Evaluating the validity of integrated science textbook on the theme of tsunami using webbed model based on Polya problem solving to enhance students’ preparedness toward disaster

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Abstract. The evaluation of the validity of textbook is important to determine whether a textbook has a proper quality. This study sought to evaluate the validity of the textbook on the aspects of content, presentation style, language and face using a valid questionnaire which was developed based on Likert scale. The validity of the textbook was assessed by three educational experts and practitioners. The data was later analyzed to determine the value of V of Aiken. The V of Aiken value of experts and practitioners on the aspect of content is 0.81 and 1, on the aspect of textbook presentation style is 0.81 and 0.94, on the aspect of language is 0.88 and 0.92, on the aspect of face is 0.89 and 1. The value of V showed that the content, presentation style, language and face of the textbook is categorized as valid. This means the textbook has satisfied most of its standard quality criteria.

1. Introduction

Textbooks are considered to be the essential component of any course [1]. Textbook are primary learning sources [2] used by students to obtain knowledge. In science teaching, textbooks have a crucial role in developing students’ scientific ideas and clarifying their scientific concepts. For these, science textbook must provide students with representations and explanations for natural phenomena in order to describe the complexity of the natural world [3]. As science is both knowladges and processes [4], science textbooks also have to provide students with activities that can guide them working on a scientific process systematically.

Textbook are vital in determining the success of learning [5]. Textbooks can develop or destroy students’ interest in a particular subject [6]. In order to develop a successful learning, textbooks’ quality must take into account. There are various aspects that have to be consider in determining a textbooks’ quality. Among the most important aspect is general structure, textual material and pictorial material [2].

General structure consists of the general information of the textbook, such as number of pages, chapters, the length of chapters, the percentage of textual and pictorial in a certain chapter and the whole textbook. Furthermore, textual material related to various elements of text, such as text for giving explanations, stimulating discourse, stimulating observations of the phenomena, giving guidelines for the individual students’s experimentation, giving instructions for other practical work,
emphasising problem-solving strategies and summarising the important concepts at the end of chapter.

Last, pictorial material presenting to support textual material. Pictorial materials include realistic images, such as photograph or drawing; conventional images, such as graphs, diagrams and maps; and hybrid images (combination of the realistic and conventional one). In addition, pictorial material also includes the images that are classified into macroscopic images that presenting experimental of natural phenomenon at the sensory level and sub microscopic images that visualise particulate level. Textual material and pictorial material can be seen broadly as the contents of textbook.

The quality of textbook content can be considered from three main criteria. They are the accordance of material with curriculum, the accuracy of material, and the presenting of supporting material [7]. The accordance of material with curriculum can be judged based on the completeness, the breadthness and the depth of material. The accuracy of material can be judged based on the accuracy of concepts, definitions, principles, procedures, examples, facts and illustrations. The presenting of supporting material can be judged based on its accordance with the development of education and technology, the advance of features, examples and references, reasoning, problem solving, concept interrelation, communication, motivation and the presenting of enrichment materials.

Textbook quality are not just seen from its content as mentioned, but also from its structure. Textbooks’ structure quality are not just seen from its content as mentioned, but also from its structure. Textbooks’ structure quality can be considered in addition to promote research activities and problem solving and to maintains textbooks’ function in communicating and presenting learning content [2]. Structure of a textbooks must provide students with a clear insight into the basic content. In addition, structure of a textbook must provide students with systematic and rational instruction.

Structure of a textbook related to its presentation style. Textbook presentation style have to impact positively to the students [5]. For this, textbook presentation style have to consider the quality of the didactic approach [8], didactic principles, principles of proximity and principles of students action and problem solving. The quality of didactic approach includes (1) the organization of the content within theme, (2) the accessibility of the content, (3) the adaptability to the students’ interests and needs, (4) the clarity of the content presentation, (5) the existence of applications and examples taken from everyday life, (6) the offer of patterns, (7) the variety of activities, (8) grading the difficulty of the activities involved and (9) the sheets with experimental activity. Moreover, the quality of didactic principles includes principle of representation, real-logicial correctness, structure and systematic. In addition, textbook should encourage students to perform activities to solve problems related to the learning content. Last, the organisation of learning process leading by the textbook have to be rational.

The quality of a textbook presentation style also can be considered from these three main criteria. They are presentation technique, presentation of teaching and learning and the completeness of presentation [7]. A textbook is considered to have a proper quality in presentation technique aspect by following these criteria: (1) the material in the textbook is presented systematically, (2) the material in the textbook is presented either in inductive or deductive manner and (3) each chapter of textbook is presented equally. Moreover, the presentation of teaching and learning should fulfil these criteria, (1) students oriented, (2) enhancing students process skill, and (3) work safety oriented. Last, the completeness of presentation can be considered from the completeness of textbook introduction, body, and closing part. Textbook introduction consists of preface, guidance, content, symbol, and notation list. Textbook body consists of text, pictures, tables, references, summary and evaluation. The closing part of textbook consists of references, indexes and glossaries.

A quality textbook also have to take into account the pupil’s age, needs, interest and prior knowledge [1]. These considerations can lead to the language and design of the textbook. Its important to use appropriate language with minimal foreign words, clear explanations and short sentences [2]. Textbook should avoid the using of complex sentence. To comprehend a sentence one must first remember it, long sentences cannot be remembered easily thus making them complicated [5]. Sentence complexity can cause confusion, misunderstanding and misinterpretation. Frequency of words, sentence length, emphasising headings, questions for actualising play a vital role in students’ ability to acquire the knowledge, time spent reading the text and mental effort to do the reading. Suitable readability levels proved to increase effectiveness of text [10].
The quality of textbook language can be considered from two criteria. They are the accordance of language with students’ age and cognitive skill as mentioned and the communication aspect [7]. The accordance of language with students’ age and cognitive skill can be judged based on its accordance with students’ intellectual and emotional development. Language used in textbook to provide explanation about concept, concept application, illustration and abstract example must be in accordance with students intellectual stage. In addition, language must be in accordance with students emotional perception. Last, the communication aspect can be judged based of the readability related to contents, the readability related to language aspect and the unity of thinking plots.

Last, a quality textbook also have to consider textbooks face. Visual friendly textbooks are believed to help students to understand the difficult concepts and to avoid misconceptions [10]. They can also increase students interest and provide a much more meaningful learning. Textbook face is related to its format, quality and clarity of illustrations, general layout, size of the book and binding, quality of editing, index, table of contents and chapter headings [11].

The quality of textbook face can be considered from three criteria. They are size, cover design and book content design. A textbook is considered to have a proper size by following these criteria: (1) textbook size is in accordance with ISO standard and (2) textbook size is in accordance with its content. Moreover, the quality of textbook cover can be judged based on (1) layout, (2) cover typography and (3) selection of fonts. Last, the quality of textbook content design can be judged based on (1) reflection of book content, (2) layout harmonisation, (3) the completeness of layout, (4) layout design, (5) topography of book content, and (6) content illustration.

Based on the explanation, there are four main aspects that must be assessed to consider the textbook quality. They are content, textbook presentation style, language and textbook face. The same four aspect also proposed by BSNP (Badan Standar Nasional Pendidikan) or Indonesian National Education Standards Department [12]. According to BSNP, a textbook must satisfy standard quality in the four aspects mentioned to be considered as a proper textbook. A textbook that can satisfy all the standard quality for all the aspects is considered as valid textbook.

The validity of a textbook can be judged through evaluation. Textbooks evaluation is a process to make a value judgment which includes the phases of selecting the information, analyzing, transferring, using and making decision on the quality of the textbooks [1]. The evaluation of a textbook must be done by the people who are specialists in this subject, didacticisms, practitioners, etc and who are not involved in the elaboration of the textbook. In this context, evaluation of textbook is done by evaluator by judging whether a certain textbook has met the standard quality based on the explained criteria.

The evaluation of a science textbook to determine its validity has been done by many researchers. Joy, Espinar and Ballado in 2017 conducting a study to evaluate the validity of a developed worktext in Basic Mathematics 2 [12]. They evaluated four aspects of the worktext to judge its validity. They are lesson objectives, lesson inputs, lesson application, and lesson enrichment. To interpret the level of validity of the worktext, they used these following scale: 4.20 – 5.00: Very Much Valid (VMV); 3.40 – 4.19: Much Valid (MV); 2.60 – 3.39: Valid (V); 1.80 – 2.59: Less Valid (LsV); 1.00 – 1.79: Least Valid (LeV). The validity of the worktext was assessed by teachers and students.

Hidayati Rahmi, Yohandri and Ratnawulan in 2018 conducted a study to evaluate the validity of basic electronic 1 module integrated character value based on conceptual change teaching model to increase students physics competency [13]. They evaluated three aspect of the module to judge its validity. They are content, construct and language. In addition, apart from judging the validity, validator also suggest some weakness of the module, so it can be revised to get a better quality. They analysed the validity data using the Likert scale which is converted to these following criteria: 0-20: Very invalid; 21-40: invalid; 41-60: less valid; 61-80: valid; 81-100; very valid.

Antrakusuma, Masykuri and Ulfa in 2018 conducted a study to evaluate the validity of scientific based chemistry android module to empower science process skill (SPS) in solubility equilibrium [14]. To make the study effective, the study employs seven validators and four validity criteria ranging from irrelevant to relevant. The data of validity is computing using Aiken formula to get its validity value.
A certain aspect is considered to be valid if it has validity value more than 0.76. The validity of the module was judged from these following aspects: content, linguistic, serving, and graphic.

The textbooks being evaluated in this study are integrated science textbooks on the theme of tsunami using webbed model based on Polya problem solving. The author claimed that the characteristics of textbook were developed based on the result of needs and context analysis. The textbook is developed in integrated science format on the theme of tsunami. Theme of the textbook was decided from context analysis which gave the author insight about tsunami possibilities in West Sumatera, the place where the textbook will be implemented. The textbook was designed to foster students' competencies in the aspect of attitude, knowledge, and skill related to students’ preparedness toward tsunami. Moreover, the textbook also was designed to satisfy the curriculum demands. Textbook was designed based on Polya problem solving in which the lesson begins with presenting students with several real-world problems related to tsunami followed by Polya steps which is completed with clear explanation to guide students in solving the problem.

This textbook has been just developed and its quality is remained unknown. Based on the explanation, to consider textbook as a proper one, textbook needs to be evaluated by experts and practitioners to find out whether the textbook has met the standard quality based on the explained criteria in the aspect of content, presentation style, language, and face. The data taken can be used to judge the validity of the textbook.

2. Objective of The Study and Research Question

The main objective of the study was to evaluate the validity of integrated science textbooks on the theme of tsunami using webbed model based on Polya problem solving to enhance students’ preparedness toward disaster in the aspect of content, presentation style, language, and face. This study was designed to answer these following research questions: (1) How is the validity of the textbook in the aspect of content? (2) How is the validity of the textbook in the aspect of presentation style? (3) How is the validity of the textbook in the aspect of language? (4) How is the validity of the textbook in the aspect of face?

3. Method

3.1 Subjects

The validity textbook was evaluated by three educational experts and three educational practitioners. The three educational experts have doctorate degree in the field of science, education, and linguistic. The three educational practitioners have 5 years minimum experience in teaching science course in junior high school on the subjects presented on the textbook. Both experts and practitioners were not involved in the elaboration of the textbook.

3.2 Instruments

Instrument used for gathering data was a valid questionnaire prepared by researcher. The validity of instrument was judged based on these following (1) the guidance on how to use the questionnaire is clearly written, (2) the evaluation items listed in the questionnaire is in accordance with evaluation indicators, (3) the evaluation items listed in the questionnaire is in accordance with the intentional purpose, (4) the evaluation items listed in the questionnaire can be interpreted easily, (5) the format of questionnaire is simple and easy to understand and (6) the language used in the questionnaire is grammatically correct. Moreover, the questionnaire was developed based on Likert scale and validator were asked to choose among “strongly disagree, disagree, agree and strongly agree” for the evaluation items listed in the questionnaire in the aspect of content, presentation style, language, and face. The questionnaire consists of 15 items for evaluating the validity of content, 12 items for evaluating the validity of textbook presentation style, 8 items for evaluating the validity of language and 8 items for evaluating the validity of textbook face.
3.3 Data Collection and Analysis
The data of validity was analysed using descriptive statistc approach. The descriptive statistic approach is concerned with the scientific method by which information is collected, organised, analysed and interpreted for the purposes of description and decision making. The data was analysed according to these following steps:

Step 1: Validators scoring each items by giving 4 (strongly agree), 3 (agree), 2 (disagree) or 1 (strongly disagree).

Step 2: Researcher determining the average score of all items for each aspects, content, textbook presentation style, language and textbook face.

Step 3: Researcher determining the value of validity using V of Aiken formula as followed:

\[ V = \frac{\sum (r - I0)}{n(c - 1)} \]  

\( I0 \) is the lowest score which is 1, \( c \) is the highest score which is 4, \( r \) is average of given score of all items for each validation aspects and \( n \) is the number of validator.

Step 4: Researcher determining the category of textbook validity based on this following table:

| Table 1. Category of Validity |
|-----------------------------|
| **Value** | **Criteria** |
| ≥ 0.6 | Valid |
| < 0.6 | Invalid |

* Source: Azwar (2015)

4. Results and Discussion
As mentioned, the validity of the textbook can be judged by evaluating the quality of its content, presentation style, language, and face. The result of content evaluation can be seen in Table 2.

| Table 2. Validators’ Evaluation on the Validity of the Content of the Textbook |
|-----------------------------|
| **Item No.** | **Validation Criteria** | **Experts** | **Educational Practitioners** |
| | | **A** | **B** | **C** | **A** | **B** | **C** |
| 1 | The book presents learning materials and activities supporting students’ awareness toward the grace of God. | 4 | 3 | 4 | 4 | 4 | 4 |
| 2 | The book presents learning material supporting students’ scientific behaviours. | 4 | 3 | 4 | 4 | 4 | 4 |
| 3 | The learning material is in accordance with core and basic competence and learning instructional indicators. | 3 | 3 | 4 | 4 | 4 | 4 |
| 4 | The learning material consists of facts, concepts, and procedures. | 3 | 3 | 4 | 4 | 4 | 4 |
| 5 | The learning material depth is in accordance with students’ age and cognitive ability. | 4 | 2 | 3 | 4 | 4 | 4 |
| 6 | Facts in given problems on the book are in accordance with the book’s theme. | 4 | 3 | 3 | 4 | 4 | 4 |
| 7 | The learning material presents the correct and exact concepts. | 3 | 3 | 3 | 4 | 4 | 4 |
| 8 | The concepts have an exact and correct definition. | 3 | 3 | 4 | 4 | 4 | 4 |
| 9 | The procedures are correct and systematic. | 3 | 3 | 3 | 4 | 4 | 4 |
| 10 | The learning material is up to date. | 4 | 3 | 4 | 4 | 4 | 4 |
| 11 | Tsunami materials in the book increases readers’ knowledge. | 4 | 3 | 4 | 4 | 4 | 4 |
Table 1 presents the result of validators’ evaluation on the validity of the content of the textbook. Both experts and practitioners consider the textbook content as valid with the value of V is 0.81 and 1. It can be seen from the table that the score given by the expert is less than the score given by the practitioners. All practitioners gave a perfect score for all the evaluation items related to the content. They are strongly agree with all evaluation items listed. This means according to the practitioners, the textbook already have satisfied all standard quality criteria of the content. Meanwhile, experts are little bit disagree with practitioners. Expert arguing that learning material presented on the textbook is not in accordance with students’s age and cognitive ability while the practitioners has an opposite judgement. Practitioners are strongly agree that learning material presented on the textbook is in accordance with students’s age and cognitive ability. This might happen due to different perspective between the experts and practitioners related to the broadness and the depth of material and its criteria that can be judged to determine its suitability with students age and cognitive ability. This aspect has to take into account. As mentioned in the introduction, students’ age and cognitive ability must be considered in developing the learning material. The learning material can’t be too easy or to difficult for the students. The quality of the learning material can affect students interest in learning deeply.

**Table 3. Validators’ Evaluation on the Validity of the Presentation Style of the Textbook**

| Item No. | Validation Criteria                                                                 | Experts          | Educational Practitioners |
|---------|------------------------------------------------------------------------------------|------------------|----------------------------|
|         |                                                                                    | A    | B  | C  | A    | B  | C  |
| 1       | The book is well structured according to the standard.                            | 4    | 2  | 3  | 4    | 4  | 4  |
| 2       | The concepts are presented systematically, from simple to complex one, and from    | 4    | 3  | 3  | 3    | 3  | 3  |
|         | concrete to abstract one.                                                          |                  |                |      |      |    |    |
| 3       | Each chapter has a proportional learning material according to core and basic      | 4    | 3  | 4  | 3    | 3  | 3  |
|         | competence.                                                                        |                  |                |      |      |    |    |
| 4       | Each table, picture, attachment, symbol has a proper and correct number and name. | 4    | 3  | 4  | 4    | 4  | 4  |
| 5       | All references are listed in bibliography.                                         | 4    | 3  | 4  | 4    | 4  | 4  |
| 6       | Examples of problems in each chapter help reinforcing students’s understanding.    | 4    | 3  | 4  | 4    | 4  | 4  |
| 7       | Evaluation is in accordance with the learning goals.                               | 3    | 3  | 4  | 4    | 4  | 4  |
| 8       | The learning material presentation places students as the subject of learning.     | 4    | 3  | 4  | 4    | 4  | 4  |
| 9       | The learning materials encourage students to be active in thingking and learning.  | 3    | 3  | 3  | 4    | 4  | 4  |
The presentation uses examples from the learners’ environment.
The concept map can describe learning material well.
Learning activities use scientific approach.

| Item No. | Validation Criteria                                      | Experts | Educational Practitioners |
|----------|----------------------------------------------------------|---------|---------------------------|
| 10       | The presentation uses examples from the learners’        |         |                           |
|          | environment.                                             | A 3     | B 3                       |
|          |                                                          | C 3     | A 4                       |
|          |                                                          | B 4     | C 4                       |
| 11       | The concept map can describe learning material well.     |         |                           |
|          |                                                          | A 4     | B 3                       |
|          |                                                          | C 4     | A 4                       |
|          |                                                          | B 4     | C 4                       |
| 12       | Learning activities use scientific approach.             |         |                           |
|          |                                                          | A 3     | B 3                       |
|          |                                                          | C 4     | A 4                       |
|          |                                                          | B 4     | C 4                       |
|          | Average                                                  | 3.67    | 2.92                      |
|          |                                                          | 3.67    | 3.83                      |
|          |                                                          | 3.83    | 3.83                      |

V value: 0.81
Validation criteria: Valid

Table 3 presents the result of validators’ evaluation on the validity of the presentation style of the textbook. Both experts and practitioners consider the textbook presentation style as valid with the value of V is 0.81 and 0.94. Same with the content, it can be seen from the table that the score given by practitioners is higher than the score given by the expert. An expert considers the textbook has a poor structure, while the other two experts and practitioners consider it very well structured. This might happen because of the parties have a different understanding about the standard quality criteria of the textbook structure. The textbook must be well structured, so the standard quality criteria of the textbook structure must take into account. Moreover, the textbook has satisfied the other standard quality criteria related to its presentation style. It can be said that the textbook has already presented properly. The textbook is systematic, proportional and well described. In addition, the textbook has a complete structure and satisfy curriculum demands, such as the use of the scientific approach, the use of examples from learners’ environment and the reinforcement of students’ understanding.

Table 4. Validators’ Evaluation on the Validity of the Language of Textbook

| Item No. | Validation Criteria                                      | Experts | Educational Practitioners |
|----------|----------------------------------------------------------|---------|---------------------------|
| 1        | The language is in accordance with students’ cognitive ability. |         |                           |
|          |                                                          | A 3     | B 3                       |
|          |                                                          | C 3     | A 3                       |
|          |                                                          | B 3     | C 3                       |
| 2        | The language is easy to understand.                      |         |                           |
|          |                                                          | A 3     | B 3                       |
|          |                                                          | C 3     | A 3                       |
|          |                                                          | B 3     | C 3                       |
| 3        | The given information’s are clear.                       |         |                           |
|          |                                                          | A 4     | B 4                       |
|          |                                                          | C 4     | A 4                       |
|          |                                                          | B 4     | C 4                       |
| 4        | Language is grammatically correct.                       |         |                           |
|          |                                                          | A 3     | B 4                       |
|          |                                                          | C 4     | A 4                       |
|          |                                                          | B 4     | C 4                       |
| 5        | The spelling used refers to the EYD.                     |         |                           |
|          |                                                          | A 3     | B 4                       |
|          |                                                          | C 4     | A 4                       |
|          |                                                          | B 4     | C 4                       |
| 6        | All contents are relevant to each other.                  |         |                           |
|          |                                                          | A 4     | B 4                       |
|          |                                                          | C 4     | A 4                       |
|          |                                                          | B 4     | C 4                       |
| 7        | All contents reflects the unity of the theme.            |         |                           |
|          |                                                          | A 4     | B 4                       |
|          |                                                          | C 4     | A 4                       |
|          |                                                          | B 4     | C 4                       |
| 8        | Symbols are presented consistently.                      |         |                           |
|          |                                                          | A 4     | B 4                       |
|          |                                                          | C 4     | A 4                       |
|          |                                                          | B 4     | C 4                       |
|          | Average                                                  | 3.50    | 3.75                      |
|          |                                                          | 3.63    | 3.75                      |
|          |                                                          | 3.75    | 3.75                      |
|          | V value                                                  | 0.88    | 0.92                      |

Table 4 presents the result of validators’ evaluation on the validity of the language of the textbook. Both experts and practitioners consider the textbook presentation style as valid with the value of V is 0.88 and 0.92. Both experts and practitioners consider textbook has satisfied all the standard quality criteria related to its language. It can be said that textbook has already had a proper language. The language used in the textbook is in accordance with students’ cognitive ability, easy to understand, clear, correct, refers to EYD. In addition all contents presenting in the textbook are relevant to each other, reflects the unity of the theme and presented consistently.
Table 5. Validators’ Evaluation on the Validity of the Face of Textbook

| Item No. | Validation Criteria                                                                 | Experts | Educational Practitioners |
|---------|------------------------------------------------------------------------------------|---------|----------------------------|
| 1       | Book has a proper size according to ISO.                                           | A 4     | B 4                        |
| 2       | Book size is in accordance with presented materials.                               | A 4     | B 4                        |
| 3       | Book has a proper and unite cover.                                                 | A 4     | B 3                        |
| 4       | Book covers reflects book contents.                                                | A 4     | B 4                        |
| 5       | Book layout is proportional.                                                       | A 4     | B 3                        |
| 6       | Illustrations and pictures are in accordance with materials.                      | A 4     | B 3                        |
| 7       | The color combination of the book interests students.                              | A 4     | B 3                        |
| 8       | The design of the book interests students.                                         | A 4     | B 3                        |
|         | Average                                                                            | A 4     | B 3.75                     |
|         | V value                                                                            | A 0.89  | B 1                        |
|         | Validation criteria                                                                | A Valid | B Valid                    |

Table 5 presents the result of validators’ evaluation on the validity of the face of the textbook. Both experts and practitioners consider the textbook face as valid with the value of V is 0.89 and 1. Both experts and practitioners consider textbook has satisfied all the standard quality criteria related to its face. It can be said that the textbook has already have a proper face. Textbook has a proper size, proper cover, proper layout. The design of the textbook interests students.

While textbook is considered to be valid in all of the aspects, experts and practitioners suggested and commented related to the quality of each aspects. Suggestion and comment were provided in the open-ended part of the questionnaire as a guidance to revise the textbook, so it will have a better quality. Revisions are just suggested in the aspect of presentation style and language. As for presentation style, the revisions are suggested on structure of the textbook, presentation of textbook content list, layout of the textbook, font using on the textbook, font size and the effectiveness and efficiency of the textbook. The textbook is judged to be too thick and heavy, causing students barely want to take it to school. Moreover, as for language, the revisions are suggested on the sentences used to explain students activities. The validators suggested the language should be much more casual and up to date, so the students get the instructions easily. The poor structured sentence the learning activities caused students hard to understand it.

5. Conclusion
Based on the result of this study, the content, presentation style, language, and face of the textbook is considered to be valid from the perspective both experts and practitioners. The content, presentation style, language and face of the textbook has satisfied most of its standard quality criteria. Textbook has had a proper content, presentation style, language and face.

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