23 (4), 2022, 1376-1381

Jurnal Pendidikan MIPA

e-ISSN: 2550-1313 | p-ISSN: 2087-9849

http://jurnal.fkip.unila.ac.id/index.php/jpmipa/

Effectiveness of Chemistry Textbooks with Problem Based Learning to Improve Students' Learning Outcomes in Main Group Elements

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Abstract: This study aims to determine the effectiveness of the main group elemental chemistry textbooks based on problem based learning in improving student learning outcomes. The design of this study was a quasi-experiment with one group pretest-posttest design. The participants in this study were sixth year chemistry education students at Universitas Sriwijaya for the 2021/2022 academic year. Test instruments was implied in this research and analyzed using statistics with N-gain data. The results showed that problem-based learning teaching materials for chemistry education students were categorized as very effective with a high level of N-gain

Keywords: chemistry textbooks, problem-based learning, chemistry learning outcomes.

Abstrak: *Penelitian ini bertujuan untuk mengetahui keefektifan buku teks kimia unsur golongan utama berbasis problem based learning dalam meningkatkan hasil belajar mahasiswa. Desain penelitian ini adalah quasi-experimental-one group pretest-posttest design. artisipan dalam penelitian ini adalah mahasiswa program studi pendidikan kimia Universitas Sriwijaya pada semester 6 yang terdiri dari kelas A dan kelas B tahun ajaran 2021/2022. Instrumen yang digunakan adalah instrumen tes. Data dianalisis menggunakan N-Gain. Hasil penelitian menunjukkan bahwa bahan ajar pembelajaran berbasis masalah untuk siswa pendidikan kimia dikategorikan sangat efektif dengan skor N-gain yang dikategorikan tinggi.*

Kata kunci: *buku teks kimia, pembelajaran berbasis masalah, hasil belajar kimia.*

▪ INTRODUCTION

One important aspect that drives the quality of education is the curriculum. UU no. 20 of 2003 states that the curriculum is an arrangement of plans and arrangements relating to the objectives, content, teaching materials, and methods used as guidelines in the implementation of learning activities to achieve national education goals. Teaching materials are all forms of materials used by lecturers to assist teaching and learning activities in the classroom (Ahmadi, 2010). Improving the learning process needs to be adjusted to student standards supported by teaching materials as an effective tool to achieve learning goals (Suryani, 2016; Chairudin & Dewi, 2021)

Rizqiyani, Dewi, & Legiani (2022) explained that as is the case today, the use of teaching materials has not been utilized, and the teaching materials used are still less attractive and students still have difficulty understanding the materials contained in the teaching materials. Rahmawati & Sukidjo (2016) stated that teaching materials in most schools are still in the form of multiple choice questions which only provide opportunities for students to learn as participants in cognitive competence. Featured printed teaching materials contain 20 multiple choice, 10 short answer essays and search commands article. Achieving aspects of affective competence can be done in learning by: problem-based learning materials to develop social skills communication, social,

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DOI: http://dx.doi.org/10.23960/jpmipa/v23i4.pp1376-1381
Received: 11 September 2022
Accepted: 25 October 2022
Published: 12 November 2022

and approachable. The selection of the right teaching materials will provide good learning facilities for students in the expected educational competencies.

Hosnan (2014) states that Problem Based Learning (PBL) is a learning model that uses a learning approach that is linked to real problems so that students can collect their own knowledge, develop their skills, be more independent and confident. Problem Based Learning (PBL) learning model is used to support students' thinking patterns at a higher level in problem-oriented situations, including "how to learn" learning. In this learning model, the lecturer plays a role in asking questions, asking questions and facilitating investigations. In the PBL learning model, lecturers must provide a space that is arranged in such a way that it is comfortable and open to exchange ideas so that students have the opportunity to improve their discovery and intelligence abilities (Wisudawati and Sulistyowati , 2014). PBL is also an active way for students to learn basic problem solving skills and gain knowledge through interaction with others, a key skill required by almost every work environment, students learn in independent small groups to define and carry out certain tasks, both life and life. real or study-based (Phungsuk, Viriyavejakul & Ratanaolarn, 2017).

Learning model Problem Based Learning or abbreviated PBL is a form of learning that aims to spur students' ability to solve problems. In the Problem-Based Model, learning is designed with problems that require students to acquire knowledge (Wahyudi, Hariyadi, & Hariani, 2014). What is important, make them proficient in solving problems, and have their own learning strategies and have the skills to participate in teams . PBL learning model is a model characterized by the use of problems that exist in the real world to train students to think. critically and skillfully solve problems and gain knowledge about important concepts from what is learned (Wijayanto, 2009). The PBL approach, an innovative teaching and learning method, stands to provide greater challenge and motivation by utilizing realistic scenarios to engage and interact with students by building on their prior knowledge, increasing understanding of basic concepts (Virk, Mahajan, & Singh, 2022) . This states that the form of problem-based learning can be applied in the development of teaching materials which are expected to improve students' understanding and learning outcomes.

Based on the results of research conducted by (Alfiantara, et al., 2016) in the form of a PBL module, it is stated that the PBL approach is feasible to be applied to basic chemistry because it can help provide clearer and more systematic information. to students, so that it can be used as a source of independent learning. The advantage of problem-based learning is that students are very enthusiastic and have broad insight in problem solving, especially those related to everyday life. The PBL module reaches a percentage of 79.90% so that the module is declared to meet the valid criteria to be used as a learning resource.

According to previous research, the development of a STEM-PBL-based module on the reaction rate material carried out by Desy Rachmawati, Sriwijaya University 4 proved valid and practical. The development of the STEM-PBL module on salt hydrolysis materials carried out by Meta Tanjung has also been proven valid, practical and effective. So that both can be used in learning for students in Basic Chemistry courses. Furthermore, according to research conducted by Sari (2016), states that there are significant differences in student learning outcomes given learning by applying chemical teaching materials to element symbols and reaction equations developed in

this study are better than student learning outcomes without teaching materials that have been developed. . In addition, based on the results of Sari's research (2016) at the expert review stage, the score of the material expert was 1, the value of the design expert was 0.65 and the value of the pedagogic expert was 0.64. The validity of the module was obtained with an average score of 0.76 from experts in the appropriate or valid category. Based on one-on-one trials and small groups, the average values are 0.85 and 0.82, which means it is very practical. So that the basic chemistry module based on STEM Problem Based Learning on the reaction rate material for students of the chemistry education study program at FKIP Sriwijaya University and proved valid and practical by using the modified ADDIE model using Tessmer's formative evaluation. Based on this, the researchers felt the need to test the effectiveness of the main group element chemistry textbooks based on problem based learning.

▪ METHOD

Participants and Research Procedures

The participants in this study were students of the chemistry education study program at Sriwijaya University in semester 6 consisting of class A and class B for the 2021/2022 academic year. This type of research is a quasi-experimental one group pretest-posttest design. In this study, it was started by giving a pretest to the participants, then the participants were given treatment by learning using the main group element chemistry textbook based on problem-based learning. After the treatment was carried out, the participants were then given a posttest.

Instrument

The instrument used in this study was a test instrument. Consists of 5 questions, i.e Hydrogen and group IA elements, group IIA and IIIA elements, group IVA and VA elements, group VIA and VII A elements, and group VIIIA and Zeolite elements.

Data analysis

The effectiveness analysis used the results of the pretest (test was given at the beginning of the meeting) and posttest (test was given at the end of the meeting). The results of this test are calculated using the N-gain formula. The results obtained from the formula will be categorized based on the gain level criteria in the following table:

Table 1. Instrument effectiveness scale

Rating Score	Category
g ≥0.7	High
0.3g 0.7_ <_≤	Average
g <0.3	Low

(Hake, 1988)

▪ RESULT AND DISSCUSSION

The main group elemental chemistry book for problem-based learning used in learning is a chemistry book that has been declared valid in terms of material, pedagogy and design, and the practicality test shows that problem-based learning on the main group element problem-based chemistry textbook is practical to use.

The Problem Based Learning (PBL) model is a learning that focuses on problem solving activities (Yulianti & Indra., 2019). With the intention that students actively have the ability to find answers to problems given by educators. In this case, educators are more of mediators and facilitators to assist students in actively constructing knowledge (Siregar, 2016). According to Yulianti & Indra., 2019 states that PBL is a learning method that challenges students to "learn and learn", working with groups to find solutions to real problems. This problem is used to connect students' curiosity and analytical skills with initiative towards learning materials. PBL prepares students to think critically, analytically and to find and use appropriate learning resources.

The effectiveness of the teaching materials that have been developed in improving student learning outcomes can be seen from the N-Gain scores from the pre-test and post-test results. The N-Gain value for each subject can be seen in Figure 1.

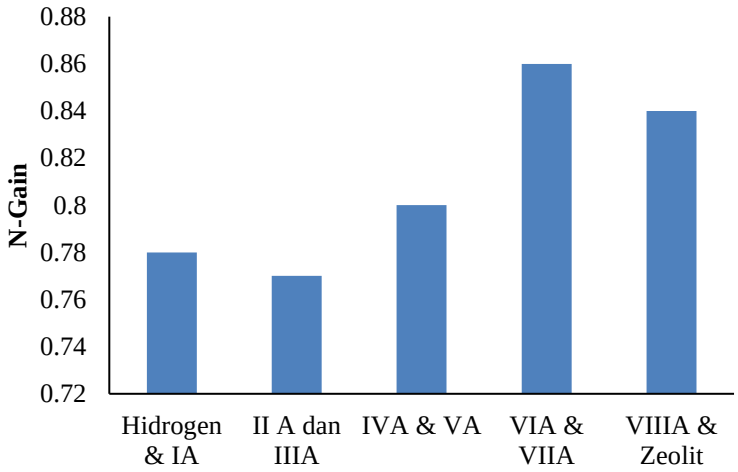

Figure 1. N-Gain score for each question

The average value of student learning outcomes in the form of pre-test and post-test, then analyzed and calculated using the N-gain formula. The results of the N-gain value obtained in this study on each subject with a high category according to Hake (1998) so that it can be said that the teaching materials that have been developed by this researcher are effective to be given to Chemistry Education students because they have shown an increase in good learning outcomes. .

Teaching materials that have been developed by researchers, namely teaching materials for chemistry of main group elements based on problem based learning meet the criteria for valid, practical, and effective teaching material products for Chemistry Education students. Teaching materials developed by researchers also have advantages in the form of loading PBL syntax on these teaching materials so that students will be more independent in solving problems and finding solutions that will improve student learning outcomes.

Trisnaningsih (2007) suggests that the development of teaching materials is a form of learning process activities to improve or improve the quality of continuous learning. Teaching materials are oriented to student learning activities so that the subject matter is prepared based on the needs and motivation of students. This is intended so that students are more enthusiastic and enthusiastic in the learning process. These

teaching materials can also be used by students independently without involving the teacher. For teachers, these teaching materials must be able to direct the teacher in determining the steps of learning in the classroom. The pattern of presentation of teaching materials is adjusted to the intellectual development of students so that they are easy to understand (Nurbaeti, 2019).

Every material developed is said to be good if it meets three criteria, namely: 1) aspects of validity (validity), (2) aspects of practicality (practical), 3) effectiveness (affectiveness) (Trianto, 2007; Suniasih, 2019) . This is also in line with Fatmawati (2016) which states that the validity, practicality and effectiveness of learning tools are very supportive in creating conducive learning and achieving the expected results. Research on the development of teaching materials based on Problem Based Learning has advantages. The advantages are: 1) teaching materials are quite interesting because there are examples of questions and practice questions in real life, 2) students can understand exercises and examples of problem-based questions 3) presentation of teaching materials using stages of problem-based learning, namely presenting problems, describing problems , solve problems, present the results and conclude (Ahmadika, Ahmad & Andayani, 2022).

▪ CONCLUSION

The effectiveness of problem-based learning teaching materials for chemistry education students is categorized as very effective because the N-gain score is in the high category. The problem-based textbooks that have been developed are feasible to use, but it would be better if a larger-scale research was conducted, involving participants from other universities.

▪ AKNOWLEDGEMENT

The research/publication of this article is funded by the DIPA Budget of the Sriwijaya University Public Service Agency for the 2021 Fiscal Year. SP DIPA-023.17.2.677515/2022, dated December 13, 2021, according to the Rector's Decree 0109/UN9.3.1/SK/2022 dated April 28, 2022.

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