

DEVELOPMENT OF STRUCTURED ASSIGNMENT SHEET ON REACTION RATE MATERIALS TO TRAIN PROBLEM-SOLVING SKILLS

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Abstract

This study aims to determine the feasibility of a Structured Assignment Sheet (SAS) on the reaction rate material to practice student Problem-Solving Skills (PSS) in terms of validity, practicality, and effectiveness criteria. The method used in this research is Research and Development (R&D). The instruments used were validation sheets, student response questionnaires, and problem-solving skills test sheets. SAS that developed was tested on 15 students of XI grade who had received material on reaction rates at SMAN 1 Manyar and SMA Assa'adah Bungah. The SAS's validity was obtained based on the assessment of two Chemistry lecturers of Universitas Negeri Surabaya and two chemistry teachers at SMAN 1 Manyar and SMA Assa'adah Bungah. The validity has obtained a percentage of content validity of 92% and constructs validity of 90%, both of them were included in the very valid category. The practicality of the SAS was obtained through student responses. It obtained a positive response of 100% in the very practical category. The effectiveness of SAS was obtained through an N-Gain score of 0.8 with high criteria. That shows that the SAS-PSS developed is suitable for use in the learning process.

Keywords: Structured Assignment Sheet (SAS), Problem-Solving Skills (PSS), Reaction Rate.

Pengembangan Lembar Penugasan Terstruktur (LPT) Pada Materi Laju Reaksi Untuk Melatihkan Keterampilan Pemecahan Masalah

Abstrak

Penelitian ini bertujuan untuk mengetahui kelayakan dari Lembar Penugasan Terstruktur (LPT) pada materi laju reaksi untuk melatih keterampilan pemecahan masalah siswa ditinjau dari kriteria validitas, kepraktisan, dan keefektifan. Metode yang digunakan pada penelitian ini adalah Research and Development (R&D). Instrumen yang digunakan adalah lembar validasi, angket respon siswa, dan lembar tes keterampilan pemecahan masalah. LPT yang dikembangkan diujikan kepada 15 siswa kelas XI yang sudah mendapatkan materi laju reaksi di SMAN 1 Manyar dan SMA Assa'adah Bungah. Validitas LPT diperoleh berdasarkan penilaian dari dua dosen kimia Universitas Negeri Surabaya dan dua guru kimia di SMAN 1 Manyar dan SMA Assa'adah Bungah, diperoleh prosentase validitas isi sebesar 92% dan validitas konstruk sebesar 90%, keduanya termasuk dalam kategori sangat valid. Kepraktisan LPT didapatkan melalui respon siswa, dengan respon positif sebesar 100% dan termasuk dalam kategori sangat praktis. Efektivitas LPT diperoleh melalui skor N-Gain sebesar 0,8 dengan kriteria tinggi. Hal ini menunjukkan bahwa LPT-KPM yang dikembangkan sesuai untuk digunakan dalam proses pembelajaran.

Kata Kunci: Lembar Penugasan Terstruktur (LPT), Keterampilan Pemecahan Masalah (KPM), Laju Reaksi.

INTRODUCTION

National education aims to develop students' potential to become human beings who

believe and fear God Almighty, have noble, healthy, knowledgeable, capable, creative, independent citizens, and become democratic and responsible citizens (Andriani, 2016). In

order to achieve these goals, we need a curriculum that plays an important role as a guideline. In the 2013 curriculum, teachers are required to develop High Order Thinking Skills (HOTS) (Widodo & Kardawati, 2013). One of them is problem-solving skills (PSS), where problem-solving skills are a major theme in research and curricula worldwide. According to Trilling & Fadel (2009), problem-solving skills are one of the 21st-century thinking skills that are expressed as expert thinking.

Efforts to solve problems require high problem-solving skills. Problem-solving skills are a form of intelligent thinking that students must have. It's in line with the National Council of Teachers of Mathematics (NCTM) in Jehabun et al. (2020), that in learning, students are required to have the ability to solve problems (problem-solving), to communicate (communication), to connect (connection), to the reason (reasoning), and to represent (representation). If students have reliable problem-solving skills, then several benefits can be obtained by students, namely: (a) students will learn that there are many ways to solve problems (divergent thinking), and more than one kind of solution that may occur, (b) students are trained to explore, think comprehensively, and reason logically, (c) develop communication skills and form social values in groups (Yarmani, A, 2016).

Problem-solving skills involve causal reasoning and help individuals make correct, careful, systematic, logical decisions and consider various points of view. Some of these benefits can improve the quality of students later. Lack of problem-solving skills results in individuals carrying out various activities without knowing the purpose and reasons for doing them (Novitasari, Ramli, & Maridi, 2015). Therefore, Mukhopadhyay (2013) has recommended that students develop problem-solving skills as a necessity in the 21st century.

One of the efforts to implement problem-solving skills is to study chemistry. Students can be scientific and can understand chemical concepts that afterward can solve the problems in them. That is why chemistry is very important (Adhitama & Sudarmin, 2015). Therefore students considered that chemistry is difficult and complicated to study. This assumption is influential because students become lazy to follow subjects, and the students would have difficulty solving problems that appear in chemistry lessons.

Based on the standard contents, one of the things students need to take part in learning activities is structured assignments. Structured assignment sheets (SAS) are worksheets designed to guide students in a lesson work program with a little help from the teacher to achieve the intended goals in the learning (Kundi, 2013). The structured assignment sheet contains Non-Routine type questions and is equipped with instructions and directions so that students can solve a problem systematically. Therefore, students can play an active role in finding solutions to each problem. So the students are trained to think in a more structured or systematic manner (Kundi, 2013)

The conducted research previously by Sulistyowati (2012) showed that students' classical completeness had not reached 85% yet, where the learning process also did not lead the students to solve the chemical problems. Marthafera, Melati, & Hadi (2018) stated that students' chemistry materials do not understand enough is reaction rate materials. It can be seen from the percentage of students completing daily tests for the last three years, and more than 50% of students did not complete. The less problem-solving skills of students were also confirmed in Prastiwi's (2018) research. The percentage of students who had difficulty understanding problems was 51.61%, difficulties preparing problem formulations were 80.65%, difficulties in implementing problem-solving were 48.39%, and difficulty checking back the results obtained by 51.61%.

Based on the data and facts that have been described, the researcher is interested in researching "Development of Structured Assignment Sheets (SAS) on The Reaction Rate Materials to Train The Problem-Solving Skills."

METHOD

This research was conducted in Gresik, to be precise SMAN 1 Manyar and SMA Assa'adah Bungah, in December 2020. This research uses the Research and Development (R&D) type. Sugiyono (2015) states that Research and Development (R&D) is a research method used to develop or validate products used in education and learning.

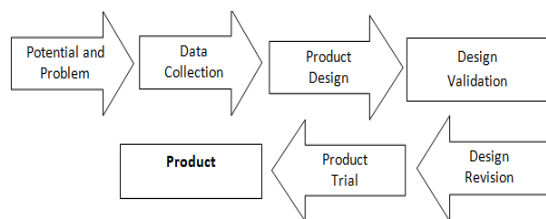


Figure 1 Research Procedure

The research procedure was guided by the steps of the R&D method but is limited to seven steps, according to development needs until the final product. This research using quantitative data gained from validity, practicality, also effectiveness appraisals. The number of research instruments depends on the variables studied, so the instruments in this study consist of a study sheet, a validation sheet, a student response questionnaire, and a pretest-posttest sheet for training and measuring problem-solving skills.

The variables used are how the validity, effectiveness, and practicality of the developed SAS-PSS. The data were obtained from chemistry lecturers, chemistry teachers, and 15 students from two schools through analysis, validation, and limited testing. Validity is measured from the results of validation, practicality through student's responses, and effectiveness measured through the results of students' problem-solving skills. The methods used are test and questionnaire methods. The instruments used in this study were validation sheets, student response questionnaires, and problem-solving skills test sheets.

The analysis data from validation experts were descriptively quantitatively. The validator provides an assessment of each component based on the Likert scale presented in Table 1.

Table 1. Likert Scale Score

Criteria	Value Scale
Very Valid	5
Valid	4
Less Valid	3
Invalid	2
Very Invalid	1

(Riduwan, 2015)

The formula used in the calculation to obtain a percentage, namely:

$$\text{Percentage (\%)} = \frac{\sum \text{score obtained}}{\sum \text{score criteria}} \times 100\%$$

Score criteria = highest score x number of aspects x number of respondents. SAS is said to

be feasible if the percentage for each criterion gets a percentage of $\geq 81\%$

The interpretation of the results score is presented in Table 2.

Table 2. Validation Score Interpretation Criteria

Percentage (%)	Criteria
0-20	Very invalid
21-40	Invalid
41-60	Quite valid
61-80	Valid
81-100	Very valid

The Problem-solving skills assessment using the One Group Pretest-Posttest Design system. In this system, the results of the pretest-posttest used as an indicator of students' problem-solving skills. The student's problem-solving skills result obtained and compared when before and after using SAS. This design can be detailed as follows:

$$O_1 \times O_2$$

Notice:

O_1 = student's problem-solving skills pretest before being given SAS by giving a test

X = given treatment to students, namely the use of the developed SAS

O_2 = student's problem-solving skills posttest after given SAS by a test

Problem-solving skills data obtained from the results of limited trials. The analysis is carried out on each component in the assessment sheet. The assessment is based on the normalized Gain score calculation based on the Archambault formula (2008), namely:

$$N\text{-gain} = \frac{\text{Score posttest} - \text{Score pretest}}{\text{score max} - \text{score pretest}} \times 100$$

Then, the results of the normalized score obtained are divided into three criteria shown in Table 3.

Table 3. Criteria for Normalized Gain

Percentage	Criteria
N-gain > 70	High
30 ≤ N-gain ≤ 70	Medium
N-gain < 30	Low

(Archambault, 2008)

Students are declared complete if the N-gain score reaches $\geq 0,7$ with high criteria, then the SAS-PSS that trained on students can be said to be effective.

The practical data was obtained from student response questionnaires after conducting

limited trials. The student response questionnaire used clear and firm answers, namely "Yes" and "No" based on the Guttman scale presented in Table 4.

Table 4. Guttman Scale Statement

Answer Criteria	Scale
Yes	1
No	0

(Riduwan, 2015)

The formula used in the calculation to obtain a percentage, namely:

$$\text{Percentage (\%)} = \frac{\sum \text{score obtained}}{\sum \text{score criteria}} \times 100\%$$

Score criteria = highest score x number of aspects x number of respondents. The interpretation of the results score is presented in Table 5.

Table 5. Student Response Score Interpretation Criteria

Percentage (%)	Criteria
0-20	Not practical
21-40	Less practical
41-60	Quite practical
61-80	Practical
81-100	Very practical

(Riduwan, 2015)

SAS developed yet can be said to be very practical if it gets a percentage of $\geq 81\%$. That means the SAS is very suitable to be applied for the learning process.

RESULTS AND DISCUSSION

These results and discussion contain a detailed description of all the research results and their analysis to prove the feasibility of this research entitled "Development of Structured Assignment Sheets (SAS) on The Reaction Rate Materials to Train The Problem-Solving Skills." The results of this development SAS-PSS research obtained the following data: analysis and validation results, the average percentage of pretest-posttest scores, and the student's responses to the developed SAS-PSS.

The appropriateness of Structured assignment sheets (SAS) should be tested before it used for the students. The appropriateness can be rated using three criteria based on Nieveen's recommendation (2010) that including the validity (content and construct), practically, also effectiveness. At the first step, after the SAS already been finished, the chemistry lecturer from FMIPA Unesa gave an appraisal by giving

some advice or maybe some critics. The appraisal for SAS was done by reviewing the content inside also the language that it used. Either already proper or not, the lecturer always gave his feedback to the SAS, so the SAS as the product can be as perfect as possible. After the SAS has been repaired based on the advice and critics, the SAS was ready to move in a further step, which a validation.



Figure 2 Cover View of SAS-PSS

Structured assignment sheets (SAS) are worksheets designed to guide students in a lesson work program with a little help from the teacher to achieve the intended goals in the learning (Kundi, 2013). The structured assignment sheet contains Non-Routine type questions and is equipped with instructions and directions so that students can solve a problem systematically. Structured assignment sheets by training students' problem-solving skills in the form of activity sheets with a given problem, complemented with directions. Before students find the expected answers, some questions are provided as a first step in finding answers. Such as determining problem formulations, variables, and so on. These stages are problem identification, definition, strategy formulation, and evaluation (Bransford & Stein, 1993). Structured assignment sheets are given to students outside of learning hours.

The indicators that use in this research of development SAS-PSS is from the adaption of IDEAL. Bransford & Stein (1993) introduced

the IDEAL Problem-Solving as a learning model that can help solve problems. The IDEAL Problem Solving is used to solve problems with well-defined questions or problems. Table 6 shows the adaptation of indicators for problem-solving skills from IDEAL Problem Solving.

Table 6. Indicators of Problem Solving Skills

Indicator	Problem Solving Skills Indicator Statement
Identify the problem	<ul style="list-style-type: none"> - Students can find problems and write problem formulations - Students can determine the variables associated with the problems
Identify the purpose	<ul style="list-style-type: none"> - Students can analyze problem-solving objectives based on problem formulations
Digging for solutions	<ul style="list-style-type: none"> - Students analyze problems through literature review - Students can write down a sequence of work steps according to the problem-solving plan that made
Implement the strategy	<ul style="list-style-type: none"> - Students can answer problems along with evidence of solving the problem
Evaluation	<ul style="list-style-type: none"> - Students double-check the problems that have solved - Students can think of the other solutions in problem-solving - Students can communicate the results of problem-solving and do the conclusions

Validity of SAS-PSS

The validation results of SAS-PSS were analyzed quantitatively. The assessment component of the validity of SAS-PSS was reviewed in terms of content and construct validity (Sugiyono, 2015). Four experts validated SAS-PSS development, to be precise, two chemistry lecturers and two chemistry teachers at SMAN 1 Manyar and SMA Assa'adah

Bungah. The average of the validation results is presented in Table 7.

Table 7. Validation Results

Components	Percentage (%)	Criteria
Content	92	Very valid
Construct	90	Very valid

In content validity, there are five components included in the feasibility of content with problem-solving skills to be trained. There is the scope of the material, the accuracy of the material, the up-to-date, the dimensions of the skills, and the suitability of the skill components. Based on the content validation results that have been averaged, the percentage is 92% with very valid criteria. It states that the SAS-PSS that has been developed is in accordance with the directions and indicators of problem-solving skills to be trained.

In construct validity, regarding the components related to one another (construct validity or consistency). The components that loaded are the presentation component and the language component. The presentation component includes presentation techniques, supporting material presentation, learning presentation, and presentation completeness. Simultaneously, the linguistic component includes the development of students, legibility, motivation ability, straightforwardness, coherence, the sequence of thought, and conformity with writing rules. Based on the construct validity results, the average was obtained 90% with very valid criteria. SAS-PSS has been presented coherently and systematically, interactive and participatory, and equipped with an introduction, a table of contents, and a bibliography (BSNP, 2014). It also has shown that SAS-PSS has consistency and linkages between components.

Based on the validation results on the validity of content and content, both have a percentage \geq of 81% with very valid criteria. It means the SAS-PSS that has been developed is very suitable for use in learning reaction rates to train students' problem-solving skills.

Practicality of SAS-PSS

The SAS-PSS's practicality was assessed based on a response questionnaire filled out by students based on the SAS-PSS given. SAS-PSS is said to be practical if it is easy to use. The questionnaire given refers to the suitability of indicators of problem-solving skills adapted from Bransford & Stein (1993) with the given

SAS-PSS. The response questionnaire sheet is given in two forms, namely open and closed responses. The closed response recapitulation results are shown in Table 8.

Tabel 8. Recapitulation of Closed Response Results

Component	Percentage	Criteria
Identify the problem	100%	Very Practical
Identify the purpose	100%	Very Practical
Digging for solutions	100%	Very Practical
Implement the strategy	100%	Very Practical
Evaluation	100%	Very Practical

Open questionnaires that made used to show the alignment of students' responses to a closed questionnaire. Student responses given through opened questionnaires show that students have facilitated to practice problem-solving skills based on the suitability of indicators with SAS-PSS.

The recapitulation of the average close response questionnaire resulted in a percentage of 100% with a very practical category. It's contingent on interpreting the score criteria on the student response that states that if the percentage obtained is $\geq 81\%$, it is categorized as very practical (Riduwan, 2015). So, it can be stated that the given SAS-PSS had fulfilled practicality.

Effectiveness of SAS-PSS

The effectiveness of SAS-PSS was assessed by increasing the results of problem-solving skills by comparing pretest-posttest. Both pretest-posttest are given up-to-date problems and are related to daily life. Besides, both tests also contain indicators of appropriate problem-solving skills. The assessment of effectiveness was taken through 15 students at SMAN 1 Manyar and SMA Assa'adah Bungah.

The results of the test for problem-solving skills are shown in Table 9.

Table 9. Student Problem-Solving Skills Result

Name	Pretest	Posttest	N-Gain
ANR	13,3	73,3	0,7
DA	6,7	70	0,7
GYR	6,7	86,7	0,9

Name	Pretest	Posttest	N-Gain
MPR	16,7	86,7	0,8
MAZ	10	76,7	0,7
MRA	33,3	93,3	0,9
NCN	36,7	86,7	0,8
NL	40	90	0,8
NIF	6,7	86,7	0,9
SAR	6,7	86,7	0,9
FT	36,7	86,7	0,8
RAQ	30	80	0,7
TK	33,3	80	0,7
MF	10	70	0,7
AS	23,3	80	0,7

The average data from pretest-posttest were analyzed also using N-Gain, which are presented in Table 10.

Table 10. N-gain Results

\bar{x} Pretest	\bar{x} Posttest	N-gain	Criteria
20,7	82,2	0.8	High

Based on the data analysis of the test results in Table 10, the N-gain value is 0.8. The increase of student's ability to solve problems indicated by the N-gain score with a high category. So that in terms of effectiveness, the SAS-PSS developed is said to be effective or very suitable for use in chemistry learning on the material of reaction rates.

SAS-PSS contains several components by the indicator as a reference. The first indicator is problem identification, where after the problems given to the students, they can find out what the problem is and formulate them. They also need to determine the control, independent, and dependent variables. The second indicator is identifying the objectives. At this stage, students are expected to know the objectives of solving the problem to be implemented. It is correlated with the expectations of Novitasari, Ramli, & Maridi (2015) that students are expected to know the purpose before carrying out all activities.

The third indicator is exploring solutions, where students are expected to analyze the problem through several sources in the literature review. After that, they also have to write down

the work steps or plans to solve the problem. So the students are trained to solve problems systematically (Kundi, 2013). The next indicator is implementing the strategy. At this stage, students are expected to solve existing problems by providing solutions based on sources obtained from literature reviews. According to Yarmani's opinion (2016), students can be trained to explore, think comprehensively, and reason logically in solving problems.

The last indicator is evaluation. Students are required to analyze and write down other solutions in solving the same problem. That has been stated by Yarmani (2016) that one of the benefits of students having reliable problem-solving skills is that students will learn that there are many ways to solve problems (divergent thinking). More than one kind of solution occurs. Besides, students are also expected to make conclusions and communicate the results of the problem-solving process through the preparation of draft documents. Where students can write coherently start from the problem identification to the conclusions. So the readers can know the problems they have and how students can solve them. The student's problem-solving skills can be analyzed from each indicator's results by comparing the pretest and posttest that are shown in Figure 1.

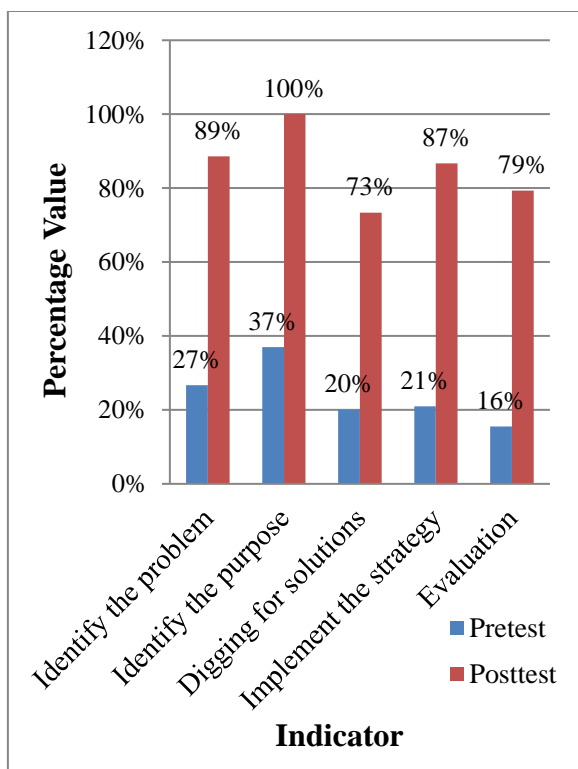


Figure 1. Problem-Solving Skills Indicator Analysis

Based on the diagram, students' problem-solving skills on each indicator ranging from problem identification to evaluation before being given SAS-PSS are 27%, 37%, 20%, 21%, and 16%. It shows that students have the most difficulty thinking of other solutions to a problem and making conclusions, which means that the student's ability to think divergent and the ability to connect concepts, theories, formulas, and equations related to the given problems still very weak. That is because students have never trained in problem-solving skills.

SAS-PSS is very suitable for applying for chemistry learning on reaction rate material to practice and improve students' problem-solving skills. Problem-solving skills are certainly relevant to the level of understanding of students. It stated that there are four reasons why problem-solving is used as the main focus in learning, one of them because solving a problem requires deep learning of the materials (Jonnasen & Hernandez-Serrano, 2002).

CONCLUSION

Based on the results and discussion that has been obtained, it can be concluded that a structured assignment sheet in reaction rate to train student's problem-solving skills is suitable and feasible. The results of content and construct validation from chemistry lecturers and teachers were obtained with very valid criteria, with a content validity percentage is 92% and construct validity is 90%. The practical aspect of SAS-PSS was obtained through a student response questionnaire after being given SAS-PSS. The practicality percentage obtained at 100% with a very practical category. Meanwhile, SAS's effectiveness is to train students' problem-solving skills obtained from the N-Gain results of students with an average result of 0.8, which is included in the high criteria. That means student's problem-solving skills improve after being given SAS-PSS.

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