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Development of Student Activity Sheets (SAS) to Practice Each Creativity Characteristics on Redox Reaction with Project Based Learning (PjBL) Model

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Abstract
This study aims to determine the feasibility of a Project Based Learning (PjBL) based student activity sheet (SAS) as a learning media on redox reaction material. The feasibility of this SAS is reviewed based on validity, practicality, and effectiveness. The research method used is the research and development model. The product trial design used a one-group pretest posttest. This research was conducted with a total of 29 student in class XI. The research instruments used in this study were SAS validation sheet, student response questionnaire sheet, student activity observation sheet, learning implementation observation sheet, creativity test question sheet, and learning outcome test question sheet. The SAS developed was declared: (1) feasible because it gets a mode score of 4, (2) practical because it gets the results of the student response questionnaire of 97.6%, the results of the observation of student activity and the observation of learning implementation which gets a mode score of 5, (3) effective for training student' creativity because it gets a p-value of 0.000 from the results of the paired sample t-test which shows that the posttest value is higher than the pretest value and there is a significant difference between the pretest and posttest values. The effectiveness of the developed SAS is also supported by the results of the learning outcomes test which get a p-value of 0.000 from the paired sample t-test results which also show that the posttest value is higher than the pretest value and there is a significant difference between the pretest and posttest values. For this reason, PjBL-based SAS on redox reaction material is suitable for use as a learning medium.

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INTRODUCTION

Learning has a special meaning, namely a process created by the teacher in order to optimize and improve all abilities possessed by students, such as the ability to think, the ability to build knowledge, the ability to solve problems, and the ability to master learning materials. These abilities need to be developed in the 21st century (Angga et al., 2022). In relation to this statement, Aryana (2019) stated that there are 4 skills that each individual needs to have related to skills in the 21st century, namely communication, collaboration, critical thinking and problem solving, creativity and innovation. (Arifin, 2017)

According to Barus (2019), there are seven learning models that teachers can apply to train thinking skills in the 21st century. One of them is Project Based Learning (PjBL) or project-based learning. Warso explains the definition of project-based learning in his book “Learning Process and Assessment” which is a method that uses project activities as a learning medium, uses questions as a starting point, and combines new knowledge with the experience of learners. During the process, learners will explore, evaluate, interpret, combine and manage information to produce various forms of learning outcomes. Through this project learning model, proactive and creative learning will be created (Lestari & Yuwono, 2022), so this model supports one of the 21st century thinking skills, namely creativity. This is supported by the results of research (Iklina & Fadilah, 2022) conducted on the PjBL learning model which is intended as an effort to improve students' thinking creativity and can help students achieve learning objectives.

However, students' creativity is still very low. This is based on the students' questionnaire in the pre-study which shows that 63% of students stated that training students' creativity is still rarely done. This is also related to chemistry learning on redox reaction material which is more often carried out in the classroom and the procurement of chemistry practicum and projects related to chemistry material is very rarely done. The reason is that the room available to function as a laboratory is not maximized and the equipment is also limited. Then based on interviews conducted at high school teachers in Mojokerto, students' creativity is still relatively low because in learning redox material, teachers usually use a direct learning model. This is supported by research conducted by Putri & Alberida (2022), according to the research the learning process that focuses on the teacher causes students to become passive and dependent on the teacher. Teachers as teachers provide less stimulation for students to practice solving problems, seeking knowledge and developing their creativity independently. For this reason, efforts to train students' creativity are needed. One of the efforts to train learners' creativity is through the use of learning media.

According to observations in research conducted by Mawardi & Indayani (2019), the approaches, strategies, media, and methods used by teachers are factors that support students' learning abilities. Highlighting the media factor as a support for learning, learning media itself is a means to a learning goal (Anitah, 2012). According to pre-research that has been done, there is no more innovative learning media used in redox reaction material at the school. The media used are only textbooks and material summary sheets and exercise questions which are considered by the teacher to be unable to train students' creativity, so learning media is needed that can foster students' thinking creativity.

One of the learning media that can overcome these problems is the student activity sheet (SAS). According to Rohani et al. (2017) SAS should contain instructions and steps to complete a task based on the competencies to be achieved, but in practice, the SAS used has not implemented this. The results of a field survey conducted at one of the senior high schools in Mojokerto provided results that in learning carried out in class, teachers used package books and SAS printed by publishers provided by the school. The SAS contains a summary of the material and exercises that are general in nature. Therefore, it is necessary to develop activity sheets that are tailored to the needs and personalities of students.

Students often view chemistry as a lesson that is not easy to learn. Research by Priliyanti et al. (2021) stated the cause of the students' views, where the first factor comes from within the students themselves and the second factor comes from outside as a support for learning. This also applies to one of the chemical materials, namely redox reactions. Redox reaction material is considered as material that is not easy and many students have difficulty when learning it. This is supported by the results of a pre-research questionnaire conducted at a high school in Mojokerto where as many as 63% of students thought that redox reaction material was not easy to learn. In line with this, Fuadah (2021) wrote that as many as 42.4% of students thought that redox reaction material was material that was difficult to understand compared to other materials. Based on the results of pre-research conducted by Fajarianingtyas & Yuniastri (2015), one of the causes of students' difficulties is the characteristics of the material which is at the submicroscopic or abstract level. Other difficulty factors are students' lack of interest in learning activities, students' lack of preparation before receiving learning, and prerequisite concepts that are not emphasized during the opening of learning.

In order for students to pay more attention and be interested in learning, an SAS is needed that can train students to be proactive in the learning process, namely by using PjBL-based SAS. Using this learning media can encourage students to work on the material studied, both individually and together with friends in the form of joint discussions. SAS can also provide the widest possible opportunity to demonstrate skills when developing thinking process abilities through searching, guessing, and reasoning (Yani, 2023). In addition, the PjBL learning model is used in the SAS developed because it has several advantages, the main of which is to make students proactive, such as being able to train students to design a process in solving problems collaboratively which can produce a real product of their own work based on responsible information management, and then presented in front of the class so that it can train communication and self-confidence by presenting their work (Dewi, 2022).

The purpose of this research is to produce project-based learning (PjBL) based SAS to train each characteristic of student creativity in redox reaction material which can be detailed as follows. 1. Produce a valid student activity sheet (SAS) to train each characteristic of creativity in redox reaction material with the Project Based Learning (PjBL) model. 2.Produce a practical student activity sheet (SAS) to train each characteristic of creativity in redox reaction material with the Project Based Learning (PjBL) model. 3.Produce effective student activity sheet (SAS) to train each characteristic of creativity in redox reaction material with the Project Based Learning (PjBL) model.

Based on the description above, it is hoped that the PjBL-based SAS developed can be declared valid, practical, and effective for practicing each of the characteristics of student creativity.

METHOD

Research Design

This research uses the type of research and development proposed by (Sukmadinata, 2013). This research consists of three steps which can be described as follows. In the first stage, namely preliminary studies, there are two steps, namely literature study and field survey. Literature study is a study to learn concepts or theories related to the activity sheet to be developed. At the literature study stage, the activities carried out are studying theories related to 21st century learning, student creativity, project-based learning models, development of teaching materials in the form of SAS, student characteristics, redox reaction material, learning theory, and relevant previous research results.

Field surveys were conducted to collect data regarding the planning and implementation of learning in schools, especially those related to the development of learning media. The field survey was conducted through interviews with chemistry teachers in schools and filling out pre-research questionnaires by students who have studied redox reaction materials. The results of interviews and pre-research questionnaires are the basis for selecting media to be developed as learning media.

The second stage is development. This stage consisted of three steps, namely drafting the SAS, reviewing and validating the SAS, and refining the SAS. The preparation of the draft SAS is based on data obtained from literature studies and field surveys. From this stage a design or initial draft of the activity sheet was obtained. The initial draft of the activity sheet was then reviewed for its suitability with the literature study and field survey results. Based on the reviewer's suggestions and input, the researcher will make revisions and after that validation is carried out by the validator before continuing to the next stage, namely the third stage, testing.

This process aims to produce activity sheets that can be used as learning media based on the results of review and validation by experts. In the second stage, data on the results of the validation of the SAS developed will be obtained. The data is then processed to obtain data on the validity of the SAS developed. Furthermore, the SAS that has been validated will be revised to get a refined SAS. If there are aspects that do not meet the valid criteria, they need to be consulted and revised until they meet the valid criteria.

The third stage is the testing stage. This test is carried out to obtain data on the practicality and effectiveness of the SAS developed. Testing was carried out on high school students in phase F who had received redox reaction material. Testing was carried out using a One Group Pretest-Posttest experimental design which is described as follows.

O_1	X	O_2

Figure 1. Experimet Design of One Group Pretest-Posttest

Description:
O_1 : pretest score (before treatment)
O_2 : posttest score (after treatment)
X : treatment, namely learning using the developed activity sheet

(Sugiyono, 2013)

Before using the SAS developed, students are given a pretest question sheet for creativity and learning outcomes. The creativity pretest question sheet is used to determine the initial creativity of students, while the learning outcomes pretest question sheet is used to determine the initial knowledge of students about redox reaction material. Furthermore, students are given treatment, namely learning using the activity sheet developed. During learning activities, observations of student activities and observations of learning implementation were carried out. After completing the learning series, each student was given a posttest question sheet on creativity and learning outcomes. This Posttest question sheet is used to determine the learning outcomes and creativity of students as an influence of the SAS developed. After the posttest, students were given a student response questionnaire on the activity sheet that had been used.

The data from the observation of students' activities, observations of learning implementation and student response questionnaires obtained were then processed to determine the practicality of the activity sheets developed. The pretest and posttest data obtained are then processed to determine the effectiveness of the activity sheets developed.

Then after obtaining the results of the response questionnaire, the results of the activity observation, the pretest and posttest answers to the learning outcomes and creativity of the students, improvements are made to the activity sheet if it has not fulfilled the aspects of practicality, and effectiveness to obtain a practical and effective activity sheet. If the activity sheet has fulfilled both aspects, it does not need to be improved anymore.

Date and Place of Research

This research was conducted in 2024. The preliminary study and development stages were carried out at the Department of Chemistry, Faculty of Mathematics and Natural Sciences, Surabaya State University. The testing stage was carried out in one of the private schools in Mojokerto on grade XI students who had received redox reaction material.

Data Collection Techniques

The data collection techniques used in this study were questionnaires, observations, and tests. Questionnaire technique is a data collection technique that is done by giving questions or statements in writing to be answered by the respondent. In this study, several questionnaires were needed, namely pre-research questionnaires, review sheets, validation sheets, and student response questionnaires. The observation technique is carried out during the learning process to observe the activities of students and the implementation of learning syntax using the developed SAS. The test technique is used to obtain quantitative data in the form of test scores as a measure of learning outcomes and creativity of students before and after using the developed activity sheet. In this study, two types of tests were used, namely *pretest* and posttest of students' learning outcomes and pretest and posttest of students' creativity.

Student Activity Sheets (SAS) Validation Data Analysis

To determine the validity of the SAS developed, the SAS validation sheet was used. The validation sheet is used to determine the degree of accuracy of the SAS developed as a measuring tool to measure students' creativity in redox reaction material. The assessment on the validation sheet was carried out by three validators which included content validity, construct validity, and graphics. The data from the validation of the developed SAS is used to determine whether the developed SAS can be used as a measuring tool to measure students' creativity. Scoring is based on a Likert scale as shown in Table 1.

Table 1. Score of Likert Scale

Score	Criteria
1	Invalid
2	Less Valid
3	Fairly Valid
4	Valid
5	Very Valid

(Adaptation of Riduwan, 2015)

The data from the validation results are ordinal data which cannot be operated mathematically (added, subtracted, divided, or multiplied), so the analysis is carried out descriptively quantitatively through determining the mode, which means that the decision is made on the largest number. After getting the mode, the SAS developed can be interpreted as valid if it gets a mode score ≥4 with valid to very valid criteria (Lutfi, 2021).

Practical Data Analysis

To determine the practicality of the SAS developed, a student response questionnaire, a student activity observation sheet, and a learning implementation observation sheet were used. The student response questionnaire was given to students after learning using the developed SAS. In the questionnaire, there are statements in the form of positive statements and negative statements. The scoring of each statement is based on the Guttman scale score in Table 2.

Table 2. Score of Guttman Scale

Response	Answer	Score
Negatif	Yes	0
	No	1
Positif	Yes	1
	No	0

(Adaptation of Riduwan, 2015)

The data obtained will be analyzed descriptively quantitatively through percentage calculations using the following formula.

$$P(\%) = \frac{F}{N} \times 100\%$$

since P: percentage of responsden's answer; F: the number of scores for each aspect; and N: number of respondents (students)

The percentage results obtained from the response questionnaire will be used to determine the practicality of the activity sheet developed by interpreting the percentage results obtained according to Table 3.

Table 3. Percentage of Student's Response Categories

Percentage (%)	Criteria
0 - 20	Impractical
21 – 40	Less Practical
41 – 60	Quite Practical
61 – 80	Practical
81 – 100	Very Practical

(Adaptation of Riduwan, 2015)

Based on Table 3, the SAS developed can be interpreted as practical if it obtains a minimum percentage of ≥61% with practical to very practical criteria.

The observation sheet for student activity and learning implementation contains statements related to student activity and learning syntax while using the developed SAS. This observation sheet will be filled in by the observer by giving a score to each available statement. Scoring is based on the Likert scale score shown in Table 4.

Table 4. Score of Likert Scale

Activity Implementation	Score	Criteria
No	0	-
Yes	1	Impractical
	2	Less Practical
	3	Quite Practical
	4	Practical
	5	Very Practical

(Adaptation of Riduwan, 2015)

The data obtained is ordinal data which will be analyzed descriptively quantitatively through determining the mode score, which means that the decision is made on the largest number. After getting the mode, the SAS developed can be interpreted as practical if it gets a mode score ≥4 with practical to very practical criteria. (Lutfi, 2021).

Effectiveness Data Analysis

Data from student creativity tests are used to determine the effectiveness of the SAS developed in training student creativity in redox reaction material, while learning outcomes test data are used to support the results of the effectiveness of the SAS developed. This data is obtained from *pretest* scores and *posttest* scores of students' creativity and learning outcomes. Analysis of creativity test data and student learning outcomes using a paired sample t-test through the Minitab application.

At first, a normality test is carried out which is necessary if data analysis is carried out using parametric statistics, where these statistics work with the assumption that the data of each research variable to be analyzed form a normal distribution (Sugiyono, 2012). The normality test used in this study is the Shapiro-Wilk technique because the samples used in this study amounted to less than 50 samples. The basis for decision making is as follows. If the p-value> 0.05, the data is declared normally distributed and if the p-value <0.05, the data is declared not normally distributed (Ngilmaya et al., 2021). If the data that has been tested produces normally distributed data, the test can be carried out to the next stage, namely the paired sample t-test.

After the data is declared normally distributed, the paired sample t-test is then carried out. This test is used to see the significance of differences in students' creativity before and after using the SAS developed based on *pretest* and *posttest* scores. The paired sample t-test was conducted through the Minitab application. If the p-value <0.05 then there is a significant difference in pretest and posttest scores. Conversely, if the p-value> 0.05 then there is no significant difference in the pretest and posttest scores.

RESULTS AND DISCUSSION

The research results are organized based on the stages in Sukmadinata's research design (2013). In this research design there are three stages, namely preliminary studies, development and testing. The following is a description of the stages carried out.

Preliminary Study

The preliminary study consisted of two steps, namely literature study and field survey. The literature study was conducted to learn the concepts and theories of the skills to be trained. According to Aryana (2019) 21st century skills need to be mastered by every individual. One of these skills is creativity. Creativity can be trained in the classroom through learning with models that can support these skills. According to Barus (2019) one of the suggested learning models to train 21st century skills is the project-based learning (PjBL) model. PjBL can facilitate students to be proactive in solving problems presented in learning, so that students can create meaningful work as an effort to solve the problems they face (Lestari & Yuwono, 2022). The results of research conducted by Qiara (2024) stated that five of the six PjBL syntax can train students' creativity.

As a place to train students' creativity, a learning media is needed, one of which is a student activity sheet (SAS). The learning material contained in the SAS to be developed is redox reaction material. This is due to the results of interviews and pre-research questionnaires in several previous studies which stated that redox reaction material is often considered not easy to learn. The reason is the nature of the material which is at the submicroscopic level, as well as the lack of interest in learning from students (Fajarianingtyas & Yuniastri, 2015).

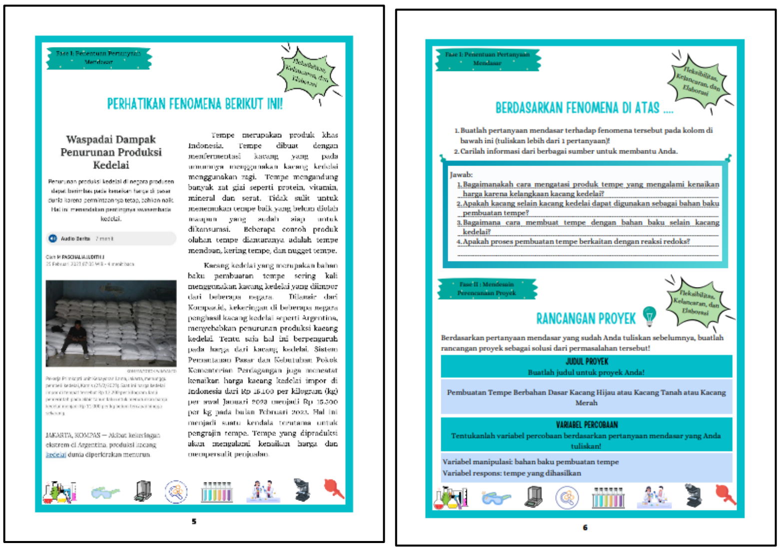
The field survey was conducted directly in one of the private schools in Mojokerto. Field surveys were conducted through giving pre-research questionnaires to students and interviews with chemistry teachers at school. Based on the results of the pre-research questionnaire, 51% of students hope to learn redox reaction material through project-based SAS because during learning using SAS, the SAS used only contains a summary of the material and practice questions. This is supported by the results of interviews with chemistry teachers at the school, where during learning takes place very rarely practicum or projects and more often use package books or SAS that are already available. In addition, 60% of students also stated that they had never practiced creativity at school. This is also confirmed by the chemistry teacher at the school, where creativity skills are rarely practiced. The results of the literature study and field survey will be used as the basis for preparing the product draft.

Development

Based on the results of the literature study and field survey, an initial product draft was prepared in the form of PjBL-based SAS which contains redox reaction material and aims to train students' creativity. The SAS developed contains creativity characteristics. The characteristics of creativity that are trained only include 3 aspects, namely flexibility, fluency, and elaboration. The aspect that is not trained is originality because in this SAS students are still at the stage of learning, practicing, and trying to apply previously learned chemical concepts in an effort to solve a real problem. However, the originality aspect is related to the fluency and flexibility aspects. If these two aspects have been mastered to the maximum, then it is possible that the originality aspect can be developed or trained in learning (Candra et al., 2019). The projects contained in the SAS developed are tempeh making and margarine making projects. The projects used non-soy beans such as peanuts, green beans, and red beans to make tempeh. The same goes for the margarine-making project. The margarine was made using a mixture of two types of vegetable oil, one of which was coconut oil. The SAS was then reviewed by one lecturer and improvements were made according to the suggestions and input given. After making improvements based on the results of the review, validation was then carried out. Validation was carried out by two chemistry lecturers and one chemistry teacher. Validation was carried out based on content validity, construct validity, and graphics. Based on the results of the review and validation, the SAS were ready to be used for testing. An example of the SAS design is described below.

(A) (B)

Figure 2. (A) Main Cover of SAS (B) Project Cover



(A) (B)

Figure 3. (A) Phase I PjBL Syntax (B) Phase II PjBL Syntax

In phase I of the PjBL syntax, students are asked to read phenomena and create fundamental questions. In phase II, students are asked to write a project design. In phase III, students determine the schedule for project implementation. In phase IV, students carry out their projects and the teacher monitors the progress of the project, students write down the results of their projects in the form of observational data, and students fill out analysis sheets containing questions related to the project. In phase V, students present the results of their projects, conduct question and answer sessions, and write conclusions on the results of the projects they carry out. In the last phase, phase VI, students evaluate the performance, project results, and learning that has been done through the PjBL model (Kemendikbud, 2014). In addition to obtaining a draft SAS that is ready to be used for the next stage, this stage also obtained validation data which is presented below.

Table 5. The Result of SAS Validation

Validity	Aspect of Validity	Mode	Criteria
Content	The correctness of the facts, concepts, principles and theories contained in the SAS	4	Valid
	Relevance of content to the characteristics of creativity being practiced	4	Valid
Construct	Suitability with learning objectives	4	Valid
	Suitability to the characteristics of creativity that are trained	4	Valid
	Suitability with PjBL syntax	5	Very Valid
Graphics	Cover	5	Very Valid
	Space to write answers	5	Very Valid
	SAS display	5	Very Valid
	Language	4	Valid

Based on Table 5, a mode score of 4 was obtained, which when interpreted, the SAS developed is valid. In content validity, the first aspect of the correctness of the content in the SAS developed must be really considered in order to minimize misconceptions during learning. In line with this, Prastowo (2015) mentions one of the content criteria of a teaching material in the knowledge aspect, namely having facts that are in the form of reality and truth, concepts, and principles.

In construct validity, the SAS developed needs to be adjusted to several aspects, one of which is the characteristics of creativity that are trained (flexibility, fluency, and elaboration). In the flexibility aspect, there are several activities in the SAS that bring out this aspect, including making basic questions, determining project ideas to be carried out, and writing answers that vary and from several points of view. In the fluency aspect, there are several activities in the SAS that bring out this aspect, including making several basic questions, writing down various possible answers to the questions in the SAS and providing several suggestions, input, or opinions related to the learning carried out. In the elaboration aspect, there are several activities in the SAS that raise this aspect, including detailing answers, questions, and statements from each activity in the SAS.

In the graphic aspect, the SAS developed was given an assessment for the overall appearance of the SAS, because SAS that has a good appearance can attract the attention of students. In addition, the language used in the SAS was also assessed, because according to Darmodjo and Kaligis in Padmaningrum (2006). SAS must make it easy for students to use in learning, so the sentence structure used must be clear and use simple and short sentences.

Testing

After the first stage, namely the preliminary study that produced the SAS, testing was then carried out for the development stage. This testing was carried out on 29 students at a school in Mojokerto. This test begins by conducting pretests for both creativity tests and student learning outcomes. After that, continued with learning activities using the developed SAS. During learning, observers will observe the activities of students and the implementation of learning syntax. After completing the entire learning series, the testing activities are closed by filling in the posttest of students' creativity and learning outcomes. The results of the test will be described as follows.

Practicality of SAS

To find out the practicality of the SAS developed, a student response questionnaire, a student activity observation sheet, and a learning implementation observation sheet were used. The student response questionnaire is used to obtain feedback data from student related to the learning carried out using the developed SAS. The data from the student response questionnaire is presented in Table 6.

Table 6. The Result of Student's Responses

Puspose of Aspects	Persentage	Criteria
Assessing the practicality of SAS	97,3%	Very Practical
Knowing the quality of SAS	98,9%	Very Practical
Knowing the practicality of learning using the PjBL model	97,0%	Very Practical
Knowing the practicality of SAS to train creativity characteristics for student	98,9%	Very Practical

Based on Table 6, an average percentage of 97.6% was obtained, which if interpreted, the SAS developed is very practical. In the aspect of knowing the practicality of the SAS developed to train the characteristics of creativity for students, a percentage of 98.9% was obtained. This is in accordance with the results of research conducted by Qiara (2024). In her research, five of the six PjBL syntaxes can train students' creativity characteristics. The syntax is the 1st syntax (determining the fundamental question), 2nd syntax (designing project design), 4th syntax (monitoring students and project progress), 5th syntax (testing results), and 6th syntax (evaluating students' experience). The fluency aspect is reflected in several activities in these syntaxes, one of which is that students provide several answers smoothly and quickly. The flexibility aspect is reflected in several activities in these syntaxes, one of which is that students provide varied answers and come from various points of view. While the elaboration aspect is reflected in when students provide detailed and detailed answers during learning activities, which are intended as a bridge to convey their ideas.

The student activity observation sheet was used to support the practicality of the SAS developed. Student activity observation data is presented in Table 7.

Table 7. The Result of Student's Activities

Learning Activites	Mode	Criteria
Phase 1	5	Very Practical
Phase 2	5	Very Practical
Phase 3	5	Very Practical
Phase 4	5	Very Practical
Phase 5	4	Practical
Phase 6	5	Very Practical

Based on the data from the student activity observation sheet as listed in table 7, it can be concluded that the SAS developed received a mode score of 5, which if interpreted, the SAS developed is very practical. Observed student activities refer to activities in each PjBL syntax. In phase I, students create questions that encourage students to carry out an activity through taking topics that are real and relevant to students, so that learning activities in the form of an investigation process can begin. In phase II, students design a project design related to problem solving from the phenomenon presented. In phase III, it is done to organize the agenda related to the implementation of the project. In phase IV, the teacher as a facilitator is responsible for supervising and observing the activities carried out by students while working on the project.

In phase V, students measure the achievement of competencies, evaluate the progress of each group's project, and provide feedback in the form of questions or responses to the understanding that students have achieved. In phase VI which is the last phase in the learning process, both teachers and students reflect on all activities that have been passed during learning with projects through a discussion to improve performance during the learning process (Kemendikbud, 2014).

In addition to observation of students' activities, observation of learning implementation was also conducted. The results of the learning implementation observation are used to support the practicality of the SAS developed. Data from the observation of learning implementation is presented in Table 8.

Table 8. The Result of Learning Implementation

Learning Implementation	Mode	Criteria
Introduction	5	Very Practical
Phase 1	4	Practical
Phase 2	5	Very Practical
Phase 3	5	Very Practical
Phase 4	5	Very Practical
Phase 5	4	Practical
Phase 6	5	Very Practical
Closing	5	Very Practical

Based on the data from the observations of learning implementation as listed in the table above, it can be concluded that the SAS developed received a mode score of 5, which if interpreted, the SAS developed is very practical and learning activities are well implemented in accordance with the PjBL syntax compiled in the teaching module.

Effectiveness of SAS

The effectiveness of SAS is based on data from *pretest* and *posttest* results of creativity and student learning outcomes. In the creativity test there are 5 description questions given to students who are done before and after using the developed SAS. The aspects of creativity that are trained include three aspects, namely flexibility, fluency, and elaboration. The data from the students' creativity test results were then analyzed using the Minitab application. The results of students' creativity tests for each aspect of creativity that is trained are presented in the following figure.

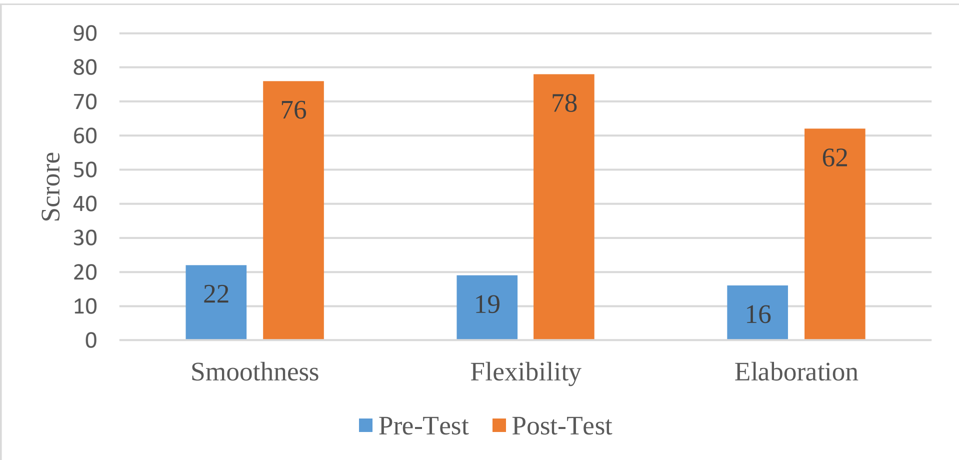
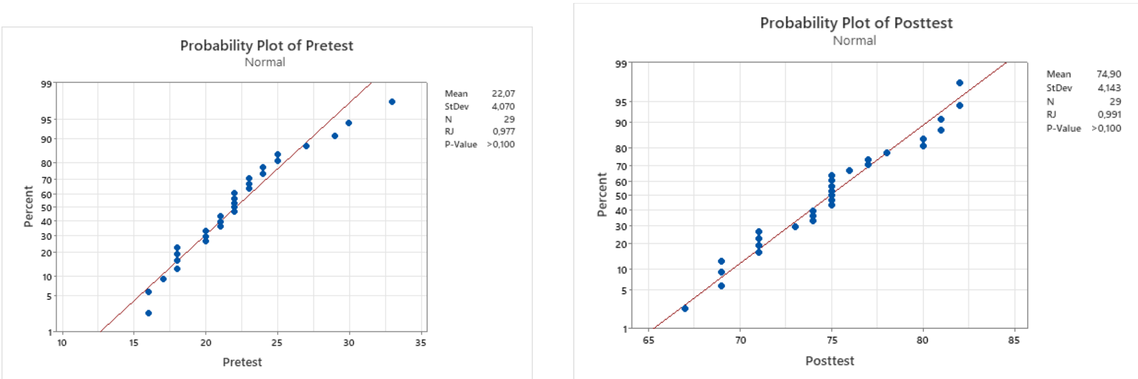


Figure 4. Pretest and Posttest Results on Each Creativity Characteristic Exercised

Based on Figure 4, it can be seen that there is an increase in the value of each creativity characteristic that is trained. Then the creativity test results were further analyzed using a paired sample t-test using the Minitab application. Paired sample t-test is a parametric statistical technique used to test the comparative hypothesis of two correlated samples with interval or ratio data. One example of a correlated sample is the *pretest* and *posttest* scores.

Before conducting a paired sample t-test, the data to be analyzed needs to be tested for normality to determine whether the data is normally distributed or not, because parametric statistics (which include paired sample t-tests) work on the assumption that the data from each research variable is normally distributed (Sugiyono, 2012). The normality test used to analyze the scores of *pretest* and *posttest* results is the Shapiro-Wilk normality test because the amount of data obtained is less than 50, namely 29 data from 29 students. This test is carried out using the Minitab application on the basis of decision making which if the *p-value*> 0.05 then the data is declared normally distributed (Ngilmaya et al., 2021). The results of normality testing on pretest and posttest data are presented as follows.

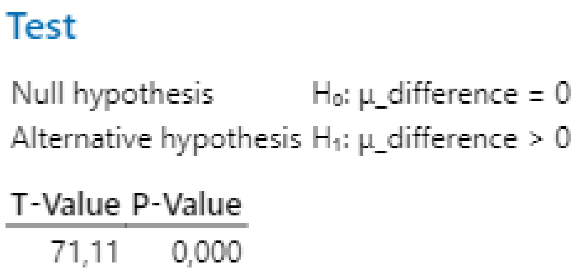


(A) (B)

Figure 5. (A) Normality Test Results on Creativity Pretest Data (B) Normality Test Results on Creativity Posttest Data

Based on Figure 5, it can be seen that the pretest and posttest values have a p-value of more than 0.100, so the data can be declared normally distributed because it has a p-value of more than 0.05 and meets the requirements of the paired sample t-test. That way, the data obtained can be analyzed using a paired sample t-test.

The hypothesis proposed in the paired sample t-test is H0 or the null hypothesis that the posttest value is smaller or equal to the pretest value andHa or the alternative hypothesis that the posttest value is greater than the pretest value (Sugiyono, 2012). The decision taken is if the p-value is smaller than 0.05, then H_0 is rejected and H_a is accepted. Conversely, if the p-value is greater than 0.05, then H0 is accepted and H_a is rejected. The results of the paired sample t-test test on the pretest and posttest data for student' creativity are presented as follows.



Test

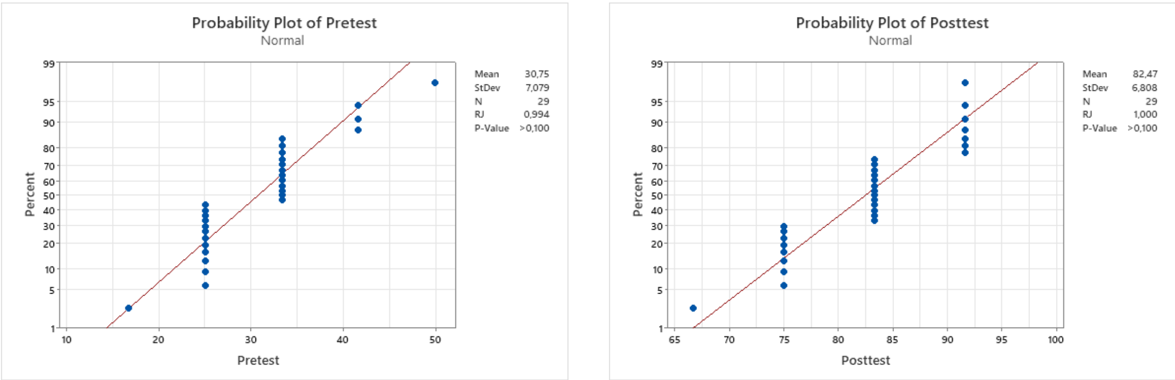
Null hypothesis H_0: μ_difference = 0
Alternative hypothesis H_1: μ_difference > 0

T-Value	P-Value
71,11	0,000

Figure 6. Paired Sample t-Test Results on Pretest and Posttest Values of Student Creativity

Based on figure 6, it can be seen that the *p-value* obtained is 0.000 so that H_0 is rejected and H_a is accepted. This shows that the *posttest* value of students' creativity after using the developed SAS is greater than the *pretest* value of students' creativity before using the developed SAS. That way, the SAS developed can be declared effective for training students' creativity in redox reaction material.

The effectiveness of SAS is also obtained through pretest and posttest data on learning outcomes. The learning outcomes test is in the form of multiple choice and consists of 12 questions related to redox reactions. This test was conducted before and after learning using the developed SAS. The learning outcome test data was then analyzed using a paired sample t-test through the Minitab application.



(A) (B)

Figure 7. (A) Normality Test Results on Pretest Data of Learning Outcomes (B) Normality Test Results on Posttest Data of Learning Outcomes

Based on figure 7, the normality test results show that the data is normally distributed for both pretest and posttest data, so it meets the requirements of paired sample t-test testing. The paired sample t-test results are shown as follows.

Test

Null hypothesis H_0: μ_difference = 0
Alternative hypothesis H_1: μ_difference > 0

T-Value	P-Value
34,19	0,000

Figure 8. Paired Sample t-Test Results on Pretest and Posttest Student Learning Outcomes

Based on figure 8, it can be seen that the *p-value* obtained is 0.000 so that H_0 is rejected and H_a is accepted. This shows that the posttest value of students' learning outcomes after using the developed SAS is greater than the pretest value of students' learning outcomes before using the developed SAS. That way, the SAS developed can be declared effective for training student' creativity in redox reaction material.

CONCLUSION

Student activity sheets (SAS) with PjBL oriented to train each characteristic of student creativity on redox reaction material can be used as learning media after being evaluated for validity, practicality, and effectiveness. SAS is declared feasible after being validated based on content, construct, and graphic validity and getting mode 4 with valid criteria. SAS is declared practical to use as a learning media after being assessed for practicality based on a student response questionnaire which gets a result of 97.6% with very practical criteria, as well as a student activity observation sheet and a learning implementation observation sheet which gets mode 5 with very practical criteria. SAS is declared effective to be used as a learning media after the pretest and posttest data on student' creativity and learning outcomes are analyzed using a paired sample t-test through the Minitab application and get a p-value of 0.000 which means that the posttest value is greater than the pretest value and there is a significant difference. Therefore, PjBL-based SAS on redox reaction material can be used to train students' creativity.

RECOMMENDATIONS

There are several suggestions for future research. First, it is recommended to develop SAS to train the originality aspect with other creativity characteristics. Secondly, in future research it would be better to use a SAS assessment rubric that can assess each of the characteristics of students' creativity.

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