HYDROGEN
JURNAL KEPENDIDIKAN KIMIA
http://ojs.ikipmataram.ac.id/index.php/hydrogen/index

February 2023, 11(1)
e-ISSN: 2656-3061
p-ISSN: 2338-6487
pp. 60-67

Enhancing Science Literacy through Development of Acid-Base E-module using Book Creator

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Article History
Received: 27-12-2022
Revised: 06-02-2023
Published: 15-02-2023

Keywords: e-module; scientific literacy; book creator; acid-base

Abstract
The aim of this study was to produce a science literacy-based e-module prototype using a book creator focused on acid-base material and to investigate user responses to the product. The Plomp model was utilized for the design of the research. The e-module was validated by two material experts and one media expert. The trial of user responses was conducted on teachers and students. The results showed that the e-module met the criteria for validity with a high average score of 97.14% for material substance and 97.27% for learning design. The media aspect received an average score of 96% for visual communication and 98.33% for software utilization. The responses of both teachers and students were positive, with average scores of 93.70% and 86.07%, respectively.

How to Cite: Krisnawati, E., Copriadi, J., & Erna, M. (2023). Enhancing Science Literacy through Development of Acid-Base E-module using Book Creator. *Hydrogen: Jurnal Kependidikan Kimia, 11*(1), 60-67. doi:https://doi.org/10.33394/hjkk.v11i1.5874

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INTRODUCTION

In chemistry education, macroscopic, submicroscopic, and symbolic aspects must be taught to students and teachers. However, a tendency has been observed to focus more on macroscopic and symbolic aspects of learning and less on microscopic ones (Widarti, 2020). The symbolic aspect, which involves abstract and complex concepts, can be difficult for students to understand due to their limited ability to think abstractly (Milenković et al., 2014). One such abstract concept is acid-base chemistry, which includes topics such as the Arrhenius, Brønsted-Lowry, and Lewis theories of acids and bases, the concentration of H+ and OH- ions in solution, the pH of a solution, experiments to make acid-base indicators, and determining the pH of an acid-base. This material is considered to meet the three basic principles of the Programme for International Student Assessment (PISA) content selection at the high school level in grade XI (Hayat and Yusuf, 2010).

Studies at SMA Negeri 1 Kerumutan and SMA Negeri 1 Pangkalan Lesung, Pelalawan indicate that the use of innovative teaching materials, particularly those that utilize technology, is limited. So far, such materials have mainly included textbook packages, PowerPoint presentations, student worksheets, and e-modules from the Ministry of Education and Culture. These e-modules are considered to be less attractive and are unable to convey historical messages through images or videos. In fact, if properly packaged, e-modules can be innovative teaching materials that stimulate independent student learning. An e-module is a digital form of a module that consists of text, images, or video and can be developed through various applications, such as android or adobe flash (Accraf et al., 2018; Raharjo et al., 2016). The advantage of using e-modules as teaching materials is that students can easily

access learning anywhere and anytime using various types of devices or computers, leading to direct feedback and a complete mastery of the subject matter (Syamsurizal et al., 2015).

Interviews also indicate that teachers rarely associate chemical material with science literacy, which is defined as the ability to understand, communicate (both orally and written), and apply science to solve problems and make informed decisions based on scientific considerations while having a high level of scientific awareness and sensitivity (Yuliati, 2017). Teaching materials that lack contextual and environmental perspectives can negatively impact students' science literacy (Kimianti et al., 2016). Therefore, science literacy should also be considered as part of e-module development.

A book creator is a useful application for creating an e-module. It is a simple, user-friendly tool for creating attractive books that can display images, text, audio, video, and other symbols (Badaruddin, 2020). Its web-based nature makes it well-suited for limited face-to-face learning. Previous research by Wahyudi et al. (2019) on the development of interactive e-modules using adobe flash on chemical bonding material to enhance students' science literacy was declared valid with teacher response scores of 87.27% and student response scores of 99%. Novia (2020) also conducted research on reaction rate material, resulting in an integrated science literacy-based android e-module with Islamic values that had valid characteristics with a score of 91.2%.

This study aims to produce a science literacy-based e-module on valid class XI IPA acid-base material using a book creator and evaluate user responses to the developed product.

METHOD

The present study was a development research that utilized the Plomp model, which consists of six phases: preliminary investigation, design, realization/construction, validation, revision, and trial. The implementation phase was not conducted as the research only reached the limited trial stage (Figure 1). The study was conducted at the Chemistry Education Study Program at FKIP Riau University, SMA Negeri 1 Kerumutan, and SMA Negeri 1 Pangkalan Lesung, Pelalawan. The instruments used for data collection were validation sheets and questionnaires. The development flow of the science literacy-based e-module is depicted in Figure 1.vThe data analysis in this study consisted of validity analysis and user response analysis. The validity of the e-module was assessed on aspects of material substance, learning design, display (visual communication), and software utilization using a Likert scale with scores ranging from 1 to 5, as seen in Table 1. The validity analysis was conducted using the Likert scale method.

Tabel 1. Scoring (Sugiyono, 2019)

Respond	Score
Strongly agree (SS)	5
Agree (S)	4
Moderate (KS)	3
Disagree (TS)	2
Strongly disagree (STS)	1

The validity analysis data and user responses were converted into qualitative values according to the validity criteria with a score of 1-5. The validity criteria and user responses are shown in Table 2.

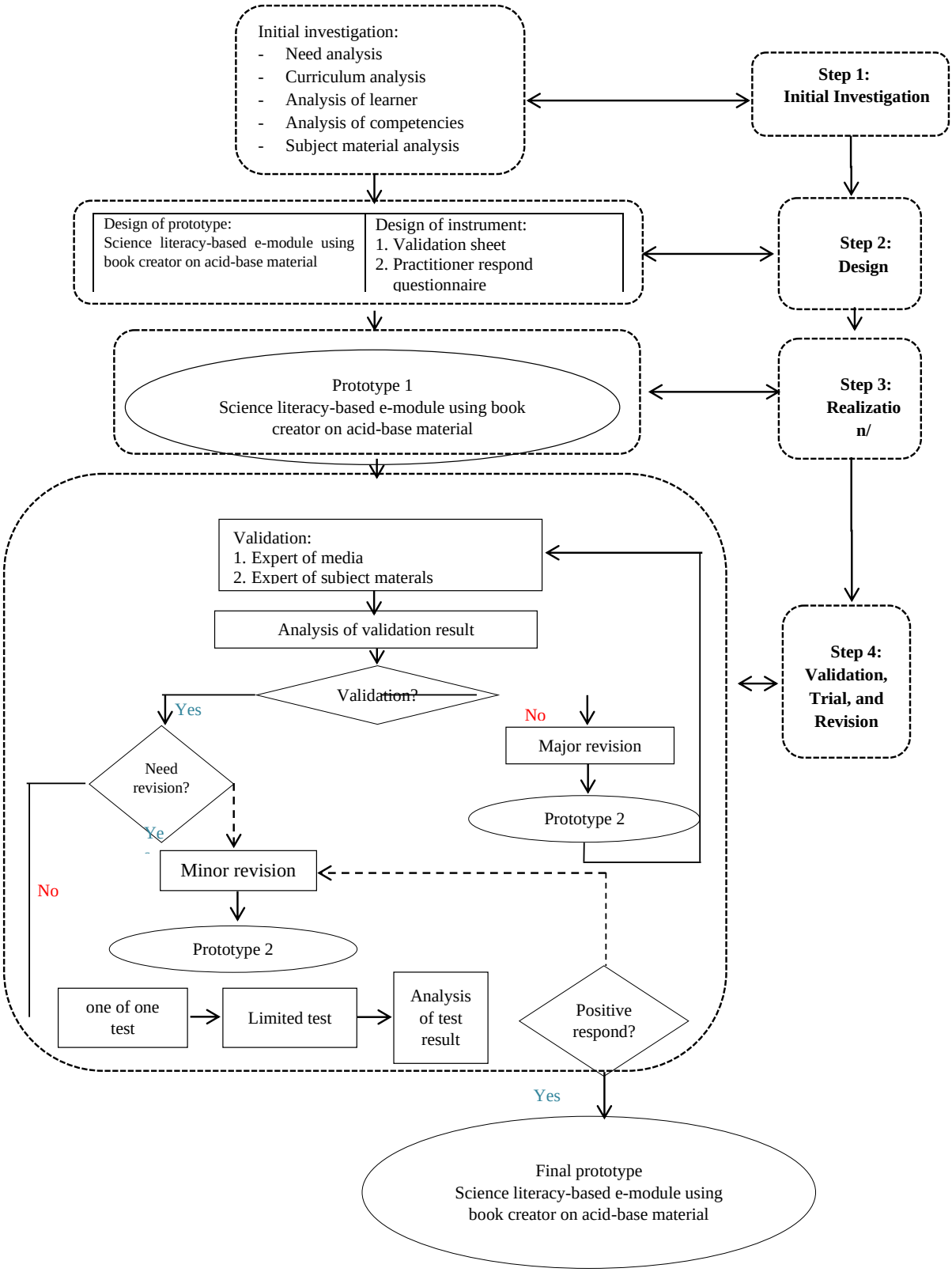


Figure 1. Science literacy-based e-module development

Tabel 2. Validity criteria (Riduwan, 2011)

Score	Validity criteria
81% – 100%	Excellent validity
61% – 80%	Good validity
41% – 60%	Fair Validity
21% – 40%	Invalid
0% –20%	Invalid

RESULTS AND DISCUSSION

Preliminary Investigation Step

In the initial investigation phase, the researcher determines the basic problems necessary in developing a product. In this phase, various activities are carried out including the following.

Need Analysis

The need analysis revealed that the teaching materials used at SMA Negeri 1 Kerumutan and SMA Negeri 1 Pangkalan Lesung, Pelalawan, including e-modules from the Ministry of Education and Culture, were found to be less attractive and ineffective in conveying historical messages through multimedia. The 2013 Curriculum (K13) emphasized active and independent student involvement in the learning process with teachers acting as facilitators.

Student Analysis

The student analysis focused on characterizing the learners, including their cognitive ability, background, basic chemistry abilities, and responses to acid-base subjects. The respondent learners, aged 16-17 years and at the formal operational stage of Piaget's theory of cognitive development, showed maximum intellectual efficiency but limited knowledge due to lack of experience.

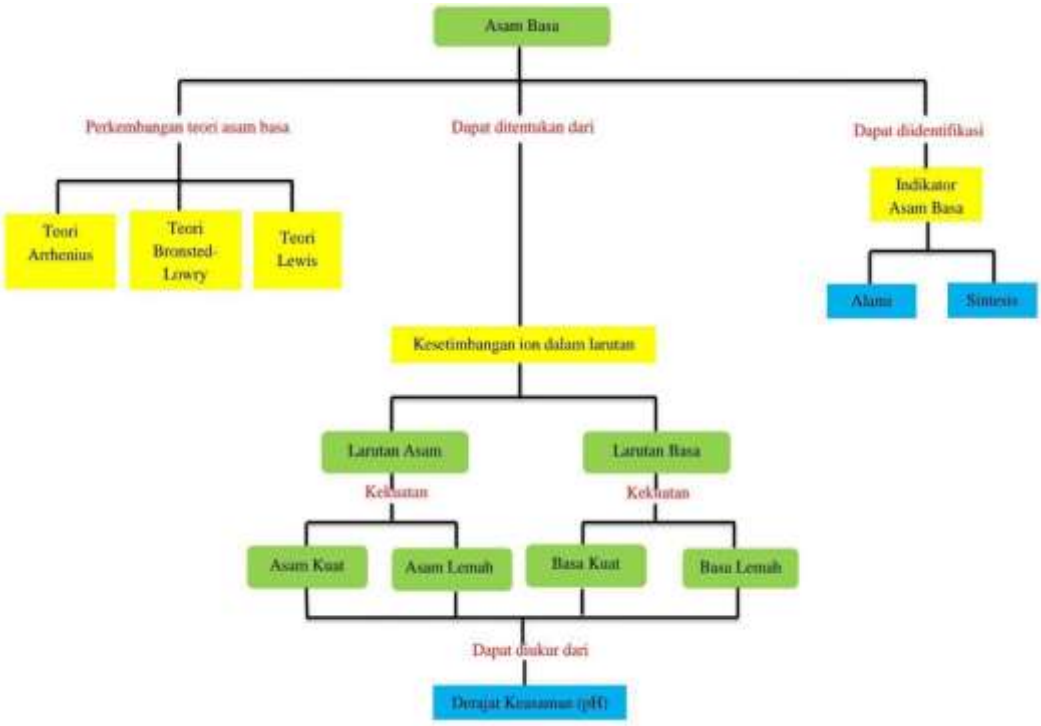


Figure 2. Acid-base concept map

Competence Standard Analysis

The competence standard analysis revealed that the acid-base material is part of the chemistry learning material in basic competencies 3.10 and 4.10 specified in the syllabus of SMA/MA chemistry subjects by the Ministry of Education and Culture (2017). The analysis resulted in formulating learning objectives and indicators of competency achievement for students.

Matter Concept Analysis

The matter concept analysis was conducted through the study of acid-base material concepts, which were then systematically arranged and presented through a concept map (Figure 2).

Design Step

The design step involved creating an e-module that comprised of various components, such as a cover page, foreword, table of contents, glossary, science literacy competencies, introduction, description, instructions for use, concept maps, and learning materials. The learning materials comprised of four learning activities, sample questions, summaries, exercises, self-assessment, chemistry information, evaluation, and bibliography. A prototype design of the e-module was represented in Figure 3.

Figure 2. E-module design

Realization/Construction Step

The construction step involved realizing the prototype design and instrument design. As a result, a science literacy-based e-module was created using a book creator, focused on acid-base material. The module was adjusted based on the results of the previous analyses and was accompanied by validation sheets and user response questionnaires.

Evaluation, Revision, and Test

Evaluation

The evaluation of the e-module was conducted on two aspects: material and media. The material aspect was evaluated in terms of the substance of the material and the learning

design, with an average score of 97.14% in the first validation and 97.27% in the second validation. The media aspect was evaluated in terms of display (visual communication) and software utilization, with an average score of 96% and 98.33%, respectively (as shown in Figure 4).

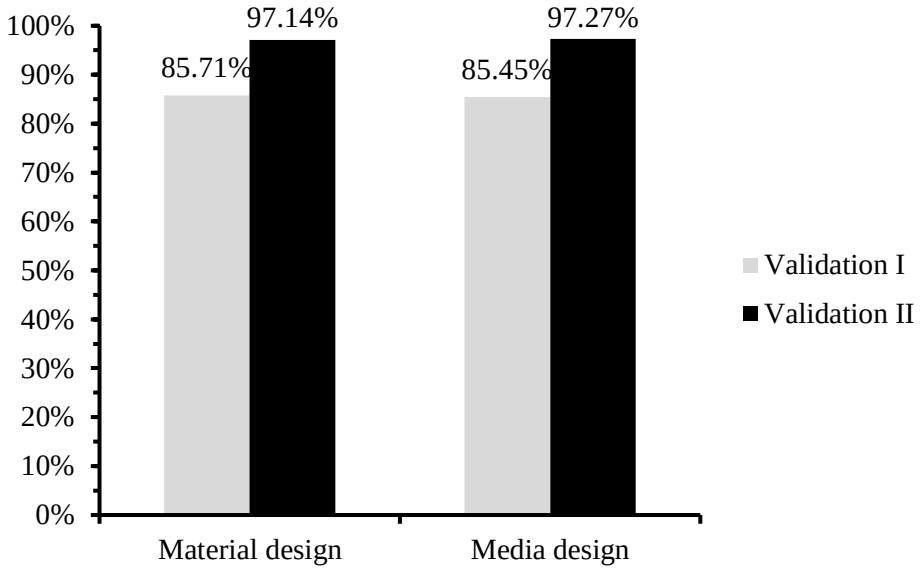


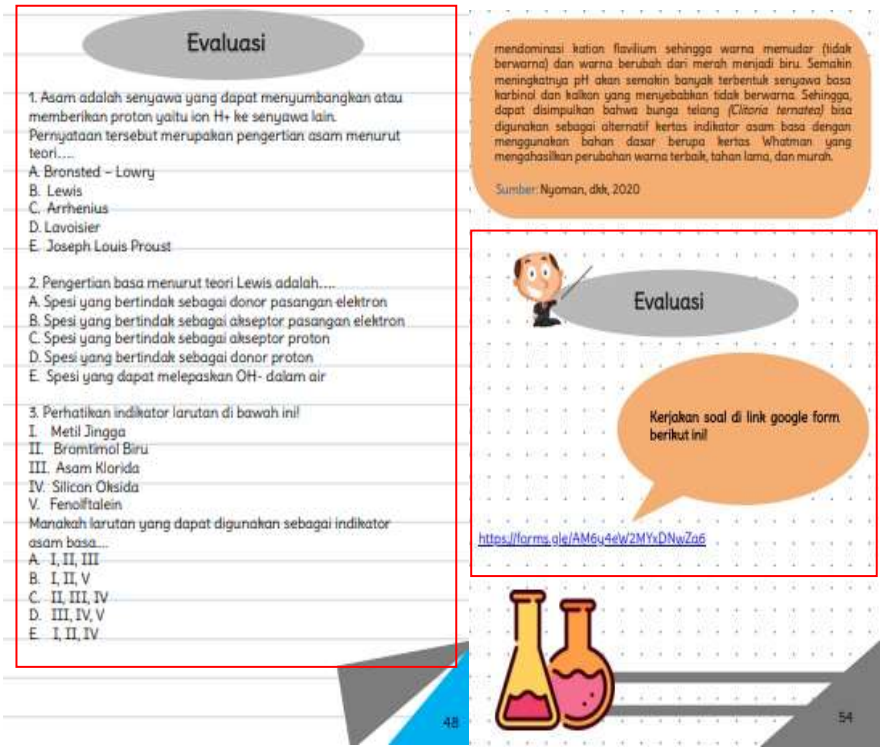
Figure 4. Material and media validation score acquisition percentage chart

Revision

Based on the suggestions and input from the validators, revisions were made to improve the e-module. This process was repeated several times until a valid e-module was produced that met the criteria set by the validators. Figure 5 shows an example of the revised media display as suggested by the media validator in terms of software utilization.

One to One Test

A one-to-one test was conducted on three students at SMA Negeri 1 Kerumutan to identify and eliminate any errors in the use of the product. The teacher response trial was conducted on two chemistry teachers, and they were evaluated based on aspects of attractiveness, effectiveness, and practicality, with an average score of 95%, 91.11%, and 95% respectively, which was considered excellent. A limited trial was carried out on 20 students from SMA Negeri 1 Kerumutan and SMA Negeri 1 Pangkalan Lesung, Pelalawan, and they were evaluated based on aspects of attractiveness, effectiveness, and practicality, with average scores of 85.83%, 86.40%, and 86%, respectively, which was considered very good. The average response from teachers and students to the developed e-module was very positive, with consecutive average scores of 93.70% and 86.07%.



(a) (b)

Figure 5 (a) Display of the e-module before revision; (b) Display of the e-module after revision

CONCLUSION

In conclusion, the development of a science literacy-based e-module on acid-base materials using book creators has demonstrated successful results. The material aspect of the e-module received a high average score of 97.14% and 97.27% for the substance of the material and the learning design, respectively. The media aspect also received high average scores of 96% for display (visual communication) and 98.33% for software utilization. The results of the one-to-one tests with teachers and students also showed a positive response with average scores of 93.70% and 86.07%. These findings indicate that the developed e-module has the potential to effectively support students in enhancing their science literacy competencies in the subject of acid-base materials.

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