Development of flipbook e-module problem-based learning (PBL) learning model to increase students’ learning outcomes in oxidation-reduction reaction material

Leny¹, K Husna¹, Rusmansyah¹, M Kusasi¹, Syahmani¹ and H Zuwida²

¹Chemical Education Study Program FKIP Lambung Mangkurat University, Indonesia
²SMAN 12 Banjarmasin, Jl Alalak Utara RT 02 Banjarmasin 70125 South Kalimantan, Indonesia.

rusmansyah@ulm.ac.id

Abstract. Research and Development has been carried out to produce a valid, practical and effective e-module flipbook model of Problem-Based Learning (PBL) to improve learning outcomes on redox material. This type of research is Research and Development (R&D) adopting the ADDIE development model. The e-module trial was carried out in Class X MIPA at SMA Negeri 12 Banjarmasin for the 2020/2021 Academic Year. Validation and observation sheets, readability questionnaires, response questionnaires, and learning outcomes tests were occupied to collect the data. In analyzing the data, descriptive analysis was used. The results showed that the developed e-module has met the following criteria: (1) Validity; the value of the content feasibility aspect of 91% (very valid), presentation of 96% (very valid), language of 95% (very valid), and media of 94.5% (very valid). (2) Practicality, seen from the readability results of e-module on individual tests of 3.5 (very good) and small groups of 3.4 (very good), student responses to e-modules of 3.3 (very good), and responses to teacher teaching activities using e-module of 3.7 (very good). (3) Effectiveness, views and learning outcomes of knowledge with an N-gain value of 0.80 (high) and the result of learning attitudes of 83.26 (very good).

1. Introduction

Education is a deliberate and planned effort to help develop the potential and ability of learners to benefit the interests of their lives as human beings and as citizens for the future. Changing the world requires knowledge and ability. Such knowledge and skills are acquired through education [1]. So, teachers who play an essential role as facilitators in learning must integrate their ability to utilize technological advances as an innovation in the learning process.

In teaching and learning in schools, it is essential that there is media as a learning process used by learners independently and maintains the spirit of learning learners. In addition, the teaching materials that are not varied and not attractive will make learners feel bored and difficult to follow the learning process. Further, the chemistry lessons are striking on concepts and calculations, which learners still consider difficult. Therefore, a material
oxidation-reduction reaction that deals with the idea of daily life so that the low learning outcomes are obtained by learners [2].

Improving quality in the learning process involves finding the suitable model, method, or medium to carry out the teaching and learning process [3]. As previously described, it can be minimized with the help of learning media, namely e-modules with problem-based learning models that learners can study independently to understand the material thoroughly.

The selection of the suitable model to improve the learning outcomes of learners to solve problems in everyday life is model problem-based learning. The problem-based learning model is a learning model that uses problems as a basis for learning materials for students. In line with this, the role of teachers in this learning model is more instrumental as a guide and facilitator so that students learn to think and solve their problems [4].

The use of teaching materials in the form of exciting modules can increase the success of a learning process, especially the influence of technological developments. Modules are often developed in the form of e-modules (electronic modules). Furthermore, E-modules can reduce paper use because e-modules can be made using various software without reducing its function as a source of information. One of which is flipbook software was in its application using smartphone technology, laptops, internet, etc.

This flipbook-based e-module aligns with the 4.0 industrial revolution that applies the digital world in various aspects of life. Currently, the development of the world of technology also impacts the habits of students in their daily lives who use smartphones as the use of digital technology in the learning process.

Based on the exposure, researchers are interested in researching the development of interactive learning multimedia, namely flipbook-based modules with Problem Based Learning (PBL) learning models, in improving learning outcomes in the oxidation-reduction reaction material of class X of the 2020/2021 school year at SMA Negeri 12 Banjarmasin.

2. Method

Research and Development (R&D) uses the development of ADDIE. Research Conducted at SMA Negeri 12 Banjarmasin class X MIPA school year 2020/2021. In individual trials conducted in class X MIPA 1, small group trials are conducted in class X MIPA 2, and limited trials are conducted in class X MIPA 3.

Data collection techniques are carried out through non-test instruments that include validation questionnaires, legibility questionnaires, response questionnaire learners, the implementation of teacher learning using e-modules, and the learning outcomes of learners' attitudes. Then, the test instrument in the form of multiple-choice questions to measure the learning outcomes of learners' knowledge given before and after treatment.

3. Research and Discussion

E-modules developed using the stages of model ADDIE (Analysis, Design, Development, Implementation, Evaluation) is presented as follows:

3.1 Stage Analysis

At the analysis stage, the activities carried out are observing problems in schools, determining the object of the experiment, making a concept analysis, and analyzing learning objectives.

3.2 Stage Design

The design stage aims to design the contents and outline of a product to be developed. At the design stage, the activities carried out are preparation of the test, media election and initial design.

3.3 Stage Development

At the stage of development of the activities carried out are as follows:
3.3.1 Validation of products by experts

The validity test aims to find out the validity level of e-modules measured based on the assessment of validators consisting of 3 lecturers of Chemical Education FKIP ULM Banjarmasin, one chemistry teacher of State High School 12 Banjarmaisn as material experts, and one lecturer of Educational Technology FKIP ULM Banjarmasin as a media expert. The results of the validator's assessment are shown in Figure 1.

![Assessment Aspect](image)

**Figure 1. E-module eligibility validation results**

Based on Figure 1 known percentage of value for the aspect of content obtained a percentage value of 91% by meeting several criteria, namely the conformity of the material loaded with basic competencies, learning indicators, and learning goals to be achieved, in addition to the support of learning materials and the updating of the material.

The presentation obtained 96% since it shows good presentation techniques equipped with various other supporters such as compelling images and videos in carrying out the learning process to encourage learners to be more interactive and participative. Moreover, the presentation is equipped with introductions, contents, and covers.

The language aspect got 95% by meeting several criteria, namely presented with a straightforward, communicative, dialogical language according to learners' intellectual development and emotional level, direct and integrated, and the consistent use of terms, symbols or icons.

The media aspect obtains a percentage value of 94.5% by meeting several criteria, namely presenting attractive displays and content that corresponds to the composition of colors, images, letter layout, sound or music, videos, and usage instructions, and has been in accordance with the characteristics of media use, attractiveness and the presence of flipbook media elements. The validity test aims to find out the validity level of e-modules measured based on the assessment of validators consisting of 3 lecturers of Chemical Education FKIP ULM Banjarmasin, one chemistry teacher of State High School 12 Banjarmaisn as material experts, and one lecturer of Educational Technology FKIP ULM Banjarmasin as a media expert. The results of the validator's assessment are shown in Figure 3.1.

3.3.2 Field trials

Field trials include individual, small-group, and limited trials. Individual and small group trials are conducted to determine the practicality of e-modules reviewed from flipbook-based e-modules readability. The average score of individual and small group trial readability questionnaires is shown in Figure 2.
Based on Figure 2, it is known that statements 2, 6, 8, and 10 obtain an average score in the very well category on individual trials. Whereas, statement 2 which is about the cover design; statement 3, which is about clear images; statement 4, which is about colors and letters and matching images; statement 5, which is about sentences; statement 7, which is about the content of the material; and statement 8 which is about the material studied obtain an average score of practical categories. So, revisions are carried out first before being tested again in small group trials.

The assessment of the readability of the e-module is based on several things. The e-module can trigger the involvement of students in learning because it is designed attractively and simply [5]. The delivery of the material relies on aspects of the text [4]. It is carried by multimedia components such as images, graphics, videos, and animations to deliver more interactive materials and increase interaction between students and teachers. Attractiveness display includes color combination selection, typeface selection, audio selection, video, and animation in designing e-modules [6].

Presentation of exciting material as challenging as any material provided if packaged more enjoyable, easy to understand, and read will make students more motivated to learn it and not feel bored following the learning [7].

The use of video in the learning process also allows learners to witness an event that cannot be detected directly. In addition, learning with video media fosters interest and motivates always to pay attention to lessons [8], making learning more effective and students responding well in video learning media.

Furthermore, you tried to be limited to knowing the practicality and effectiveness of flipbook-based modules—the practicality of e-modules reviewed from the student responses, the teacher's teaching activity in using e-modules. At the same time, the effectiveness of e-modules is examined from the learning outcomes of knowledge and attitudes of learners. Here is the average score of the learner's response is shown in Figure 3.
Based on Figure 3, statements 3, 4, 5, 7, 8, 9, and 10 obtained an average score of category very well, except statement 1 regarding high willingness in the following learning, statement 2 about understanding learning materials, and statement 6 regarding the curiosity of learners gaining good categories. The use of e-modules by using flipbook software can provide positive things for learners in assisting the learning process by facilitating it with clear and easy-to-understand material. Some videos are beneficial so that it is interesting for them to learn independently both in the classroom and outside school [9].

Learning oxidation-reduction reaction material with flipbook-based e-modules using the PBL model makes it easier for learners to understand. The results show that the e-modules used can make it easier for learners to understand the material because the e-module presents concise material and communicative language to help learners understand the material more easily.

Using e-modules as teaching materials can facilitate and motivate students in the learning process because it is equipped with material descriptions, animations, videos, answer sheets, and final formative test questions [10].

The results of the student response show that the interest of learners is outstanding to learn during the learning process because in the learning process using the stages or synths of problem-based learning models to make learners have more high interest during learning. Learning using suitable models and media will improve students' good skills and high motivation [11].

Flipbook-based e-modules using the PBL model will add to learners' curiosity to learn the material presented. In addition, after using flipbook-based e-modules, student's critical attitude can be fostered.

Flipbook-based e-modules using the PBL model foster awareness of learners' thought processes in solving problems related to the material. They present learning steps that can make learners construct for themselves and consciously solve the given problem. Hence, using the PBL learning model, the student can achieve the right indicators to solve problems [12].

Contextual learning is more interesting for learners due to the facts used in the learning process to relate the experience possessed by learners; this can be seen from the real problems of the student's daily life contained in teaching materials. Therefore learners can connect the experience that has been learned before, and it is easy for learners to produce learning to be more meaningful [13].

Implementing the PBL model can improve students' activeness and learning achievement [14] and positively and significantly influence students' learning outcomes [15]. Thus e-modules with PBL learning models are otherwise effective in improving problem-solving skills [16].

The ability of teaching activities of teachers using e-modules is seen from the assessment of 3 observers. Here is the average score of the acquisition of teacher teaching activities in using e-modules shown in Figure 4.

![Figure 4. Average teacher teaching activity score using e-modules](image-url)
Based on Figure 4, responses to teacher teaching activities using e-modules applying the average score criteria are very practical. At the time, the teacher used an e-module based electronic media flipbook on the oxidation-reduction reaction material using the steps of the PBL model that can make learners learn independently so that the achievement of learning indicators and goals can be achieved. It follows the characteristics of user-friendly e-modules, which means that e-modules should be friendly with the user.

PBL learning there are parts of the problem that learners must solve to train the ability of learners in reasoning, solving problems, finding and declared effective in improving the ability to solve problems [17]. In addition, it can provide opportunities for learners to interact with teachers and between learners with their groups [18]. Although the learning process is only through online meetings, learners look active during the learning process and work on problems that prove learners are responsible for the tasks assigned.

3.4 Stage Implementation
The effectiveness of an e-module development can be known through the learning results of knowledge N-gain in limited trials conducted after individual and small group trials. The analysis of this study was conducted the first test of sample prerequisites on data measurement results of learning knowledge before and after using flipbook-based e-modules. Unfortunately, the results obtained from learning knowledge before and after being treated are distributed abnormally. It suggests that the prerequisite test was not met; therefore, nonparametric analysis was used for hypothesis testing to determine differences in knowledge learning outcomes before and after using flipbook-based e-modules. Based on the hypothesis test results using nonparametric analysis with the Wilcoxon Signed Rank Test showing the rejection of H0 and acceptance of H1, there is a difference in the average learning outcome of knowledge before and after using a flipbook-based e-module. The following are the results of learning knowledge with the Wilcoxon Signed Rank Test, which can be seen as follows:

| Table 1. Wilcoxon Signed-Rank Test |
|------------------------------------|
| N        | Mean Rank | Sum of Ranks |
| posttest – pretest                  |
| Negative Ranks                      | 0a        | 0,00         |
| Positive Ranks                      | 23b       | 12,00        |
| Ties                                | 0c        |              |
| Total                               | 23        |              |

a. posttest < pretest  
b. posttest > pretest  
c. posttest = pretest

Test Statistics

posttest – pretest

Z     -4.242b
Asymp. Sig. (2-tailed)    0,00

a. Wilcoxon Signed Ranks Test  
b. Based on negative ranks.

Furthermore, at this stage, learning activities are carried out based on the Learning Implementation Plan (P) using the PBL model. E-modules are effective if there is a change in learners' learning outcomes before(pretest) and after(posttest) using flipbook-based e-modules. The average learning score of knowledge from a limited trial conducted in class X MIPA 3 at SMAN 12 Banjarmasin is presented in Figure 5.
Figure 5 Limited trial pre-test and post-test values

Figure 5 shows that obtained a pretest value of 29.55 and a posttest average of 85.64; through these values, an increase from the learning outcomes of learners with an average N-gain of 0.80. It is because of the use of flipbook-based e-modules using the previously revised PBL model that limited trial classes experience an increase in learning outcomes.

PBL-based e-modules provide innovative learning resources for learners. Learning is more effective and engaging and facilitates learners to actively achieve learning goals, [19] thus increasing learners' scores from pretest to posttest on oxidation-reduction reaction material.

The advantages of developing flipbook-based e-modules applied to oxidation-reduction reaction materials with the ADDIE development model appeal to learners [20], making it easier for learners to understand learning materials and motivate and improve learning outcomes. Flipbook Maker-based e-modules effectively improve learning outcomes or achievement indexes and strengthen the students' character [21]. In addition to being attractive, learners can also increase motivation and interest in learning because it is easier to use in making electronic teaching materials [22].

The PBL model applied is also influential for the learning process because the PBL learning model can increase teacher activity, student activity, student affectivity, student thinking, critical thinking, knowledge learning outcomes, and students can respond well[23]. In addition, applying the Problem Based Learning model contributes significantly to learning outcomes so that it affects learners' learning outcomes on oxidation-reduction reaction material [24].

Effectiveness to the learning outcomes of learners' attitudes was measured during the learning process at two meetings consisting of curiosity and cooperation. The percentage of the value of learning outcomes of the learner's attitude obtained is shown in Figure 6.

Based on Figure 6 above, it is known that curiosity and cooperation aspects obtained 79.56 and 86.51, respectively. Therefore, it got an average score of 83.26 with a very good category. It is undoubtedly affected by the use of flipbook-based e-modules using the PBL model with the role of teachers as facilitators who guide the learning process so that learners have good curiosity and cooperation.
Learners have an attitude of curiosity because the videos provided in the e-module can be studied further by learners; the questions that arise in the material and questions also add to learners' curiosity. Curiosity will arise when learners or students ask questions and seek answers from statements [25]. Furthermore, the attitude of cooperation of learners is evidenced by the attitude of students actively discussing following their respective groups. Because with the attitude of collaboration owned by learners, they will be easy to socialize with their friends. The attitude of cooperation is essential to be instilled in students to be easy to socialize wherever they are and foster an open mindset, and easy to accept differences [26].

3.5 Evaluation Stage
This stage activity is carried out to analyze the use of e-module-based learning devices at the implementation stage whether there are still shortcomings. If there are no deficiencies and revisions, then the learning device is suitable for use. Finally, the evaluation stage is evaluated, which includes formative evaluation in the form of individuals, small group evaluations, and field trials.

4. Conclusion
Based on the results of research and discussion, can be made conclusions as follows: (a) The e-module flipbook model of Problem Based Learning (PBL) on the redox material developed is very valid. In terms of content it is 91% (very feasible), presentation is 96% (very feasible), language is 95% (very feasible) and media is 94.5% (very feasible); (b) the e-module flipbook model Problem-Based Learning (PBL) on the redox material has met the practical category with an average score on the individual test of 3.5 (excellent), the small group test of 3.4 (excellent), student questionnaire responses of 3.3 (excellent) and teacher teaching activities using e-modules of 3.6 (excellent); (c) The e-module flipbook model Problem-Based Learning (PBL) on the redox material has met the effective criteria. In the limited trial class, the learning outcomes of knowledge with the N-gain value between pretest and posttest are 0.80 (height), and attitude learning outcomes are 83.26.

References
[1] Sari A N I and Suharto B 2017 Journal of Chemistry And Education 1 1-14
[2] Yakina, Kurniati T and Fadhilah R 2017 Ar-Razi Jurnal Ilmiah 5 287-97
[3] Raihana E, Iriani R and Leny 2017 Journal of Chemistry And Education 15 8-64
[4] Mentari, M U 2014 Comparative Study of Student Chemistry Learning Outcomes Using the PBL (Problem Based Learning) Learning Model and the TPS (Think Pair Share) Learning Model (Universitas Bengkulu)
[5] Shilpa S and Sunita M 2016 International Journal of Home Science 2 214-15
[6] Winatha K R, Suhartono N and Agustini K 2018 Technology and Vocational Education Journal 15 188
[7] Dewi M S A and Lestari M A P 2020 Scientific Journal of Education and Learning 4 433-41
[8] Prastowo A 2016 Creative Guide to Making Innovative Teaching Materials (Yogyakarta: Diva Press)
[9] Romayanti C, Sundaryono A and Handayani D 2020 J. Educ. Chem. 4 51-8
[10] Sari W, Jufrida and Pathoni H 2017 Journal of Physical Education 1 10
[11] Sardadevi N, Winarti A and Leny 2017 Journal of Chemistry And Education 1 195-203
[12] Yulinar and Suherman 2019 Journal of Mathematics Education and Education 8 233-9
[13] Yildiz A and Baltaci S 2016 The Online Journal of New Horizons in Education 155-160
[14] Ariyngas A S K 2015 Journal of Chemical Education (JPK) 4 1-9
[15] Ningras A S K 2017 Influence of Problem Based Learning (PBL) Model Using Multimedia On Student Learning Outcomes Class X SMAN 7 Mataram Year of Study 2015/2016 (Universitas Mataram)
[16] Zhafriah T, Erna, M and Rery R U 2021 Proceedings of the National Seminar on Research and Devotion
[17] Zhafriah T, Erna, M and Rery R U 2021 Proceedings of The National Research and Service Seminar
[18] Elinawati W, Duda H J and Julung H 2018 Jurnal Sainsmat 13-24
[19] Jaenudin A, Baedhowi and Murwaningsih T 2017 Advances in Social Science, Education and
[20] Anandari Q S et al 2019 Pedagogical Journal 6 416-36
[21] Asmi A R, Surbakti A N D and Hudaidah 2018 Social Science Education Journal 27 1-10
[22] Silitonga F S and Khoirunnisa F 2018 Journal of Zarah 6 63-7
[23] Lathifah N H, Kusasi M and Rusmasyah 2019 Journal of Chemistry and Education 3 1-9
[24] Janah M C, Widodo A T and Kasmui 2018 Journal of Chemical Education Innovation 12 2097-107
[25] Puspitasari M T, Santoso S and Muchsini 2015 UNS art Journal 1 31-9
[26] Rahayu D, Puspita A M I and Puspitaningsih F (2020). Educational Research Journal 7 111-22