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Learning Module on Buffer Material with a CRT Approach to Solve Problem Topics in Jombang Typical Coffee Beer-Drink

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ABSTRACT

Objective: Learning with the CRT approach is suitable for realizing contextual learning in the Independent Curriculum. So, research was carried out to develop a PBL model learning module using a CRT approach that is ideal for application in teaching chemistry regarding buffer solutions. **Method:** The research carried out was of a qualitative descriptive type. Open module development uses the Research and Development (R&D) method. The research stages include definition, design, development, and dissemination. **Results:** The trial of the teaching application module was carried out at 3rd State Senior High School Jombang. The results show that the Learning module developed is suitable for learning Buffer material using the CRT approach, which is indicated by a validity score of 4 in the outstanding category and can complete 35 students with an average increase in learning outcomes in the N-Gain score in the medium category. **Novelty:** The novelty of this research lies in the CRT approach, which is essential to apply to the independent curriculum combined with the PBL learning model to train students to analyze a problem in a buffer material.

INTRODUCTION

The current curriculum in Indonesia is the Merdeka curriculum with a new learning paradigm. Through quality education, students are taught to participate in building social life (Manurung & Zubir Moondra, 2023; Sulastry et al., 2023). Accuracy in choosing a learning model is one of the essential and crucial things for educators to plan so that learning can run smoothly (Dewi & Azizah, 2019; Oktaviani et al., 2020). The learning model is designed to realize learning objectives (Hidayah et al., 2021; Ramlah et al., 2023; Saragi & Dalimunthe, 2022). One of the learning models recommended to be applied to the Merdeka curriculum is Problem-Based Learning (Chusnah et al., 2020). This problem-based learning model allows students to solve problems in real situations through the concepts they already have, building their knowledge through learning that focuses on problem-solving (Herlina, 2020; Mardiansyah et al., 2022). The PBL learning model allows students to actively process learning through sequences of activities such as problem orientation, group organization in solving problems with educators' guidance, and presentations on problem-solving and evaluation (Rahmayanti et al., 2023; Zainal, 2022).

This sometimes does not correspond to the facts in the field, which rarely apply this learning model, but instead, learning that focuses on educators and only follows the learning flow in textbooks. The often-used learning does not facilitate students (Effendi & Iryani, 2023; Purwandari et al., 2022). To actively train their minds to understand essential competencies and does not foster students' curiosity about something (Silaban et al., 2021; Widyaningrum et al., 2023)

Learning chemistry material, which students consider an abstract science far from being applied daily, must be corrected. Chemistry is an essential contextual science and finds many applications in everyday life (Suswati, 2021; Taofek & Agustini, 2020). Meanwhile, school-centered learning must be designed contextually so that students know their knowledge will also be helpful in their lives (Sanova et al., 2021). It can also be inserted through local culture to bring chemistry closer to students' lives. An approach that connects scientific fields and involves local cultural wisdom is defined as the culturally responsive teaching (CRT) approach. Through the CRT approach, character education can also be instilled that upholds the customs and culture of the students' origins (Juniar et al., 2022; Rahmawati et al., 2020).

Applications that link the local culture of the local area through classroom learning are rarely carried out by educators today. This is in contrast to the importance of inheriting and disseminating Indonesian local wisdom culture, which is regulated in the 1945 Constitution No. 5 of 2017 concerning the advancement of civilization, stating that regional cultural diversity is the nation's wealth and identity which is very necessary to advance Indonesian national culture amidst the dynamics of world development so that There must be efforts to pass on local wisdom (Agustina, 2021).

At the end of learning, the goal remains how students can achieve the learning objectives at the beginning. Students are said to be pursuing optimal education when they are declared successful in mastering the competency indicators of a material (Parbo et al., 2021; Susanty, 2023). Student learning outcomes refer to each school in determining how high the minimum completion criteria are. The expected learning outcomes of students are increased learning outcomes, which indicates that students who previously did not understand the concept will now understand the idea (Nabella & Dwiningsih, 2022; Oktavia et al., 2023). In achieving learning success, several elements are interrelated and sustainable by educators, students, curriculum, teaching, evaluation, and environment (Anjelina, 2021; Khabibah, 2021; Rushiana et al., 2023).

This research is in line with several previous studies, one of which was presented by Purnomo et al. (2023), where an integrated STEM-PBL and ADDIE-PBL learning module was produced with research results that were valid, practical, and effective for use with students (Susi & Yenti, 2020). Other research states that using the PBL learning model in learning activities in chemistry branches is more effective for students than conventional learning models that adhere to student centers (Hidayah, 2021). Other similar research also produced a learning module with a PBL learning model with an ethnoscience approach developed using buffer solution material, which can increase activities and influence chemical literacy abilities (Sanova, 2021). Buffer material was chosen because buffer material is material that requires a fair amount of prerequisite understanding. Before understanding buffer material, students must understand the concept of acids and bases, categorizing weak acids and weak bases, determining the pH of solutions, etc. (Kadaritna et al., 2021; Tri et al., 2023).

The novelty of this research is using the problem-based learning model, which is being promoted in the independent curriculum. In this lesson, the activities provided are students' skills in preparing problem-solving plans, which are based on the student's conceptual knowledge and are supported by the literacy studies carried out. Based on the background of the problem and the knowledge supported by relevant research, research was conducted with the title Learning Module on Buffer Material with a Culturally Responsive Teaching Approach to Solve Problem Topics in Jombang Typical Coffee Beer. This research aims to produce a learning module suitable for learning the PBL model using the CRT approach regarding its validity, effectiveness, and practicality.

RESEARCH METHOD

The research was conducted at State Senior High School 3 Jombang, East Java, in the 2023/2024 academic year. The learning tools are designed to be applied to 28 students in class XI-6. Research conducted to develop learning modules used the 4D model method (Thiagarajan et al., 1974). The research design with the 4D model was carried out in 4 stages: define, design, develop, and disseminate. This research measured the learning module's validity, effectiveness, and practicality.

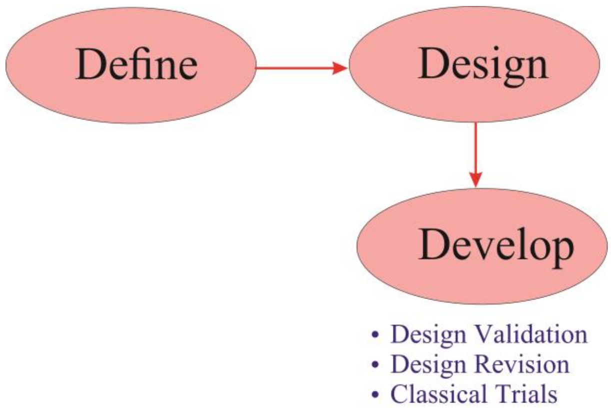

Figure 1. Research stages.

The research stage begins with defining, which is carried out to identify what problems are experienced by students in the class. After the issues in the classroom have been addressed, the next stage is design. At this design stage, a learning module is created that is adapted to the students' characteristics, the material's characteristics, and the results of the problem identification carried out at the defined stage. The third stage is development, where design validation is carried out at this stage, and design revisions are based on validation results and classical trials.

Three validators with chemistry teaching backgrounds validated the learning module developed. The validated aspects are the completeness of minimum components, essential and meaningful, sustainable, contextual, simple, and supporting components. At the trial stage, the level of learning achievement of students in the class used as a trial is also measured. The story of student learning achievement is measured based on the assessment of the learning instrument given at the end of the lesson. The level of learning achievement is analyzed, and the learning completeness is measured classically. The minimum completeness criteria used are adjusted to the school's regulations where the research is carried out, namely 75 for chemistry subjects.

Table 1. Learning module validity instrument.

Principle	Observation Aspect
Minimum component completeness	• Are there clear learning objectives, learning steps, and learning assessments?
Essential and meaningful	• Clarity in the formulation of learning objectives meets SMART (Specific, Measurable, Achievable, Relevant, and Time) criteria (does not give rise to multiple interpretations and contains behavioral learning outcomes) Objective

Principle	Observation Aspect
	• Does the module contain appropriate learning objectives aligned with the intended learning achievements? • Are the main concepts to be studied and core knowledge, skills, and attitudes to be learned clearly stated? • Is the content being studied free from ethnicity, religion, race, and intergroup content of pornography, pornographic action, and provocation? • Are there meaningful questions and trigger questions that target core concepts? Activity • Do the activities flow coherently and systematically according to time allocation? • Is the series of activities oriented towards strengthening higher area competencies and thinking abilities? • Does the learning module include various activities (including remedial and enrichment) that are student-centered/make students active participants? Assessment • Is there an initial learning assessment and assessment method to check students' readiness? • Does the assessment measure the achievement of the Learning Objectives? • Does the assessment provide feedback on the student's learning process? • Are the criteria for measuring the achievement of Learning Objectives clearly stated?
Continuous	• Is the learning sequence systematic and logical? • Are there key questions that help teachers and students to reflect on classroom learning activities? • Are the assessments listed in the learning module aligned with learning activities?
Contextual	• Does the learning module contain alternative activities to be implemented in different school environments? • Can the learning module accommodate students with different needs? • Does the learning module contain local wisdom from the local area?
Simple	• Does the learning module use language that is clear and easy to understand? • Is the language/terms used easy to understand?
Supporting component	• Is selecting learning sources/media appropriate to students' objectives, material, and characteristics? • Are there remedial or enrichment activities? Is there a bibliography?

The scoring used the criteria of not good, quite good, sound, and very good, with a score range of 1-4, according to Table 2.

Table 2. Validity scoring criteria.

Score	Criteria
1	Not good
2	Pretty good
3	Good
4	Very good

The effectiveness of the learning module is reviewed from the results of the pre-and post-test tests given before and after learning. Effectiveness is measured based on students' level of completeness and viewed from the results of the increase in scores obtained, which are analyzed using the Normalized Gain formula:

$$\text{N-Gain} = \frac{(Post\ Test - Pre\ Test)}{(Maximal\ score - Pre\ test)}$$

The results of the N-Gain analysis are categorized based on Table 3.

Table 3. N-Gain Categories

Gain	Category
$g \geq 0.7$	High
$0.7 > g > 0.3$	Medium
$g > 0.3$	Low

(Hake, 1999)

Students' pre-test and post-test scores did statistical inferential tests such as normality and homogeneity tests. The student who has an increased score on their test can be defined as the learning module is practical. The practicality of the learning module was determined based on random interviews with five students who were given the lesson. So, the learning module is suitable for use in terms of three aspects: validity, effectiveness, and practicality.

RESULTS AND DISCUSSION

Results

Research data has been obtained to develop a chemistry learning tool using buffer solution material using a problem-based learning model with a culturally responsive teaching approach to solving problems surrounding typical Jombang coffee beer. The results of the validity of the learning module are presented in Figure 2.

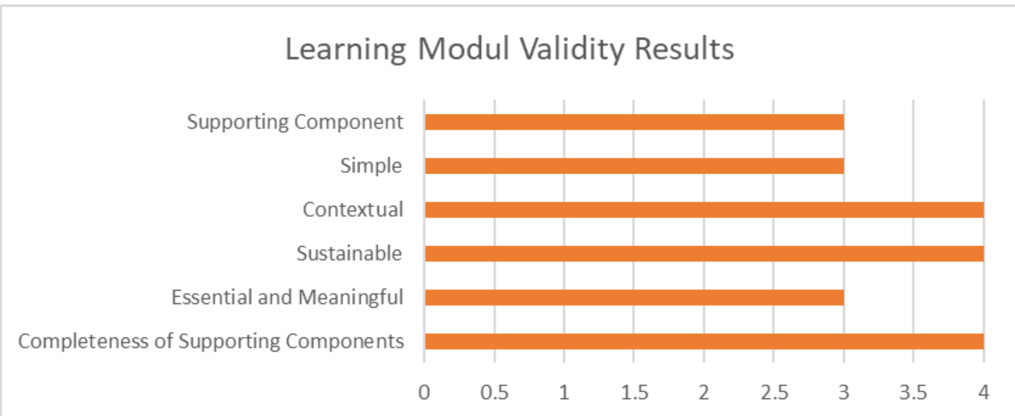

Figure 2. Learning module validity results.

Based on the analysis of the results, the first principle regarding the completeness of minimum components shows various learning objectives, learning steps, and assessments in the learning module. Based on the conclusion of the validity results from 3 chemistry educator validators, the validity of the learning module produced was in the excellent category.

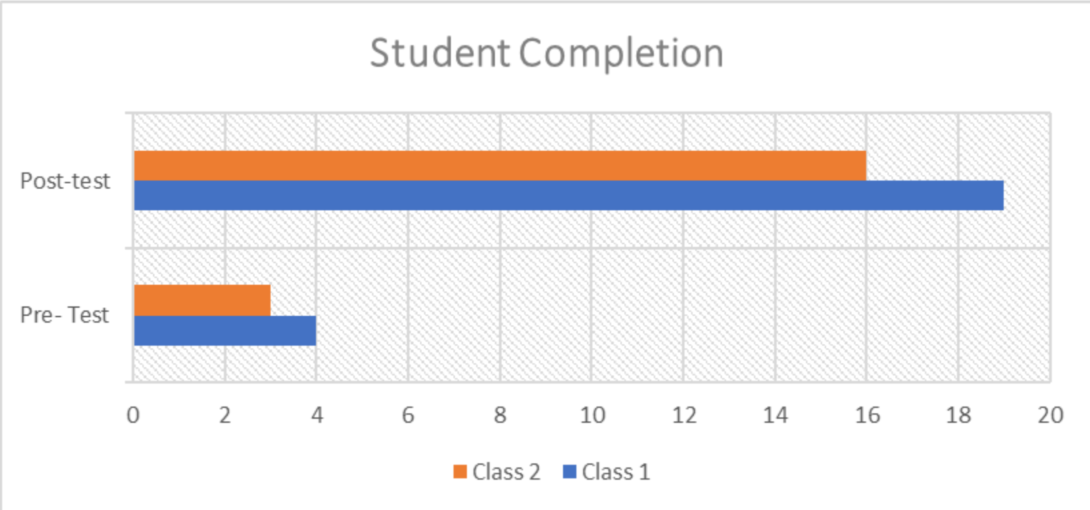

Figure 3. Results of student learning completion.

The effectiveness of the learning modules developed was obtained from 2 different classes at the same school. Student completeness was at a score of 75. The results obtained in the first class increased from 4 to 19 students who reached the minimum completeness criteria with an average increase in N-Gain of 0.4 in the medium category (Hake, 1999). The results obtained in the second class from the pre-test were three students who completed it, which were then increased in the post-test to 16 students who completed it. The increase in N-gain obtained in the second class received an average score of 0.2. Based on Figure 3, the teaching module can increase students' learning effectiveness in the medium category, as evidenced by the results of increasing student learning outcomes in pre-test and post-test activities.

Discussion

Define

The first step in the research is to define where the researcher makes observations to find problems in classroom learning. At this stage, the researcher observed the teaching and interviewed several chemistry educators so that several interesting problem topics were realized in a learning module. The background to the design of the chemistry learning module on buffer solution material using a problem-based learning model and a culturally responsive teaching approach, among others, is that the learning often given to students is a teacher-centered direct instruction learning model (Juniar et al., 2022; Rahmawati et al., 2020). Another background is the low level of student participation and monotonous textbook learning without being connected to problems in everyday life. Another fundamental background is the learning module, which was designed without considering that students need to be trained in 21st-century skills. The skills that should be taught are learning and innovation, using technology and information media, and working and surviving using life skills.

Design

With this background, the research continued to the next stage, namely design. Creating a learning module using the PBL model minimizes the number of students by getting used to the student-centered learning design. With the PBL model, students are trained to be the focus of learning, so students must be active in understanding problems, organizing problem-solving, looking for various learning sources, and even at the evaluation stage of how to solve a problem with the knowledge and sources that have been studied (Chusnah et al., 2020).

The background to the problem is that students should be trained in 21st-century skills at the point of learning skills, innovation, and survival using life skills by presenting issues contextual to students' lives. Researchers designed a learning module with the theme of coffee beer with learning activities analyzing the composition of making coffee beer. So, at the end of the lesson, students are expected to evaluate the composition of coffee beer and what substances need to be added to a composition (Ramlah et al., 2023). This knowledge is obtained based on students' understanding of the buffer concept.

Develop

At the development stage, validation and design revision steps are carried out. Three validators from chemistry teaching backgrounds validated the learning module feasibility test. The principles analyzed are minimum component completeness, essential and meaningful, sustainable, contextual, simple, and supporting components (Nabella & Dwiningsih, 2022; Oktavia et al., 2023). The results of the validity of the learning module are presented in Figure 2. According to the essential and meaningful principles, the goal meets specific, measurable, achievable, relevant, and time criteria. Meanwhile, in the activity aspect, it is said that the flow of learning activities is coherent, systematic, and follows the time allocation. The series of activities are oriented towards strengthening competence and the ability to think in high areas. The learning module also provides remedial and enrichment. In the assessment aspect, it is said that there is no initial assessment to check students' knowledge, but the evaluation is sufficient to measure the achievement of learning objectives. Assessment feedback for students is carried out with a cognitive test assessment equipped with criteria for measuring learning objectives complete with a question grid (Agustina, 2021).

Based on the continuous principle, the result is that learning is systematic and logical. In the constant principle, there are keywords to help educators and students reflect on learning activities and assessments appropriate to learning activities. Based on simple principles, the research showed that the learning module used clear and accessible language for students to understand. From the various principles of validity of the learning modules studied notes and conclusions from the validator were provided that the researchers had been able to develop learning modules that were effective for learning and had created learning that suited the needs and characteristics of students and had been linked to local, regional culture as an embodiment of a contextual approach. Based on the conclusion of the validity results from 3 chemistry educator validators, the validity of the learning module produced was in the excellent category (Jawadiyah et al., 2021).

The final result obtained is the feasibility of the learning module in terms of validity, which is in the excellent category. The effectiveness of the learning modules developed in learning can improve learning outcomes with an average N-Gain score of 0.4 in the medium category; 16 students from the first class and 18 from the second class can achieve the minimum completeness criteria.

CONCLUSION

Fundamental Finding: Research has been carried out to determine the feasibility of a chemistry learning module in supporting materials using a problem-based learning model with a culturally responsive teaching approach. **Implication:** This research can be used as a basis for educators to develop innovative learning tools that can be applied in various chemistry studies and other subjects. **Limitation:** This research discusses the development of Learning modules on buffer learning with PBL learning with a Culturally Responsive Teaching approach. **Future Research:** Further research that can be done is to apply the PBL learning model with a CRT approach to other relevant topics. Other research developments can also be carried out by using learning to buffer material with learning models and different approaches to teaching other learning skills.

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