

Conference Paper

Development of an Enrichment Book of Colloid Industry Products as a Source of Literacy for Senior High School Students

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Abstract

The aim of this research was to develop an enrichment book of colloid industry products as a source of literacy and to determine the quality of this book. The approach used in this study was Design-Based Research, which included four phases of development: 1) a questionnaire about needs was filled in by 5 teachers and 83 students; 2) the book was developed using CorelDraw X8 software and a literature search was conducted of online articles, journals and other supporting books; 3) cycles of testing were conducted, in which three experts and three peer reviewers assessed the book, and several revisions were produced; and 4) reflection and final evaluation were conducted, in which 5 teachers and 20 students from SMA N 2 Sleman, SMA N 2 Yogyakarta, SMA 1 Tempel, and MAN 3 Sleman assessed the substance, presentation, language and graphics of the book. Through this process, an enrichment book of colloidal industry products titled “Proses Pembuatan Koloid di Industri untuk SMA/MA Kelas XI” was produced. The book received a score 62.8 out of a maximum score of 70, which corresponded to a rating of ‘very good quality’.

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1. Introduction

According to Abidin, Mulyati and Yunansyah (2017), traditionally, literacy is seen as the ability to read and write. People who can be said to be literate in this view are people who are able to read and write or are illiterate. The definition of literacy then develops into the ability to read, write, speak, and listen [1]. The notion of literacy continues to develop to be more specific to a study such as chemical literacy. Chemical literacy is the ability to identify, analyze and process chemical concepts in order to solve problems in everyday life and communicate every chemical phenomenon scientifically[2]. Chemical literacy is part of scientific literacy [3]. Based on study about “The Meaning of scientific Literacy” by Holbrook and Rannikmae (2009), all, however, see the need for scientific literacy to relate to an ability of functionality as a citizen within society (at home, at work,

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in the community), not purely at a knowledge level, but in making decisions and acting as a responsible person [4].

Based on the scientific literacy test by Programme of International Student Assessment (PISA) in 2015, Indonesian students are ranked 64th out of 72 participating countries with a score of 403 from an average score of 493, while in 2018 PISA Indonesia is ranked 70th out of 78 participating countries with a score of 396 from an average score of 489 [5]. These results describe the low level of literacy of Indonesian students.

In 2016, Indonesian government issued a program to increase the level of literacy between students called Gerakan Literasi Sekolah (GLS). According to the GLS manual in high school level, GLS has the general purpose of developing the character of students through the culture of the school literacy ecosystem by providing a variety of reading books so they become lifelong learners. Its specific goal is to make a fun and friendly school as a learning place for students so that they are able to manage knowledge and maintain sustainable learning [6].

Even though GLS was implemented in 2016, literacy levels of the students did not increase based on PISA results in 2015 to 2018. According to research conducted by Latifah (2019), regarding the implementation of GLS, that one of the inhibiting factors for GLS is the lack of enrichment books [7]. According to the needs analysis conducted on five high schools (SMA/MA) chemistry teachers, 80% teachers stated that the enrichment book of industrial process of colloid products was not yet available. Therefore, it is necessary to develop an "Enrichment Book of Colloid Industry Product as a Source of Literation for Senior High School Students."

2. Related Works/Literature Review

During the analysis of problem, researcher did a review on similar study that had been done before, such as Ambarsari's research (2019) with the title, "Pengembangan Buku Pengayaan Mengenai Kimia Organik Materi Alkana, Sikloalkana, Alkena, Alkuna, dan Haloalkana Berbasis Kontekstual disertai Mekanisme Reaksi". The research method used is the Design Based Research (DBR) model with four steps, namely 1) analysis of practical problems by researchers and practitioners in collaboration; 2) development of solutions informed by existing design principles and technological innovations; 3) iterative cycles of testing and refinement of solutions in practice; 4) reflection to produce design principles and enhance solution implementation. The results of the analysis of the enrichment book obtained an average score of 115.8 with an ideal percentage of

86.32% in the very good category [8]. The DBR model was successfully applied in her research and it was similar to the development model in this research. The difference between them is located in step 3.

Furthermore, Wulandari's research (2017) entitled, "Pengembangan Buku Saku Pengetahuan Kimia Materi Sistem Koloid sebagai Alternatif Sumber Belajar Mandiri untuk Siswa Kelas XI SMA/MA". The result is that this pocket book of chemical enrichment for the colloid system material is suitable for use as an alternative source of independent learning for students of class XI SMA / MA with excellent assessment results with an average score of 125.3 and an ideal percentage of 86.4% by 10 reviewers [9]. It has the same learning topic that is written in the book as a product, also the development of the non-text books on colloid system that was done by Risky (2018) and Pratiwi (2014). The book contains the general process of making colloids in everyday life, such as how to make milk and jelly. In addition, there are examples of the application of colloids in water treatment, sugar refining, and blood clotting [10, 11]. But none of the developing topics explain the process of making colloids in industry, that's why it is chosen as the specific topic.

3. Material & Methodology

The development model used in this research is the Design Based Research (DBR) model. DBR evolved near the beginning of the 21st century and was heralded as a practical research methodology that could effectively bridge the chasm between research and practice in formal education [12].

Three fundamental principles of BDR are: 1) addressing complex problems in real contexts in collaboration with practitioners; 2) integrating known and hypothetical design principles with technological advances to render plausible solutions to these complex problems; and 3) conducting rigorous and reflective inquiry to test and refine innovative learning environments as well as to define new design principles [13].

Those DBR principles can be describe as a four steps of development, that is: 1) Analysis of Problems, 2) Development of Innovation, 3) Iterative Cycles of Testing and Refinement, and 4) Reflection or Evaluation (Figure 1).

Analysis of Problems is done with a "needs questionnaire" filled out by 5 teachers and 83 students. Development of innovation, done by CorelDraw X8 software, meanwhile the references of the product collected from online articles, journals and other supporting books. Cycle of testing and refinement done by the assessment of three

expert judgements (a media expert and two material experts) and three peer reviewers produced Revision I, II, III of the enrichment book. Reflection or final evaluation, done by the assessment of substance aspects, presentation, language and graphics from 5 teachers as a reviewer and 20 students from SMA N 2 Sleman, SMA N 2 Yogyakarta, SMA 1 Tempel, and MAN 3 Sleman. The data results in this step are qualitative and quantitative data. Qualitative data in the form of input / suggestions. Quantitative data is in the form of reviewer assessments using a Likert scale and student responses using the Guttman scale. Reviewer’s assessment is used to determine the quality of the enrichment book produced.

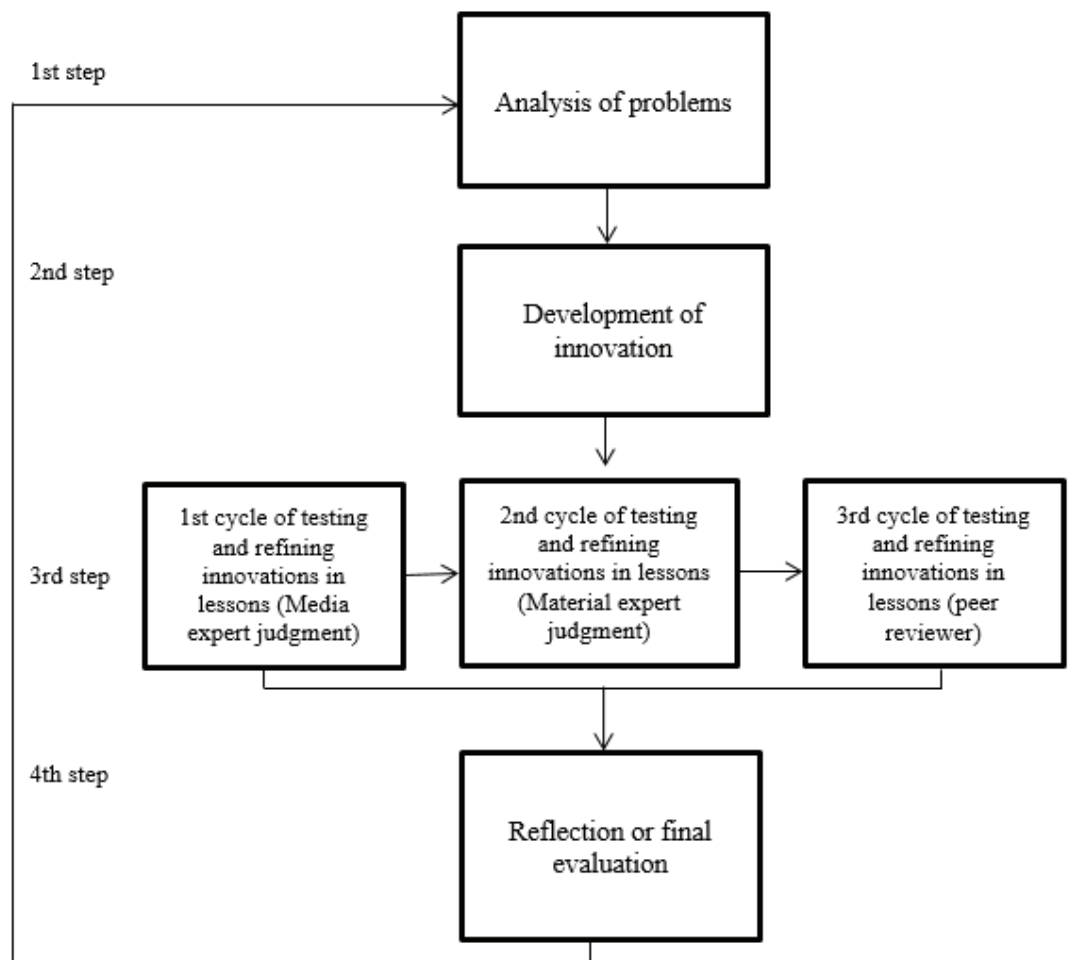


Figure 1: Details of design based research implementation steps

4. Results and Discussion

4.1. Results

4.1.1. Analysis of problem

Analysis of problems is done by collecting data through a needs analysis questionnaire. This questionnaire was filled out by 5 teachers 83 students as the respondents. The data obtained was that 81.9% of GLS had been implemented in schools, 74.7% of students said that the book supporting industrial process literacy for colloid products was not yet available. As many as 92.8% of students agreed to the need for the development of a colloid product industrial process book. Besides, the results of the needs analysis questionnaire from teachers were, GLS has been implemented, Students need to know the making process of colloid in industry. They also give suggestion about the content that needed to be included in the colloid production process book, that is, the name of the colloid product, the type of colloid, the industry profile, the product's usefulness, the advantages or disadvantages of the product or the negative and positive impacts it had.

4.1.2. Development of innovation

Innovation development is carried out after conducting a needs analysis. At this step, the product is designed and the topic was determined and developed. The result is a book consisting of nine chapters, namely, Introduction, Hairspray, Industrial Smoke, Whipped Cream, Mayonnaise, Paint, Styrofoam, Cheese and Glass Cups. The material is compiled based on references from books, journals, articles and other supporting media. The material was originally written using Ms. Word. Furthermore, the product design process is done by CorelDraw X8 software. Finally, an enrichment book titled "Proses Pembuatan Koloid di Industri untuk SMA/MA Kelas XI" was produced. The cover of the product can be seen in Figure 2 and 3.

4.1.3. Cycle of testing and refining

At this step, the enrichment book was being test and refine. There are three repetitions of the testing and refining, first by material experts and media experts; second by material experts and finally by peer reviewers. They gave a lot of corrections to the

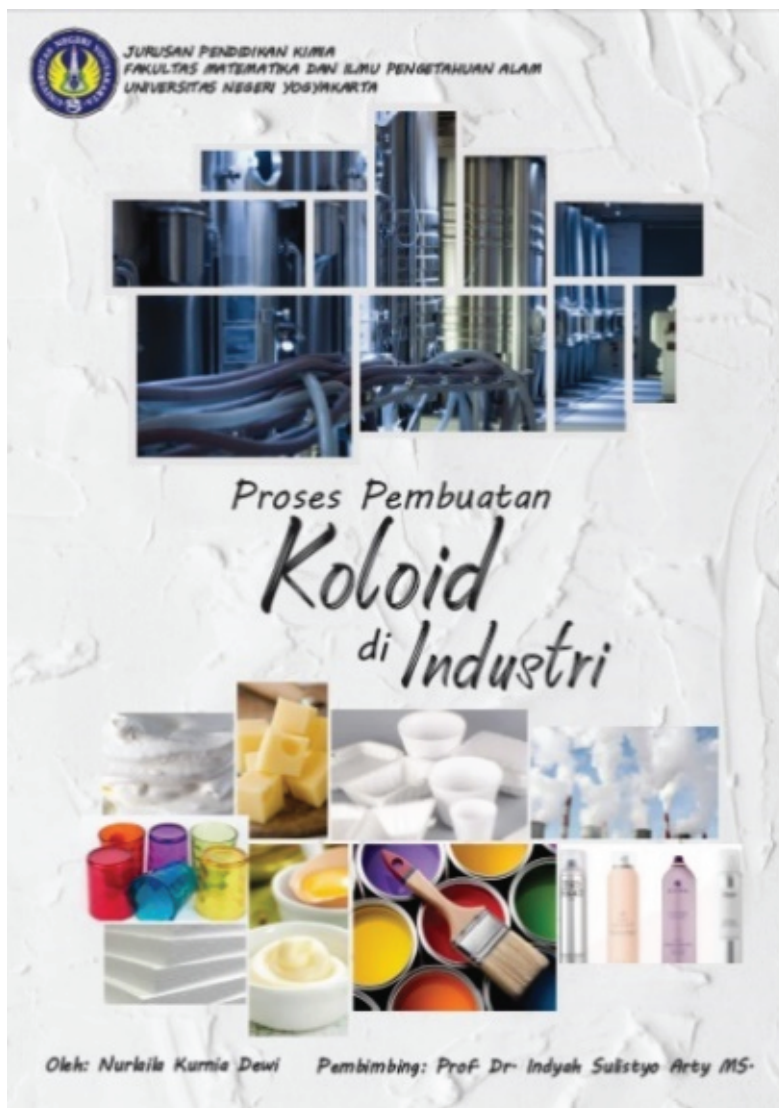


Figure 2: Cover page view

enrichment book so that the researcher could refining the book to make it better. The book that has been refined can be seen on Figure 4 and 5.

4.1.4. Reflection or final evaluation

The last step is the final reflection or evaluation, at this stage the products that have been revised and approved by the supervisor are assessed by five SMA / MA teachers as reviewers and test responses on 20 students of class XI SMA / MA. The results can be observed in Table 1.



Figure 3: Chapter page view

TABLE 1: Reviewer result

Aspects	Average score per aspect	Maximum average score per aspect	5 Scale	Quality
Substance	22,8	25	4,6	Very good
Presentation	13,6	15	4,5	Very good
Language	9	10	4,5	Very good
Graphics	17,4	20	4,4	Very good

4.2. Discussion

The ultimate goal of design-based research to build a stronger connection between educational research and real world problems. An emphasis is placed on an iterative research process that does not just evaluate an innovative product or intervention, but systematically attempts to refine the innovation while also producing design principles

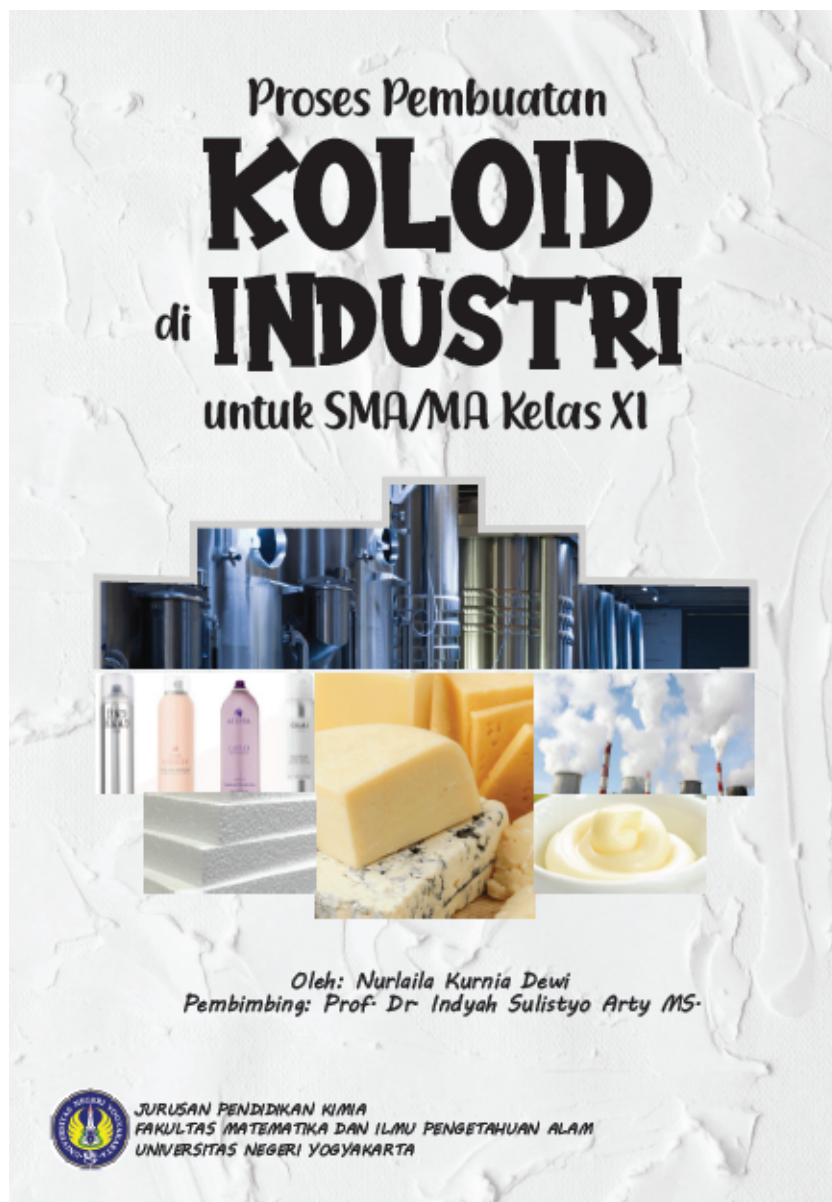


Figure 4: Cover view after refined

that can guide similar research and development endeavors [14]. That's why researcher involved teachers and students from the first step of DBR that is analysis of problems.

Analysis of problems done by a need assessment filled by 5 chemistry teachers and 83 students. By analysis of problems, researcher decided to made a learning media, an enrichment book as a source of literacy, develop the major topic of colloid chemistry. There are a lot of learning media that has been develop with the topic of colloid chemistry such as Chemistry Ludo base on Chemo-Edutainment (CET) [15]; Animation Media for Colloid [16]; Colloid Chemistry Interactive Learning Media [17]; and Chemical Remi Card [18].

In the process of analysing the problems, researcher decided that “industry profile” cannot be one of the sub topics in the book because after being reviewed, the content is not suitable. Industry profiles generally contain specific information such as the name of the industry, date of establishment of the industry, office address or industry address, industry contact such as telephone numbers, email addresses and websites. Therefore, the content is not appropriate to be included in the book because the information provided is specific. After the enrichment book was produced, it being reviewed on the next step.

A model of design-based research illustrates how the iterative cycles which are characteristic of design-based research are part of the process of refining the solutions [19]. The number of repetition in the iterative cycles depends on the needs of the researchers. In this study, researchers made three repetitions of the testing and refining, first by material experts and media experts; second by material experts and finally by peer reviewers. The first assessment and improvement resulted in the Revision I enrichment book. The media expert’s assessment focused on assessing the graphic and presentation aspects including the components in the book cover, layout arrangement and selection of fonts and conformity to the material presented in the book, while expert judgment on the focus material on the material and language aspects.

The product of Revision I was further assessed by two material experts and improved to produce an enrichment book of Revision II. The input given covers all aspects, namely material, presentation, language and graphics. Furthermore, the book was assessed by three peer reviewers. In general, these inputs highlight aspects of presentation, language and graphics. In the presentation aspect, there are suggestions for improvements to the numbering in the sub material and blank pages so that they are tidied up and used so that the presentation on each page is attractive and makes it easier for the reader. In terms of language, there are suggestions for a more precise adjustment of the term in the discussion of chapter 3 regarding industrial smoke as well as reviewing typography and sentence structure. In the graphical aspect, there are input on the layout of the book skin, changes in the typeface on the book cover and suggestions for making the skin of the book more attractive. The assessment is used to improve the product until the Revision III enrichment book is obtained.

Last step was evaluation, Fitria and Wisdawatia (2018) in their study to develop chemical enrichment book as a science literacy source took 3 chemistry teachers and 10 students in the field of testing as the evaluation [20]. Meanwhile in this research, evaluation was done by 5 chemistry teachers and 20 students. After being reviewed by

the teachers, the result was graphic aspects get the lowest rating compared to other aspects but the quality is still in the very good category. In addition, the results of data processing on students' responses resulted in an average score of 20.6 from a maximum score of 22 with the very interested category. And the quality of the book based on the reviewer's assessment obtained an average score of 62.8 from a maximum score of 70 with an ideal percentage of 89.7%.

Although this research aim to develop an enrichment as a source of literacy and got an ideal percentage of 89.7%, the literacy level of the students is yet to be known, further research is required. Hernani, Saefulloh, & Mudzakir, A. (2017) was success to measure the literacy level in their study entitled "The first year pre-service teachers' chemical literacy in individual learning case using the fuel cell technology based-chemical enrichment book" [21].

5. Conclusion

The product of this development research is an enrichment book entitled "The Process of Making Colloids in Industry for Class XI Senior High School/MA students". The quality of the book based on the reviewer's assessment obtained an average score of 62.8 from a maximum score of 70 with an ideal percentage of 89.7% and it is included in the very good category so it is suitable to be used as a source of literacy for class XI Senior High School/MA students.

Based on the result of the study, the researcher would like to suggest other researchers to use other software that provides complete text editing features so that the presentation of the book is tidier and easier to read. Future research may develop the same topic, but with the addition of new topics to increase the knowledge of the students. And it is necessary to carry out further research on the effectiveness of using the enrichment book "The Process of Making Colloids in Industry for Class XI Senior High School/MA" as a source of literacy. Future research may also investigate if it is possible to implement the book in the class combined with a learning model such as Inquiry Based-Learning or Problem Based-Learning.

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