



Development of Chemo-Entrepreneurship (CEP) Electrochemical Enrichment Book

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Abstract: Development of Chemo-Entrepreneurship (CEP) Electrochemical Enrichment Book. Electrochemical material is considered complex and contains daily life applications related to entrepreneurship. This study aims to develop an electrochemical enrichment book containing them entrepreneurship (CEP), test the quality of enrichment books based on expert judgment, and determine students' responses to enrichment books. The development of the enrichment book adapts the 4-D model, which is limited to the developing stage. Quality testing uses a Likert scale quality assessment instrument to use the expert judgment method. At the same time, the students' responses were carried out with a Guttman scale questionnaire sheet instrument. The results of this study are electrochemical enrichment books containing Chemo-entrepreneurship. Quality test results show that the percentage of the quality of the product is based on the assessment of material experts 96.67% with the category of Very Good, 100% of media experts with the category of Very Good, and reviewers 87.2% with the category Very Good. The response of students showed the percentage of product ideals by 93%.

Keywords: Chemo-entrepreneurship, Enrichment book, Electrochemistry

Abstrak: Pengembangan Buku Pengayaan Elektrokimia Bermuatan Chemo-Entrepreneurship (CEP). Materi elektrokimia dianggap kompleks dan memuat aplikasi dalam kehidupan sehari-hari yang berkaitan dengan kewirausahaan. Penelitian ini bertujuan mengembangkan buku pengayaan elektrokimia yang bermuatan Chemo-Entrepreneurship (CEP), menguji kualitas buku pengayaan berdasarkan penilaian ahli, dan mengetahui respon siswa terhadap buku pengayaan. Pengembangan buku pengayaan mengadaptasi model 4-D yang dibatasi pada tahap pengembangan. Pengujian kualitas menggunakan instrumen penilaian kualitas skala likert dengan menggunakan metode expert judgment. Sedangkan respon siswa dilakukan dengan instrumen lembar angket skala Guttman. Hasil penelitian ini berupa buku pengayaan elektrokimia bermuatan Chemo-entrepreneurship. Hasil uji kualitas menunjukkan persentase kualitas produk berdasarkan penilaian ahli materi 96,67% dengan kategori Sangat Baik, ahli media 100% dengan kategori Sangat Baik, dan reviewer (guru kimia) 87,2% dengan kategori Sangat Baik. Respon siswa menunjukkan persentase produk ideal sebesar 93%.

Kata kunci: Chemo-entrepreneurship, Buku pengayaan, Elektrokimia

▪ INTRODUCTION

Literacy is one of the skills needed by students in 21st-century learning (Frydenberg & Andone, 2011). Through good literacy, students can understand and sort out oral and written information to support life success and competencies (Irianto & Febrianti, 2017). Therefore, literacy skills need to be instilled from an early age. Students' literacy skills are closely related to the demands of reading skills, leading to the ability to understand information analytically, critically, and reflectively (Gambrill, 2006). The low reading skill of the Indonesian people is one of the problems faced by the government to improve the quality of human resources (HR). Based on the 2015 Program for International Student Assessment (PISA) study, it was stated that Indonesia's position in the reading literacy category was 69 out of 76 country participants with a score of 397 (Kusmana, 2017). This research indicates the low interest in reading by the Indonesian people.

One of the factors causing the low interest in reading in Indonesian society is the learning system that has not made students have to read more literacy and seek more information/knowledge than what is taught in class (Kartika & Nugrahanto, 2014). In general, learning in schools has made students only rely on teacher lectures without reading other literature. Even though the information/knowledge obtained by students themselves is usually more attached, more abundant, and more meaningful for themselves (Wahyuni, 2009). Therefore, an effort is needed to increase awareness in students to seek knowledge independently.

Students can obtain a lot of information/knowledge independently by increasing the reading literacy culture. The government is trying to instill a culture of reading literacy in students through the GLS program as stipulated in Permendikbud No. 23 of 2015. One of the activities in the GLS is to require students to read non-lesson books 15 minutes before class starts (Mutu et al., 2017). Through this habituation, students are expected to be able to become literate individuals. Schools have an essential role in maximizing this program. The school must actively ensure the continuity of the GLS program, carry out internal monitoring and evaluation, develop libraries school reading corners, and provide a variety of book titles that can increase students' reading interest (Widayoko et al., 2018). However, school libraries generally only provide textbooks, package books, or textbooks from the center, so they do not attract students' interest in reading (Wahyuni, 2009).

Books are one of the means to build student literacy so that many parties, including the government and the private sector, can develop both textbooks and non-text books. Permendikbud No. 8 of 2016 states that in addition to textbooks, non-text/enrichment books can be used in the learning process. Non-text/enrichment books contain material that can enrich textbooks (Depdiknas, 2007). Based on its function as a teaching book, enrichment books are divided into three types, namely knowledge, skills, and personality enrichment books. Non-text books with the type of knowledge enrichment books can develop students' knowledge (knowledge development) which is not only a science (science and social) which is a field of study but can enrich students' insight, understanding, and reasoning. However, based on interviews with chemistry teachers in Yogyakarta, the availability of knowledge enrichment books that support the School Literacy Movement (GLS) and learning chemistry is still very minimal. Students need chemical enrichment books to understand learning materials at school better.

Chemistry is a branch of natural science (IPA) that studies the properties, structure of matter, composition, changes, and the energy that accompanies changes (Sari & Wijayanti, 2017). Kean and Middlecamp in Rumansyah (2002) state that the difficulty of studying chemistry is related to the characteristics of chemistry, which are abstract,

simplification of actual science, and having a lot of materials or materials. Based on the results of the study, one of the chemical materials considered difficult by students was electrochemistry (Haryani, Prasetya, & Saptarini 2014). Electrochemical material is abstract, such as the movement of electrons, the flow of electric current, and the movement of ions in a salt bridge, so it is considered difficult by students (Fatmawati, 2013). One way that can be used to overcome students' difficulties in learning chemistry is by using supporting learning resources that review the material in more depth, such as enrichment books. The electrochemical material in textbooks from school has not been equipped with examples of the application of electrochemical concepts in everyday life. Many applications of electrochemistry in everyday life are filled with entrepreneurship which in chemistry is called chemo-entrepreneurship, which can develop students' entrepreneurial knowledge and insight, such as electroplating events.

Entrepreneurial insight can foster an entrepreneurial spirit, which is one of the students' skills to face the world of work. The Central Bureau of Statistics (BPS) states that the number of unemployed high school/MA graduates as of August 2018 is 7.95% (www.bps.go.id). Therefore, it is important to instill an entrepreneurial spirit to foster an entrepreneurial spirit. The cultivation of entrepreneurial skills within the scope of formal teaching, including high school, can be internalized through several aspects, including integrated with the material of each subject, integrated with extracurricular activities, self-development activities, contained in teaching materials, local content, and through school culture (Sunaeningsih, 2017). One of the media/teaching materials to accommodate this problem is the electrochemical enrichment book containing Chemo-entrepreneurship. An enrichment book, a learning support book that contains complementary materials for the CEP approach, can be internalized more optimally. It is hoped that the existence of an electrochemical enrichment book containing Chemo-entrepreneurship can improve students' literacy skills, increase understanding of electrochemical material, and motivate students to become entrepreneurs.

▪ **METHOD**

The research is research *and development* (R&D). The development research model used in this study adopts the 4-D development model (*Define, Design, Development, Disseminate*). This research aims to produce a useful product and test the quality of the product being developed (Sugiyono, 2013). The product produced in this research is an electrochemical enrichment book containing *chemo-entrepreneurship* (CEP) for senior high school Class XII. The research subjects to develop a *chemo-entrepreneurship* (CEP) electrochemical enrichment book for senior high school Class XII are one material expert lecturer, one media expert lecturer, a chemistry teacher, and students.

The media development procedure in this study uses a 4D development model consisting of 4 stages, namely Define, Design, Development, and Disseminate. This development research is only carried out until the development stage. The define stage includes determining and defining all activities to plan research through needs analysis and curriculum analysis. A needs analysis was carried out by conducting interviews with several chemistry teachers and students of class XII MIPA to find out the problems/obstacles that occurred during the chemistry learning process in the classroom. At the same time, the curriculum analysis was carried out by studying literature to see the competency standards contained in the 2013 curriculum.

The design phase includes media selection, format selection, collection of references, making instruments, and making the product's initial design. The development

stage includes activities to develop the initial design of the product that has been made, which is then consulted with the supervisor. The revised product was then validated and assessed by one media expert lecturer, one material expert lecturer, and four high school chemistry teachers as reviewers, and ten students of class XII MIPA responded, followed by product revision. This stage aims to produce an electrochemical chemistry enrichment book containing Chemo-entrepreneurship (CEP) that meets the criteria for good media quality.

The data collected in this study were expert validation data, media quality assessment data, and student response data. This research's data collection techniques are interviews, literature studies, and questionnaires. The instrument used in this study was a product validation and assessment sheet.

The data obtained in this study were analyzed according to the type and use in the study, namely needs analysis, curriculum analysis, and analysis of the quality of enrichment books. Product assessment is described per product quality aspect based on the assessments of media experts, material experts, and reviewers. The results of the assessment of the quality of the enrichment books made are determined by the following steps: (1) changing the results of the product quality assessment in the form of letters into a score (2) calculating the average score of the assessment of each validator for each aspect of assessment indicators. (3) the average score is converted into qualitative data (4) calculates the percentage of product quality for all aspects of the assessment indicators. (5) calculate the ideal percentage of product quality in each aspect of the assessment indicator. The ideal assessment criteria can be seen in Table 1 (Sukardjo & Sari, 2009).

Table 1. Criteria for the ideal assessment category

| Formula | Category |
|--|-----------|
| $X_i + 1,8 S_{Bi} < X$ | Very good |
| $X_i + 0.60 S_{Bi} < X \leq X_i + 1.8 S_{Bi}$ | Good |
| $X_i - 0.60 S_{Bi} < X \leq X_i + 0.60 S_{Bi}$ | Enough |
| $X_i - 1.8 S_{Bi} < X \leq X_i - 0.60 S_{Bi}$ | Less |
| $X \leq X_i - 1.8 S_{Bi}$ | Very less |

Description:

X = actual score

X_i = average number of ideal score s
 $= \frac{1}{2} \times (\text{ideal maximum score} + \text{ideal minimum score})$

S_{Bi} = standard deviation of ideal score
 $= \frac{1}{6} \times (\text{ideal maximum score} - \text{ideal minimum score})$

Ideal maximum score = \sum criteria item x highest score

Ideal minimum score = \sum criteria item x lowest score

Meanwhile, the response of class XII students to the enrichment book made was determined by the following steps: (1) changing the response results in the form of letters into scores (2) calculating the average score of the response results, (3) calculate the percentage of the overall ideal of students' responses to the product, and (4) calculate the ideal percentage for each aspect of the response. The formula used calculate the ideal percentage:

$$\% = \frac{\text{The average score of all aspect}}{\text{The highest ideal score of all aspect}} \times 100\%$$

▪ RESULT AND DISCUSSION

The research results and discussion are presented in an inseparable part so that the research results are directly discussed in one part. The study results are exposures in the form of data generated during the research process. The discussion contains the meaning of the results and comparisons with theories and similar research results. Each research result must be discussed and analyzed.

The development research results are the Chemo-entrepreneurship Loaded Electrochemical Enrichment Book (CEP) for Class XII Students. In addition to the books produced, this research also analyzes product quality based on the assessments of chemistry experts and teachers and student responses to the product. The initial stage of the research, namely the design phase (definition), includes a needs analysis based on interviews with several chemistry teachers and students of class XII MIPA to determine the conditions of chemistry learning in the classroom, as well as curriculum analysis with literature studies to adapt the material to the applicable curriculum. Based on the interviews conducted, information was obtained that learning chemistry in the classroom used textbooks provided by the school, which did not explain the electrochemical material in more detail, so supporting teaching materials such as enrichment books were needed. Meanwhile, based on a literature study using the 2013 curriculum, the essential competencies that students must acquire in electrochemistry are obtained.

The next stage, namely the design stage, includes media selection based on the results of interviews, format selection, collection of references with various literature, making instruments based on quality standards for good enrichment books, and making initial product designs. After obtaining the initial design, further, development is carried out. The initial product design is then developed into an enrichment book at the development stage. The product is an electrochemical enrichment book containing chemo-entrepreneurship (CEP) consisting of a cover page, an initial section, a content section, and a closing section. The cover page of the electrochemical enrichment book contains the title of the book, supporting pictures, type of book, class, and author's name.

The first part of the enrichment book contains the book's identity, the introduction, and the table of contents. The content section of the enrichment book consists of a description of the material, entrepreneurship information, and a simple practicum. The material description consists of six sub-sections of material, namely electrochemistry, redox, voltaic cells, electrolysis, corrosion, and electrochemical applications. The display of one of the subsection titles in the enrichment book can be seen in Figure 1.



Figure 1. Display of subsection titles in electrochemistry enrichment books

Entrepreneurial information supports information in the form of products resulting from electrochemistry and several forms of entrepreneurs with electrochemical principles. The display of entrepreneurial information in the electrochemical enrichment book can be seen in Figure 2.

CEP Info

PT. Nitama (*Hot Dip Galvanizing and Construction Industry*), merupakan salah satu perusahaan yang bergerak dalam jasa galvanis dengan teknik pencelupan, yang menyediakan layanan pelapisan anti karat pada besi-baja.

Pelapisan anti karat ini bertujuan untuk memperpanjang usia pakai dari besi-baja pada konstruksi karena terhindar dari korosi dan karat. Usaha ini terletak di Jl. Tawang Suko, Sukosari, Kartoharjo, Madiun, Jawa Timur. Info lebih lanjut: admin@nitama.co.id

Figure 2. Display of entrepreneurship information in the electrochemical enrichment book

Simple practicum is a simple practicum activity with electrochemical principles equipped with cost analysis. The appearance of practical activities in the electrochemical enrichment book and the analysis of production costs in the electrochemical enrichment book can be seen in Figure 3 and Figure 4. The closing section of the enrichment book consists of a summary of the material, a glossary, a bibliography, and the author. The summary of the material can make it easier for the reader to know the essential points contained in the electrochemical enrichment book. The glossary contains some of the terms in the electrochemical enrichment book and their meanings. Bibliography contains a list of several books and web addresses that are used as references in writing books. About the author, contains the identity and history of the author's teacher.

| Analisis Biaya Produksi | | | |
|---|-------------------------------|-----------|--------------|
| I. Modal | | | |
| No. | Nama bahan | Komposisi | Harga |
| 1. | Kabel listrik | 1 m | Rp. 1.500,- |
| 2. | Baterai 9 V | 1 buah | Rp. 5.000,- |
| 3. | Larutan CuSO_4 0,1 M | 10 gram | Rp. 10.000,- |
| 4. | Lempeng logam tembaga | 1 buah | Rp. 16.500,- |
| Total | | | Rp. 32.000,- |
| Biaya jasa plating 2 barang = Rp. 32.000,-/2 = Rp. 18.000,- | | | |
| II. Harga jual | | | |
| Harga jual jasa plating = Rp. 30.000,- | | | |
| III. Keuntungan | | | |
| Harga jual-modal = Rp(30.000 - 18.000) | | | |
| = Rp. 12.000,- | | | |

Figure 3. Display of a production cost analysis in an electrochemical enrichment book

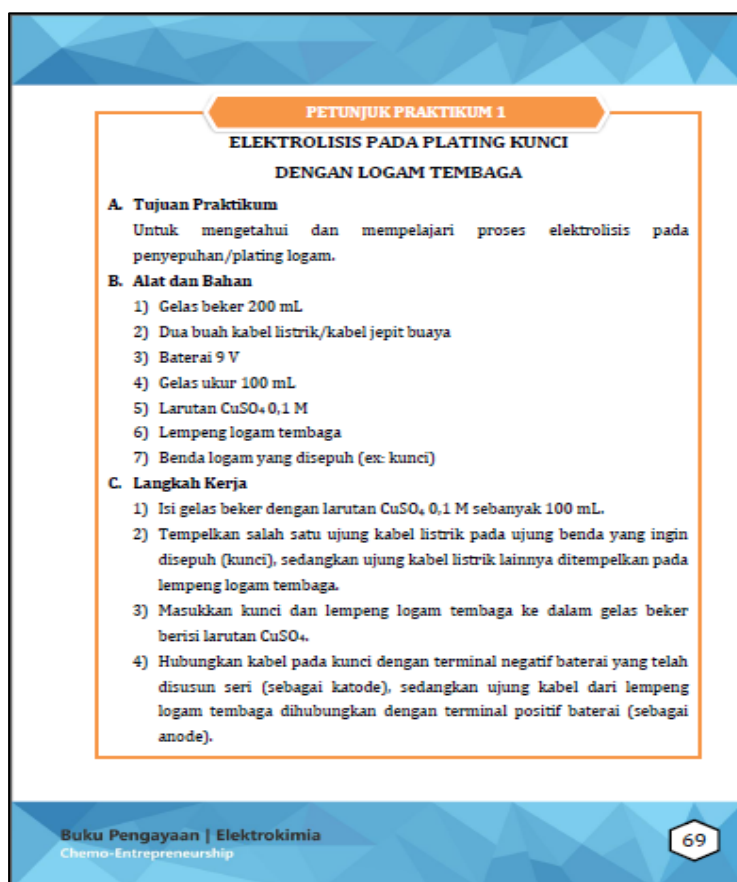


Figure 4 . Display of practical activities in the electrochemical enrichment book

The printed product was then consulted with the supervisor, then validated and assessed by one material expert lecturer, one media expert lecturer and four high school chemistry teachers as reviewers, and were responded by ten students of class XII MIPA to obtain product validation data and product assessment data. Validation data in the form of suggestions and inputs are used as material for product revision, while product assessment data as a result of product quality assessment based on predetermined enrichment book quality standards include aspects of content feasibility, language feasibility, presentation, graphics, characteristics of enrichment books, and aspects of the chemo-entrepreneurship approach. CEP).

The quality of the electrochemical enrichment book based on the assessment carried out by material expert lecturers for each aspect of the assessment is stated in Table 2.

Table 2. Data on the quality assessment of the chemo-entrepreneurship (CEP) electrochemical enrichment book by material experts

| Assessment Aspect | Score Average | Ideal Percentage (%) | Category |
|--|---------------|----------------------|----------|
| Content Eligibility | 15 | 100 | SB |
| Language Eligibility | 20 | 100 | SB |
| Approach <i>Chemoentrepreneurship</i> | 9 | 90 | SB |
| Characteristics Knowledge Enrichment Book | 14 | 93.3 | SB |
| Whole | 58 | 96.67 | SB |

Based on the assessment of material experts, the average score is 58, the percentage of ideality is 96.67%, and the quality category is Very Good (SB). The quality of the electrochemical enrichment book based on the assessment carried out by media expert lecturers for each aspect of the assessment is stated in Table 3.

Table 3. Data on the quality assessment of the *chemo-entrepreneurship* (CEP) electrochemical enrichment book by media experts

| Assessment Aspect | Average Score | Ideal Percentage (%) | Category |
|--|---------------|----------------------|----------|
| Presentation | 15 | 100 | SB |
| Graphics | 15 | 100 | SB |
| Characteristics of Knowledge Enrichment Book | 15 | 100 | SB |
| Whole | 45 | 100 | SB |

Based on the assessment of media experts, it has an average score of 45, the percentage of ideality is 100%, and the quality category is Very Good (SB).

The quality of the electrochemical enrichment book based on the assessment conducted by the reviewer (high school chemistry teacher) for each aspect of the assessment is stated in Table 4.

Table 4 . Data on quality assessment of chemo-entrepreneurship (CEP) electrochemical enrichment books by reviewers

| Assessment Aspect | Average Score | Ideal percentage (%) | Category |
|------------------------------------|---------------|----------------------|----------|
| Content Eligibility | 13.25 | 88.33 | SB |
| Language Eligibility | 17.75 | 88.75 | SB |
| Presentation | 13 | 86.67 | SB |
| Graphics | 12.75 | 85 | SB |
| Characteristics of Enrichment Book | 12.75 | 85 | SB |
| CEP Approach | 9 | 90 | SB |
| Whole | 45 | 78.5 | 87.2 |

Based on the assessment of the four *reviewers* (chemistry teachers) overall, they have an average score of 78.5, the ideal percentage is 87.2%, and the quality category is Very Good (SB). Student responses to the electrochemical enrichment book for each assessment aspect are presented in Table 5.

Table 5. Results of the Analysis of Student Responses to the *Chemo-entrepreneurship* (CEP) Electrochemical Enrichment Book

| Assessment Aspect | Average Score | Ideal percentage (%) |
|--|---------------|----------------------|
| Theory | 1.8 | 90% |
| Language | 2 | 100% |
| Complete information | 1.6 | 80% |
| Book cover and layout design | 2 | 100% |
| <i>Chemo-entrepreneurship</i> Approach (CEP) | 1.9 | 95% |

Based on student responses, the percentage of ideality for each aspect of the assessment was obtained, with details of the ideal percentage of the material aspect being 90%, the language and book *cover design/layout* aspect being 100%, the information completeness aspect being 80%, the *Chemo-entrepreneurship approach* (CEP) being 95%. Overall, students' responses to the product obtained an ideal percentage of 93%. Based on the results of validation, quality assessment of electrochemical enrichment books by material experts, media experts, *reviewers*, as well as the results of student responses, the results show that the product that has been developed is valid or feasible to be used as one of the supporting learning resources for students. However, there are still some things that become suggestions and input from the validator regarding the resulting product so that it becomes material for revision/improvement of the developed enrichment book.

▪ CONCLUSION

Based on the results of the research and discussion that has been carried out, it can be concluded that (1) the electrochemical enrichment book developed in the form of B5-sized print media, which contains electrochemical material in more depth accompanied by information on entrepreneurial activities with electrochemical principles, (2) the results of the assessment of the electrochemical enrichment book by expert lecturers and *the reviewer* showed that the enrichment book received a score in the Very Good (SB) category so that it was suitable to be used as a supporting learning resource, and (3) the results of the student's response to the enrichment book scored in the Very Good (SB) category.

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