on the SAS for project 3 on making herbal drinks.

The hand sanitizer making project, the green chemistry principle applied is principle number 5, namely safer solvents and auxiliaries. This can be seen from the use of water as the main solvent in the formulation process, thereby minimizing the use of hazardous chemicals and supporting the creation of products that are more environmentally friendly and safe for users.

The liquid organic fertilizer making project the green chemistry principle applied is principle number 1, namely pollution prevention. The use of organic materials as a source of plant nutrients reduces dependence on synthetic chemical fertilizers that have the potential to pollute the environment. In addition, the manufacturing process tends to produce less waste because all materials are naturally degradable, thereby supporting more sustainable environmental management.

The herbal beverage making project, the green chemistry principle applied is principle number 7, namely use renewable feedstocks. The ingredients used, such as herbal plants, come from renewable natural resources that are available on a sustainable basis. The use of these biological resources not only supports consumer health through the selection of natural ingredients, but also contributes to reducing environmental impact because it does not rely on synthetic chemicals.

Meeting 2 was conducted on Thursday, August 14, 2023, and began with the implementation trial of the student activity sheet (SAS), covering learning activities from phase 5 to phase 6. During this session, students engaged in the final stages of the project based learning sequence, allowing them to complete the assigned tasks and consolidate their understanding of green chemistry concepts.

Practicality

The practicality of the SAS was reviewed based on the results of the student response questionnaire, the results of student activities, and the results of learning implementation. A student response questionnaire was given after using the SAS developed to obtain student responses regarding the feasibility of the SAS. Assessment was based on a Likert scale [18] Data from the student response questionnaire results are shown in Table 5.

Table 5. Results of Student Response Questionnaire

Assessment Aspect	Percentage
Learning using the PjBL model	96,3%
SAS on content criteria	97,8%
SAS on language criteria	97,1%
SAS on presentation criteria	95,6%
Creative thinking skills	97,1%

Based on Table 5, the learning assessment aspects that used the PjBL model obtained a percentage of 96,3% with a very good category. The assessment aspect of SAS use in content criteria obtained a percentage of 97,8% with a very good category, in linguistic criteria it obtained a percentage of 97,1% with a very good category, and the presentation category obtained a percentage of 95,6% with a very good category. The creative thinking skills aspect obtained a percentage of 97,1% with a very good category. This is in accordance with Lutfi [25], who states that the practicality of the developed SAS can be interpreted as practical if it obtains a practicality percentage > 61% in the good to very good category.

The student response questionnaire was also supported by the results of observations of teacher and student activities during two learning sessions. The observation assessment used a Likert scale with a score of 1-5 [20]. The results of the learning implementation observation are shown in Table 6.

Table 6. Observation Results on Learning Implementation

No.	Learning Activities	Observation Results of Learning		Mode
		First Meeting	Second Meeting	
1.	Introduction	5	5	5
2.	Phase 1: Determining Fundamental Questions	5	-	5
3.	Phase 2: Plan of procedure for project	5	-	5
4.	Phase 3: Creat a schedule	5	-	5
5.	Phase 4: Action the project with the facitily and monitorine	-	5	5
6.	Phase 5: Reporting and presenting the result of the project	-	5	5
7.	Phase 6: Evaluate process and outcome of the project	-	5	5
8.	Closing	5	5	5

Based on Table 6, it can be seen that the implementation of the PjBL model in each phase obtained a mode of 5 with a category of very good. This shows that teachers have carried out the learning process proportionally, so SAS is interpreted as very practical to be applied as a learning media.

Then, the feasibility of the developed SAS was also evaluated based on the results of observations of student activities. Student activities were analyzed based on their involvement during the learning process, which referred to the implementation of the PjBL stages in the student activity sheet. The results of observations of student activities are shown in Table 7.

Table 7. Results of Student Activity Observations

Meeting	Percentage	Category
1	94,82%	Very good
2	92,59%	Very good

Based on Table 7, the results of the analysis of the first and second meetings showed that student activity was in the excellent category with percentages of 94,82% and 92,59%. This indicates the application of PjBL syntax and high student activity, which played a role in improving creative thinking skills during the use of the developed SAS, so SAS is interpreted as very practical to be applied as a learning media.

Effectiveness

The development of this student activity sheet and its subsequent effectiveness test aim to determine the extent to which the resulting SAS can enhance students' creative thinking skills in the context of green chemistry learning. Through the integration of project based learning principles and activities aligned with the concepts of green chemistry. This study aims to evaluate not only the pedagogical quality of the developed materials but also their potential in developing higher-order thinking skills that are essential for solving real world problems.

The level of effectiveness was assessed through a test measuring students' creative thinking skills, which referred to the four indicators proposed by Torrance: fluency, flexibility, originality, and elaboration. Prior to implementing the learning process using the developed student activity sheets, students were administered a pretest to determine their initial level of creative thinking. Following the completion of the learning activities using the student activity sheets, students were given a posttest to evaluate their final abilities and determine the extent of improvement.

The creative thinking skills test consisted of eight essay questions, structured to represent each indicator proportionally. Specifically, two questions were designed to measure fluency, two for flexibility, two for originality, and two for elaboration. This structure ensured that all dimensions of creative thinking were assessed comprehensively and consistently.

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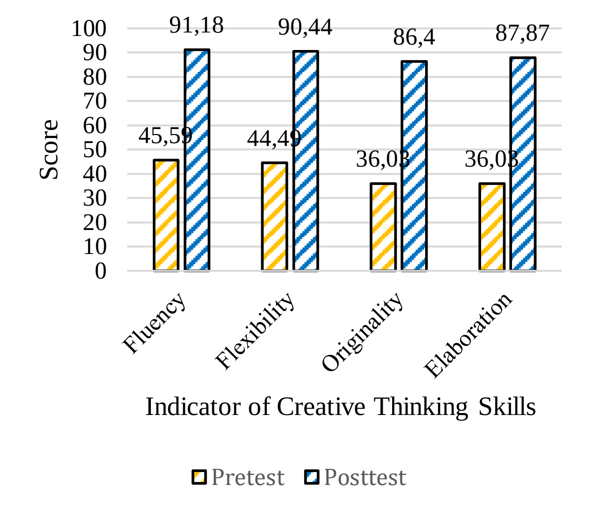

Figure 2. Pretest and Posttest Results for each Creative Thinking Skill Indicator of Students

Based on Figure 2, there was an increase in the pretest and posttest scores of students on each indicator of creative thinking skills. On the fluency indicator, the pretest score of 49,59 increased to 91,18 on the posttest. The flexibility indicator shows an increase from 44,49 to 90,44, while the originality indicator increased from 36,03 to 86,40. For the elaboration indicator, the pretest score was 36,03, and the posttest score reached 87,87.

Tabel 8. N-gain score for each Creative Thinking Skills Indicator

Indicator of Creative Thinking Skills	**N-Gain**
Fluency	0,84
Flexibility	0,83
Originality	0,79
Elaboration	0,81

Table 8 shows that the N-gain values for each creative thinking skill indicator indicate an improvement. The fluency indicator with an N-gain value of 0,84 is in the high category, the flexibility indicator with an N-gain value of 0,83 is in the high category, the originality indicator with an N-gain value of 0,79 is in the high category, and the elaboration indicator with an N-gain value of 0,81 is in the high category. Therefore, the SAS developed can help improve students' creative thinking skills, so it can be interpreted that SAS are effective for use as learning media.

The creative thinking skill indicator with the lowest increase and N-gain value is originality. According to Fahmi and Wuryandini [26], originality refers to the ability of students to provide unique answers that are different from others. The low increase in this indicator is due to the fact that some students are still unable to provide answers that are truly different or rarely produced by other students in completing the pretest and posttest questions.

Next, to determine the effect of providing activity sheets to students on their creative thinking skills, statistical analysis was conducted, beginning with a prerequisite test and followed by a hypothesis test.

The prerequisite test was conducted using a normality test. The type of normality test was determined based on the sample size, namely the Kolmogorov Smirnov test for samples of more than 50, and the Shapiro Wilk test for samples of less than 50. Since the sample size of this study was 34 students, the Shapiro Wilk test was used. If the significance value is $> 0,05$, the data is normally distributed and can be further analyzed with a parametric paired sample t-test, but if the significance value is $< 0,05$, the data is said to be not normally distributed and is analyzed using a non-parametric test, namely the Wilcoxon test [27]. The following table shows the results of the normality test for the pretest and posttest of creative thinking skills.

Table 9. Test of Normality

	Shapiro-Wilk		
	Statistic	**df**	**Sig.**
Pretest	.949	34	.114
Posttest	.924	34	.021

Based on the results of the normality test, there were 34 data points, so the Shapiro-Wilk test was used because the number was less than 50. The results showed that the pretest significance value was 0,114 ($> 0,05$), while the posttest significance value was 0,021 ($< 0,05$). Based on these results, it can be concluded that the posttest data is not normally distributed. Therefore, further analysis was performed using the Wilcoxon non parametric test [27].

Data analysis was performed using the Wilcoxon test, which is a nonparametric test used as an alternative for paired data when the data is not normally distributed. The hypothesis used in the Wilcoxon test is as follows:

- H_o: There was no difference in the average scores between the pretest and posttest of students' creative thinking skills after using PjBL oriented SAS.
- H_a: There was a difference in the average scores between the pretest and posttest of students' creative thinking skills after using PjBL oriented SAS.

Decisions are based on the significance value (sig. 2-tailed), that is, if the significance value is $< 0{,}05$, then H_o is rejected and Ha is accepted. If the significance value is $> 0{,}05$, then H_o is accepted and H_a is rejected [27].

Table 10. Test of Wilcoxon

	Posttest - Pretest
Z	-5.092[b]
Asymp. Sig. (2-tailed)	.000

The test results showed a significance value (2-tailed) of 0.000, which is less than 0,05, so H_o was rejected and H_a was accepted. Thus, it can be concluded that there was a difference in the average pretest and posttest scores for students' creative thinking skills after using the project based learning activity sheets. Therefore, the SAS that is developed can help improve students' creative thinking skills, so that it can be interpreted that SAS is effective for use as a learning media.

CONCLUSION

Based on the results of research and discussion, project based learning activity sheets for students to improve their creative thinking skills in green chemistry are deemed suitable for use as learning media in terms of validity, practicality, and effectiveness, namely:

a. The validity of project based learning activity sheets for improving students' creative thinking skills in green chemistry was deemed valid in terms of content validity and construct validity, with a mode of 4 in the good category.
b. The practicality of project based learning activity sheets for students to improve their creative thinking skills in green chemistry was deemed highly practical based on the responses of students, who gave an average rating of 96,9% in the very good category, supported by the results of student activities, which received an average rating of 93,7% with a very good category and learning implementation results that obtained an average percentage of 100% with a very good category.
c. The effectiveness of project based learning activity sheets for improving students' creative thinking skills in green chemistry was found to be effective in terms of the improvement in students' creative thinking skills as seen from the N-gain scores for each creative thinking skill indicator, which were in the high category, namely fluency of 0,84, flexibility of 0,83, originality of 0,79, and elaboration of 0,81. These results are also supported by the Wilcoxon test with H_a accepted. Thus, it can be concluded that there is a difference in the average between the pretest and posttest results of students' creative thinking skills after using project based learning oriented SAS.

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