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Validity and Practicality of Reaction Rate Student Worksheets based on Problem Based Learning Integrated with Ethnoscience to Train Critical Thinking Skills

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Abstract:Validity and Practicality of Reaction Rate Student Worksheets based on PBL Integrated with Ethnoscience to Train Critical Thinking Skills. The objective research is to develop reaction rate student worksheets based on PBL integrated with ethnoscience and determine the validity and practicality. Type of research used is Educational Design Research with Plomp's development models. There are two stage: preliminary research, prototyping and assessment, but this research is limited to the prototype III stage. Subjects of this research consist of 3 chemistry lecturers FMIPA UNP, 2 chemistry teachers, and 9 students of Phase F SMAN 2 Padang. There are two instruments used, which are validity and practicality questionnaires. Aiken's V formula was used to analyze the validity data obtained, while the practicality data was analyzed by the percentage method. The results showed an average V value of 0.87 in the valid category. Meanwhile, the practicality of the students' response was obtained at 89% and the teacher's response was 90% with a very practical category. Results of this research are the reaction rate student worksheets based on PBL integrated with ethnoscience for critical thinking is valid and practical, so this student worksheets can to continue to determine its effectiveness.

Keywords: Liveworksheets, Problem Based Learning, Reaction Rates, Ethnoscience, and Critical Thinking.

Abstrak:Validitas dan Praktikalitas LKPD Laju Reaksi Berbasis PBL Terintegrasi Etnosains untuk Melatih Keterampilan Berpikir Kritis. *Penelitian ini bertujuan untuk mengembangkan LKPD laju reaksi berbasis PBL terintegrasi etnosains dan menguji kevalidan serta kepraktisan. Jenis penelitian yang dipakai adalah Educational Design Research dengan model pengembangan Plomp. Model pengembangan ini terdiri dari fase penelitian pendahuluan, pengembangan prototipe dan penilaian, namun pada penelitian ini dibatasi sampai tahap prototipe III. Subjek penelitian ini terdiri dari 3 orang dosen kimia FMIPA UNP, 2 orang guru kimia, dan 9 peserta didik Fase F SMAN 2 Padang. Pada penelitian menggunakan Instrumen berupa angket validitas dan praktikalitas. Rumus Aiken's V digunakan untuk menganalisa data validitas yang didapatkan, sedangkan data praktikalitas dianalisa dengan metode persentase. Hasil penelitian menunjukkan nilai rata-rata V adalah 0,87 dengan kategori valid. Sedangkan untuk hasil angket praktikalitas respon peserta didik diperoleh sebesar 89% dan respon guru sebesar 90% dengan kedua respon dalam kategori sangat praktis. Hasil*

penelitian ini didapatkan bahwa LKPD laju reaksi berbasis PBL terintegrasi etnosains untuk berpikir kritis sudah valid dan praktis, sehingga LKPD ini dapat dilanjutkan untuk menentukan keefektifannya.

Kata kunci: *Lembar Kerja Peserta Didik, Problem Based Learning, Laju Reaksi, Etnosains, dan Berpikir Kritis.*

▪ INTRODUCTION

The fading of cultural values and authenticity makes students more familiar with western culture and forget their own culture, therefore the introduction of culture can be linked to learning and be able to support the implementation of an independent curriculum so that culture is maintained (Sumarni, 2018). Learning in chemistry is a part of science that is not just solving problems but must also understand the interpretation of facts, chemical laws and chemical materials that are abstract in nature (Amelia, 2017). Chemistry has always been considered something that are not closely related to daily life because it is considered complicated, abstract and dangerous (Sutrisno et al., 2020). Students also find it difficult to relate the chemical phenomena they learn to their surrounding life (Priyambodo & Wulaningrum, 2017). One form of contextualization in chemistry concepts can be done in the learning process through an ethnoscience approach (Laksono et al., 2023).

Ethnoscience is an approach that is directly related to scientific knowledge derived from the knowledge of a community or ethnic group that focuses about the ways, norms, and values that direct or how things are done in a particular culture context (Sumarni, 2018). Ethnoscience can be defined as a set of knowledge owned by a community/tribe that is obtained by using certain methods and following certain procedures that are part of the traditions of a particular community, and the 'truth' can be tested empirically (Sudarmin, 2014). Articulations between local and scientific knowledge are effective for culturally-sensitive scientific education, especially (but not exclusively) in schools directly related to traditional communities (Sotero et al., 2020). It is necessary to take a learning approach by incorporating cultural elements so that students better understand the concept of chemistry and recognize the surrounding culture so as to change the perception of students that chemistry is close to everyday life (Andayani et al., 2021). The ethnoscience approach is one of the strategies to realize the environment and skills in the learning process through cultural integration (Rusman, 2019).

One of the skills that students must have today is critical reasoning, so that students think logically and rationally when facing challenges given in the learning process (Nurhamidah & Andromeda, 2023). Critical thinking is a cognitive activity that is directly related to the use of the mind, learning to think critically means using mental processes such as attention, categorization, selection, and judgment (Cottrell, 2023). Critical thinking is also defined as reasonable, reflective thinking that focuses on decisions about what to believe or do that emphasizes reasonableness, reflection, and the decision-making process (Ennis, 2011). The recommended learning model to support learners in dealing with a problem by thinking critically is problem based learning, abbreviated as PBL model (Arends, 2014).

PBL model focuses on real issues and challenging it in helping pupils to understand real life situation (Allen et al., 2011). PBL is a social constructivism method capable of creating an active learning environment among students (Zakaria et al., 2019). Problem solving skills by students can be trained effectively assisted by using

one of the teaching guidelines in the format of a student worksheets which can support students to express creative ideas and can thoroughly explore the authentic phenomena in student worksheets (Astuti et al., 2017). Student worksheets is interpreted as one of the many types of printed teaching materials that can make the learning process more memorable and contextual and students get a full opportunity to express their critical thinking skills in solving their problems (Prastowo, 2014). Student worksheets is packaged in such a way that students can learn the material independently, so that students become more active to solve existing problems through group discussion activities, practicum, and activities to answer problems related to everyday life (Dibyantini & Putri, 2023).

Increasing critical thinking in the learning process will increase if it is integrated with ethnoscience (Nuralita et al., 2020). In line with the statement of Temuningsih et al. (2017) that the ethnoscience approach in PBL is able to develop critical thinking in the learning process by integrating cultural context or local wisdom, so that the process of learning is more meaningful and contextual. The ethnoscience integrated PBL model will be suitable to be applied to one of the chemistry materials, namely the reaction rate, because it is expected that students can to solve authentic problems through the application of the PBL model.

Reaction rate material is one of the materials that is classified as complex with a combination of abstract knowledge which includes the reaction rate equation, reaction order with calculations, factors that influence the occurrence of reaction rates, and collision theory (Muliaman, 2021). Students are not only required to be able to calculate and memorize, but are more required to obtain concepts that are closely related to the reaction rate and real experience through learning activities (Andromeda et al., 2018). However, with teacher-centered learning, students need to be made aware of the use of reaction rate ideas in various problems (Zulfah & Novita, 2023). Therefore, reaction rate material can be associated with ethnoscience integrated learning in West Sumatra, namely *manyiriah* and *tapai puluik*.

Based on interview results with chemistry teachers and giving questionnaires to 75 students at SMAN 2 Padang, SMAN 7 Padang and SMAN 13 Padang in January 2024, it is known that so far learning is still rarely associated with local cultural wisdom, learning still often uses conventional methods in the form of lectures with the help of Power Point (PPT) and student worksheets. The material on the student worksheets used has not been associated with problems that have elements of local ethnoscience. In line with the student questionnaire results, it is known that the data of several teaching materials used in learning are 13.3% of textbooks, 62.7% of student worksheets, 18.7% of PPT, and 5.3% of modules. The results of distributing student questionnaires also obtained data as much as 86.7% of student worksheets given by teachers to students have not been associated with elements of ethnoscience in West Sumatra, and data were also obtained by 72% of students would be enthusiastic if chemistry learning was related to ethnoscience.

Several previous studies have conducted studies related to teaching materials development of. However, the activities provided have not been associated with ethnoscience integrated problem-based learning models, especially Minangkabau culture. Based on this, this study aims to develop reaction rate student worksheets based on PBL integrated with ethnoscience to train critical thinking skills.

▪ METHOD

This type of research is Educational Design Research (EDR) with Plomp's development model. This research was conducted at SMAN 2 Padang in the odd semester of the 2024/2025 school year. EDR is a structured study to design and develop a systematic learning system with evaluation of educational interventions (Plomp & Nieveen, 2013). This type of research generates design principles for use in solving educational problems (Akker et al., 2006). This research consists of several subjects, namely three chemistry lecturers from FMIPA UNP as validators, two chemistry teachers of SMAN 2 Padang as validators and students, especially phase F as subjects of practicality. This research was carried out according to the procedures of the Plomp development model which consists of three phase, namely the initial investigation phase, the prototype development phase and the assessment phase, but this research was limited to the second stage, namely the prototype phase.

The results of the study were analyzed using descriptive statistics to obtain average numbers and percentages. The instruments used in data collection were validity and practicality instruments. Assessment results from validators on each statement were analyzed using the Aiken's V formula (Aiken, 1985), where the formulas are as follows.

$$V = \frac{\sum s}{n\,(c-1)}$$

$$s = r - I_0$$

In the context of validity assessment, several variables must be considered. V (validity) represents the degree of accuracy or correctness of an evaluation. To calculate this, various parameters are used, such as the score obtained from the validator (s), which is the lowest score in a given category. Additionally, r refers to the score given by the validator, while L0 denotes the lowest validity assessment score. The number of validators involved in the evaluation is represented by n, and c refers to the highest validity rating score. All of these components work together to produce a validity value that reflects how reliable and accurate the assessment is.

Based on the V value obtained, the validity of the reaction rate student worksheets will be known if the assessment that has been carried out has been converted according to the categories in the table below.

Table 1. Validation Index Categories

Scale	Category
V< 0.80	Invalid
V≥ 0.80	Valid

(Aiken, 1985)

Another assessment instrument used in this research is a practicality instrument to student worksheets prakticality categorize that have been developed. Practicality test data assessment is obtained through the percentage method (%) with the following formula

$$\text{NP} = \frac{R}{SM}\,x\;100\%$$

In this formula, R is the raw score obtained by the student, i.e. the score actually achieved by the student in the practical assessment or non-test section. SM is the maximum score that could have been achieved in a given non-test section, i.e. the

highest score that could have been obtained if the student obtained a perfect result. The NP, or practicality score, is calculated by comparing the score obtained by the student (R) with the maximum possible score (SM), then multiplying it by 100 to get the result in percentage form. This means that the NP shows the percentage of the score the student achieved compared to the maximum score available in the non-test section. As such, this formula is used to evaluate how well students have performed a practical task or activity that does not take the form of a written exam.

Percent value of reaction rate student worksheets based on PBL integrated ethnoscience practicality can be grouped into several criteria in the table below.

Table 2. Practicality Category

Value	Category
86% - 100%	Very practical
76% - 85%	Practical
60% - 75%	Practical enough
55% - 59%	Less practical
≤ 54%	Not practical

(Fransisca et al., 2019)

▪ RESULT AND DISCUSSION

Research on the development of reaction rate student worksheets based on PBL integrated ethnoscience for train critical thinking skills was conducted at SMA Negeri 2 Padang. This research uses the Plomp development model which has proceeded to the second stage with the following explanation.

Preliminary Research

Need Analysis and Content

In the needs analysis stage, data were collected through interviews with three chemistry teachers from three different schools namely SMAN 2, SMAN 7, and SMAN 13 Padang. The purpose is to see the problems that are being faced by teachers and students during learning process. At this stage it was found that students had difficulty in linking the chemical phenomena studied with the surrounding life, the lack of utilization of ethnoscience in the learning process, and the student worksheets used in schools had not been associated with ethnoscience. This is also supported by data obtained from the students' questionnaire which shows that 86% of the students' answers say that the student worksheets given by the teacher has not been associated with ethnoscience elements. The use of teaching materials also obtained data of 13.3% of package books, 62% of student worksheets, 18.7% ppt and 5.3% modules, this shows that there have been many uses of student worksheets in learning so that it is more supportive to continue to develop student worksheets to make it better and more relevant.

Review of Literature

At this phase, information is collected from various sources that are relevant and in line with this research. Previous research to develop reaction rate student worsheets based on PBL for valid and practical driving schools has been conducted by Putri & Suryani (2023). Further research by producing electronic student worksheets chemistry on reaction rate material based on PBL that has met the eligibility criteria for implementation has also been carried out by Winarti et al., (2024). Other researchers

have also conducted research related to the effect of ethnoscience-based PBL models on student learning outcomes on reaction rate material which shows that PBL models affect learning outcomes, especially on the subchapter of reaction rate factors due to the integration of ethnoscience, so that learning is more meaningful (Basit et al., 2023). However, studies that discuss the development of reaction rate student worksheets based on PBL integrated with ethnoscience to train critical thinking skills have not been conducted.

Conceptual Framework

At this stage, identification and analysis of various important concepts are conducted based on the results of the initial investigation that has been done. This analysis is done by reviewing sources relevant to concept understanding of the selected reaction rate and ethnoscience material.

Development or Prototyping Phase

Prototype I

Prototype I is the result of product design and implementation carried out at the initial investigation stage. The results of prototype I are in the form of a PBL-based reaction rate student worksheets design integrated with ethnoscience to train critical thinking skills. The resulting product follows the format of the student worksheets component in accordance with the guidelines described by the authors Prastowo, (2014) and learning based on PBL syntax as outlined by Arends, (2014).

Prototype II

In prototype II, formative evaluation is done in the form of self evaluation with the checklist system. In the self evaluation, inspection and review of the completeness of student worksheets components that support learning such as cover, preface, concept map, table of contents, instructions for use, learning outcomes (CP), learning objectives (TP), worksheets and bibliography. Based on self evaluation, it is found that the components of reaction rate student worksheets based on PBL integrated with ethnoscience to train critical thinking skills are complete. The following is the form of the cover and learning activities of the student worksheets that has been developed.

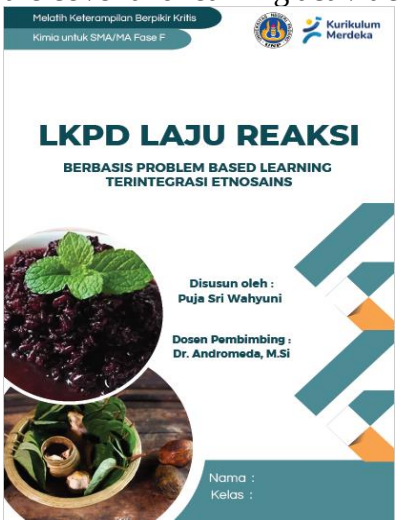

Figure 1. Cover

Figure 2. Learning Activities in Student Worksheets

Prototype III

At this stage, the formative evaluation involved expert review dan one to one evaluation on prototype II.

a. Expert review

The assessment by experts was carried out by three lecturers from FMIPA UNP and two teachers from SMAN 2 Padang to get data on the validity results of the LKPD that had been developed. There are several aspects that are assessed to get the results of the validity of the student worksheets, in table 3 shows the five aspects that are assessed along with the values and categories obtained from the assessment of experts.

The assessment by experts were carried out from three lecturers from FMIPA UNP and two teachers from SMAN 2 Padang to get data on the validity results of the student worksheets that had been developed. There are several aspects that are assessed to get results of the validity of the student worksheets, in table 3 can be seen five aspects that are assessed along with the values and categories obtained from the assessment of experts.

Table 3. Results of Validity Data Analysis

Aspect	Score V	Category
Content components	0,86	valid
Presentation components	0,87	valid
Linguistic components	0,85	valid
Graphical components	0,90	valid
Critical thinking	0,85	valid
Average	0,87	valid

The validation results show that the product meets the needs of users and improvements must be made if there are criticisms and suggestions from the validator. The validity of this student worksheets consists of content and construct validity, the content validity consists of an assessment of the content of the student worksheets and is related to critical thinking while the construct validation is seen from the presentation, linguistic and graphical aspects of the student worksheets. In table 3, it can be seen the results of validation with the highest value of the graphical aspect of 0.90 with the valid category, while the lowest value is seen from the linguistic aspects and critical thinking, which is 0.85 with the valid category. From the results of the analysis, the cause of the low validation value in the linguistic aspect is due to the use of Minangkabau regional language because student worksheets is integrated with ethnoscience in West Sumatra and also many scientific terms related to ethnoscience.

In the aspect of critical thinking which also gets the lowest score of the five aspects but is still in the valid category, this is because the questions in the student worksheets are still lacking in the explanation indicator, especially in the part of explaining with reasons and self regulation in the part of considering each argument before drawing conclusions. Overall, this reaction rate student worksheets based on PBL integrated ethnoscience is suitable for use in learning. The integration of ethnoscience will form a good mindset to continue to love the habits or culture that has developed in society, so the importance of learning using an ethnoscience approach as a learning resource so that students get a more meaningful learning process (Utari et al., 2020).

b. One to one evaluation

One to one evaluation was conducted on three students by selecting one person with low ability, one person with medium ability, and one person with high ability. In this evaluation, the results obtained that the student worksheets cover is attractive, the use of language that is easy to understand, the ethnoscience studies presented are relevant to the material, the syntax of the PBL model can train students in critical thinking and also be able to link ethnoscience with chemistry learning.

Prototype IV

At this point, the formative evaluation was continued by involving a practicality questionnaire given to teachers and students. Results of this practicality can be viewed in the tables 4 and 5 below.

Table 4. Practicality Results of Teacher Response Questionnaire

Aspect	Percentage	Category
Attractiveness	95%	Very practical
User friendliness	90%	Very practical
Efficiency of time	90%	Very practical
Benefits	87%	Very practical
Average	90%	Very practical

Table 5. Hasil Praktikalitas Angket Respon Peserta Didik

Aspect	Percentage	Category
Attractiveness	90%	Very practical
User friendliness	88%	Very practical
Efficiency of time	89%	Very practical
Benefits	90%	Very practical
Average	89%	Very practical

The practicality of the student worksheets is determined through the teacher response questionnaire and student response questionnaire results. The questionnaire results that can be viewed in table 4 and table 5 explain that the reaction rate student worksheets based on PBL integrated with ethnoscience shows an average of 90% for the teacher response questionnaire and 89% for the student response questionnaire, so that the product that has been developed gets a very practical category in the aspects of attractiveness, user friendlines, efficiency of time, and benefits.

▪ CONCLUSION

The research showed that the reaction rate student worksheets based on PBL integrated ethnoscience to train critical thinking skills has been successfully developed. The results of validation show that the student worksheets that has been develop is valid with a V average value of 0.87. The practicality results of this student worksheets get a practicality percentage of 90% from the teacher questionnaire and 89% from the student questionnaire, this percentage shows that the student worksheets is included in the very practical category. So, overall this student worksheets is declared feasible and practical to use.

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