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Research paper

Developing Workbook Science plus English to Improve Students' Mastery of Science Content in English

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Abstract

One of the challenges of teaching English for Science students in Indonesia is the training to comprehend science content in English. They need to have the skill to improve their science development knowledge by exploring it through latest information from scientific journals and text books. In fact, most of the students have limited English proficiency that results in the limited variety source of their literature references. Their pre-test result was not satisfactory by only reaching the average of 67. To overcome the problem, the workbook that integrated English skill and science content was developed to support the learning process. The design of research was Research and Development consisting of conducting need analysis, designing product, expert validation, revising product, trial in small scale level, and using the product in the learning process. The instrument to gather the data was the validation sheet for the expert containing indicators of valid criteria of workbook from the aspect of the material, language and media, the students' response questionnaire related to the use of workbook and science content in English test. The data were analyzed descriptively based on the data obtained from the research. The validation from the experts of language, material and media to produce a valid and feasible product showed that the workbook was feasible to be used as instructional material. The result showed that the expert of material, language and media gave the score of respectively 100, 92 and 92. The workbook also proved to be effective to improve the students' mastery of science content in English material with the average of 80. The workbook entitled Science plus English was designed to revise the previous instructional material and it has never been developed as instructional material. The novelty is the integration of English skill lesson and science content.

Keywords: *instructional material; workbook; English for Science.*

1. Introduction

English as one of the international languages plays an important role as the source of information and knowledge development. It is the language of international summit meetings, science, technology, business, tourism, medicine etc (1). Most of journals and developed information are mostly written in English. To obtain the update from the latest development of information and technology, it needs a good the English language competency. The problem of insufficient English proficiency directly impedes the achievement of information and development (2).

In Indonesian primary and secondary school students only learn English twice a week or two hours of lesson of 45 minutes each time. At the university, English in the non-English department is taught only one or two meetings a week, each meeting is 100 minutes or two credits during the first two semesters. In some universities, English is taught in the first semester because it is not part of the university's curriculum. This academic fact is not beneficial for students because a number of compulsory textbooks used are written in English (3). In fact the non-English department students have limited English proficiency, although English is a compulsory subject at secondary and high school level in Indonesia, they do not show the ability to communicate actively in English (4).

To overcome that problem of English proficiency, the English teaching in Indonesia has always been developed by implementing English as medium instruction in secondary and college level (5). English is a compulsory subject for students in those levels of education and the purpose is to improve the English skill competency as the global language. In the college level, English course is usually designed based on the major of study. The content of course is adjusted based on the needs of the graduate competency. For example, the English course for science students aims to deliver the science concept and development in English.

The material of English for Science course consists of the skill in English in the context of science. The concept reinforcement material includes strengthening vocabulary mastery in science. In delivering the material, the lecturer used two different sources to teach English and science content that resulted the ineffectiveness of the material comprehension. The language and content needs to be integrated because the students are learning how to use a language more proficiently. Students are also learning the language of the various subjects (6). Therefore the instructional material that integrates the science concept and English skill is viewed as the alternative supplement to improve the science concept mastery in English.

The appropriate instructional material needs to be prepared to result a meaningful learning (7). The appropriate instructional material by conducting need analysis is expected to result a good

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learning outcome. To help students to comprehend science vocabulary the activity of filling in the blank, predicting text, and reordering are proven to be effective to improve vocabulary mastery and reading comprehension of college students (8). Hence, the strategy can be implemented in the instructional material to train the science concept mastery in English.

The workbook is designed to fulfill the need of integrated instructional material. The material is the integration of science and English language material. The format of instructional material is in the form of workbook that contains the exercise and the concept of science material and English language skill. The workbook is an effective method for teaching material to students (9)

2. Literature Review

2.1. Developing Instructional Material

Teaching materials is one of the important aspects needed in the learning process. Teaching materials can help teachers to convey information or materials by attracting and effectively motivating students to learn more (10). The use of creative materials can make students understand the material more easily (11). Understanding of concepts will not be mastered with the maximum without the use of teaching materials (12). So it can be concluded that the teaching materials is an intermediary medium used in the learning process to make learning goals more clear and simplify the teaching process.

To simplify the teaching process and make students understand the material more easily, the teaching materials used should be sufficient and appropriate. Appropriate instructional materials should be prepared to produce meaningful learning outcomes (7) whereas the inadequacy of teaching materials may lead to student passivity in the learning process (10). So that sufficient and appropriate teaching materials needed to support the learning process to produce good learning outcomes.

In English for science course, lecturer uses the EMI method in the learning process the students receive the material presented in English. Not only English and written proficiency of English but they also need to master the material of science. So based on the facts or circumstances it can be concluded that the integrated teaching materials that combine the concept of science and English should be developed to support the learning process in English language courses for science.

Teaching materials developed through the stages of research and development proved to improve student achievement in lectures. (13) proves that the development of teaching materials with REACT strategy shows that there is no unfinished learning objective and students are also interested in following the learning process. Development of teaching materials based on potential problems can also be proven to improve students 'comprehension and applicability (14).The correct instructional materials are also proven to improve the students' learning motivation so that they can produce learning outcomes with average A (15).

2.2. English for Science Course

In English for Science course, students are expected to master science content in English language. The materials in the workbook are supporting students to master science material in English, the material consists of science vocabulary in English and English language skill. The concept of strengthening the concept consists of strengthening vocabulary mastery in the field of science. To help students, the material of science vocabulary will be a worksheet designed to fill in the blank, make predictions, create sequences and predict text of science passage in English. Those activities prove to be effective in improving reading comprehension and vocabulary of science (8).

English as Medium Instruction (EMI) integrates language learning and subjects (16). Students are trained in using English in accordance with the required context, in which case they are in need of mastering science content in English. In this course students' ability is trained to develop English proficiency both orally and in writing. Good proficiency in spoken English will be useful in presentations whereas written English proficiency will be useful at the time of article writing. The corresponding teaching material is by combining the concept of science in English.

3. Methodology/Materials

3.1. Research Design

The design of this research is research and development (R & D). R & D is a fundamental research activity to obtain the need of users, and proceed it to product development. According to Borg and Gall, research and development is a method to develop or validate the products in education and learning process.

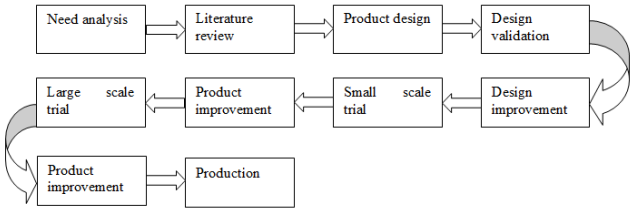

Fig. 1: Development Stages

3.2. Research Subject

The subject was the second semester students of science education who took the course English for Science. The number of students was 50 from the total population of 100.

3.3. Research Steps

The research steps consist of

a) Need analysis

b) The problem and potential condition were observed and the need analysis was conducted to define the appropriate product to be developed.

c) Literature review

d) Literature study is used the basis of the product development. It can also be used as the material for specific product planning that is expected to solve the problem

e) Product design

f) The product design should meet the criteria of material, language and design aspects.

g) Design validation

h) The validation is performed by the expert validator of each aspect. The validator was chosen based on their expertise in each aspect. The validation consisted of content, language and design validation.

i) Design improvement

j) After being validated, the product was revised based on the experts' suggestion. The revision is intended to make improvement for product design.

k) Small scale trial

l) The small scale trial was performed after producing a fix product design. The trial of product was conducted on five students.

m) Product improvement

n) From the result of small scale trial, the product was reevaluated and revised based on the students' suggestion.

o) Large scale trial

p) This step was the real implementation of the product. The product was used as the instructional material in the learning process and to find out its effectiveness the experimental model of one shot case study was performed.

q) Product improvement

r) From the result of large scale trial, the product was reevaluated based on the result of implementation.

s) Production

t) If the product is considered to be valid, then it can be produced in a big scale of production. The product of can be produced as instructional material in the learning process.

3.3. Instrument

The instrument used to collect the data was expert validation sheet and students' response used in the small and large scale trial. The effectiveness was found out from the vocabulary test mastery and observation sheet.

3.4. Data Analysis

The data were validated and analyzed descriptively based on the criteria in the Table 1.

Table 1: Criteria of Expert Validation

Percentage	Criteria
81,25% < skor ≤ 100%	Very good
62,50% < skor ≤ 81,25%	Good
43,75% < skor ≤ 62,50%	Fair
25,00% < skor ≤ 43,75%	Poor

Based on the expert validation questionnaire, the workbook product can be said to be feasible if the score is >62.50%. If the scoring result is ≤ 62.50% then the product needs to have major revision. While, the effectiveness of workbook is assessed based on the criteria in the Table 2.

Table 2: Criteria of Expert Validation

Percentage	Criteria
82-100	Very good
64-81	Good
46-63	Fair
28-45	Poor
10-27	Very poor

The indicators of success effectiveness in this study are:
1. The developed instructional material meets the eligibility criteria according to expert validation.
2. The workbook can help students to achieve average learning outcomes with minimum good criteria.

4. Results and Findings

4.1. Result

The development of the workbook consisted of Analysis, Design, Development, Implementation and Evaluation. The results are presented as follows.

a. **Analysis**

Need analysis was conducted to see the real condition of the students' need and ability. At this stage of students were interviewed related to English for Science course material that they can use to develop their English proficiency. The interviews resulted in the conclusion that students need contextual English material in the field of science so it can help them to master the vocabulary in science and practice other English skills.

b. **Design**

After conducting need analysis, the material of workbook was designed based on the purpose of learning in the lesson plan. The material was the integration between science and English language skill material. The workbook consists of the passages in science topics of physics, biology and chemistry and the language skill exercise of reading, writing, listening and speaking. It was designed to help students to master the integrated skill of science and English.

c. **Develop**

After designing the material based on the purpose of learning, the design was then developed into a workbook. The workbook is a book consisting integrated material of science and English to help students to improve their English proficiency. The design was validated by the experts to result the best product, they consisted of material, language and media expert. After finishing the final design of the workbook , it was then validated by the material experts, language and media to find out its feasibility. The product must meet the criteria of ≤ 62.50% to be considered as feasible and it can be used in the learning process. Based on the experimental material expert's validation results get the scores shown in Table 3.

Table 3: Experts' Validation

Expert	Before Revision	After Revision
Material	100%	100%
Language	92%	100%
Media	92%	100%

The validation results and suggestions for improvements from the material, language and media experts are described as follow.

1. Material expert

The Material expert assessed the concept of material to avoid misconceptions. The expert gave score to very good criteria and did not suggest a major revision because the percentage of assessment was 100%. Although all aspects of the assessment have succeeded in reaching 100% of the total score, the expert suggested some improvement of making the text position to be in the align text left format to make it easier to read.

Before Revision After Revision

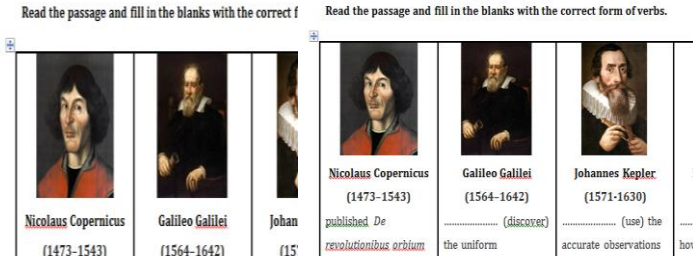

Fig.2: Revision of Material Aspect

2. Language expert

The language expert also gave very feasible criteria judgment in the language aspect with 92% of percentage. Some aspects got a score of 4 from the total score of 5 on the grammatical structure and sentence structure aspects to give some improvements in the language aspects. The first suggestion is to improve the order of the sentences on the exercise instruction so that they can be better understood as the example shown in Figure 4.

Before Revision After Revision

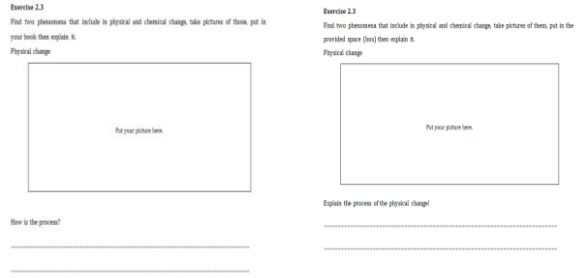

Fig 3: Revision of Language Aspect

3. Media expert

The media expert gave the score of 92% and gave some suggestion to adjust the illustration based on the passage content. The result is presented in Figure 4

Before Revision After Revision

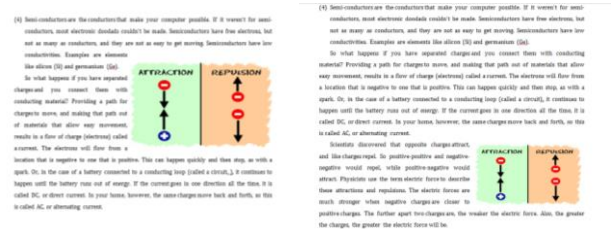

Fig.4: Revision of Media Aspect

d. **Trial**

In trial scale stage, students respond that the developed teaching materials are interesting and can be used independently. Book size is also practical to carry, but the font size was becoming the problem because there were some unreadable contents because it was too small. The improvement was making the font to be bigger without changing the size of the book.

e. **Implementation**

The workbook is used to help students improving their English proficiency in mastering science content. It proved that it can help students to improve the content mastery of science with the average of 80 or in the good criteria.

4.2. Findings

The development of workbook is integrating the material of science and English language skill. In order to make English language input as comprehensible as possible, the teachers should present information through several media for example graphs, demonstrations, reading, and writing strategies. The focus of the teaching should be inspired by the content to be learned that help to identify the language skills required to learn the content and the reasoning abilities needed to improve it (17). Teachers must persistently train language and content skills because language and content learning have a synergistic relationship (6).

The development of feasible workbook based on validation of material experts, language and media was based on the need analysis of students. It was developed based on student needs and adjusted with the characteristics of material. The development of teaching materials based on potential problems can also be proven to improve students' understanding and applicability (18).

A suitable instructional material can also result good criteria of learning outcomes, in line with (19) research that states the appropriate teaching materials proven to improve the motivation of learning from students. Students also show good motivation by showing their good response towards workbook because it can be used as self-study supplement and help understand science content in English.

5. Conclusion

Based on the research results it can be concluded that

1. The developed workbook is feasible to use in the learning process based on expert validation.
2. It can help students to achieve learning outcomes or science content mastery with an average of 80 or in good criteria.

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