Validity analysis of digital module based on generic science skills on environmental pollution topic for 10th grade students

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ABSTRACT

The development of digital modules based on interesting generic science skills can be integrated in biology learning. Generic science skills (GSS) are related to skills through application and biological context. The factual and procedural knowledge obtained by students can be explored in the environmental pollution material because of various concepts and solve various real problems. This research is a descriptive study that explains the stages of digital module validation analysis based on generic science skills on environmental pollution for grade 10 high school students. Digital module validation test refers to five aspects such as (1) suitability of material, (2) presentation, (3) language, (4) generic science skills, and (5) visual/appearance. The subjects in the research at the initial review stage were three validators consisting of practitioners who are experts in learning biology and learning media. Based on the results of the study, it is known that the module developed as a whole is very valid in reference to aspects, namely the feasibility of the content aspect, the feasibility of the presentation aspect, the feasibility of the language aspect, the feasibility of the GSS aspect and the appearance, this shows that the digital module produced can be continued at the next stage.

INTRODUCTION

The use of modules in learning is very important to the success of learning, especially for learning biology (Prawita & Prayitno, 2019). It facilitates schools and teachers to impart education to students at large quantity and make optimum use of technology in educational sector (Naim, 2021). One form of module that can be used by students at any time is using digital modules. The characteristic of using digital modules is learner independence. Various research results regarding the use of digital modules affect the cognitive learning outcomes of students such as those conducted by Ayuningtyas et al. (2022) and Rusminah et al. (2022).

Module development based on generic science skills as an alternative that is integrated in biology learning because of factual and procedural knowledge of the environmental pollution material (Ulger & Cepni, 2020). Generic science skills can be used to learn various concepts and solve various scientific problems, especially biological concepts (Putra et al., 2021). In addition, it is also part of scientific work to understand concepts and other scientific activities (Rosidah et al., 2017).

Generic science skills have eight indicators consisting of direct observation, indirect observation, large scale consciousness of nature's objects, symbolic language, logical framework, logical inference, causal law, mathematical modeling and concept building ability (Maknun, 2015). Generic science in various lessons can be applied as learning activities (Schneider et al., 2019). In addition, the learning model, the condition of students and facilities support the implementation of generic science skills (Taofiq et al., 2018). The utilization of generic science skills in students has different results between indicators (Valiyev & Ibrahimova, 2021) besides that some indicators in GSS have not been mastered properly such as indirect, direct observation aspects of 32,83, aspects of sense of scale of 48,43 in chemistry learning (Rosidah et al., 2017).

The environmental material, including pollution, is one of the materials that must be taught to students as part of an effort to foster awareness, responsibility, and attitude as a whole human being can be done (Kamis et al., 2017). In addition to the characteristics is the development of digital modules that represent a logically completed intra-subject unit of learning (topic, multiple topics, and sections (Olkhovaya et al., 2022), so that the help of digital modules can help motivate, be active and care for the environment (Imtihana et al., 2014). In addition, generic science indicators such as aspects of indirect observation and logical frameworks and logical inference can appear in this material. Research on the development of digital biology modules on the topic of environmental pollution has been carried out by several researchers, including Pada et al. (2021) and Wahyuningsih et al. (2021). In general, the research results show that digital biology modules can improve students' understanding, learning motivation, and attitudes. However, so far there has been no report on integrating generic science skills in digital biology modules on the topic of environmental pollution.

The use of digital modules that have been equipped with images, diagrams or charts, and short videos is expected to be able to help students visualize them (Freeman et al., 2016). Moreover, learning biology relates to abstract and complicated concepts so that visual representations can help in interpreting learning (Utami et al., 2021). In addition, students are given access to learning through supplements prepared in digital modules so that it becomes one of the innovations in Biology learning (Teri et al., 2014). Based on this explanation, a study was conducted which aimed to describe the validation test for the development of generic science skill-based modules on environmental pollution for 10th grade high school students.

METHODS

This research is a descriptive study that explains the stages of digital module validation analysis based on generic science skills on environmental pollution for grade 10 high school students. Digital module validation test refers to five aspects such as (1) suitability of material, (2)

presentation, (3) language, (4) generic science skills, and (5) visual/appearance. The subjects in the research at the initial review stage were three validators consisting of practitioners who are experts in learning biology and learning media. The implementation of the research was carried out for two semesters in the 2022-2023 school year.

The research steps were carried out by (1) preparing a questionnaire containing validity indicators such as 5 aspects of feasibility, namely content, presentation of material, language, learning independence and visual, (2) testing the digital module by giving values through scores 1, 2, 3, and 4 (1 = not good, 2 = less good, 3 = good, 4 = very good), (3) providing input and responses and writing on the questionnaire, (4) calculating the results of the validation test on each aspect with the following formulation:

$$V = \frac{Ts}{Tmax} x 100\%$$

Description:
V   = Validity
Ts   = Total validation score from validators
Tmax   = Total expected maximum score

(5) Provide an assessment in the form of validation results with the categories found in Table 1.

Table 1. Validity criteria based on score range

Score Range	Criteria	Description
3,26 – 4,00	Very valid	No need for revision
2,51 – 3,25	Valid	Minor revision
1,76 – 2,50	Less valid	Major revision
1,00 – 1,75	Not valid	Total revision

(6) Revising the digital module on environmental pollution based on the validator's suggestions. Furthermore, the research continued to the practicality test if the resulting module was categorized as at least valid.

RESULTS AND DISCUSSION

The validation test aims to get a digital module that is feasible before the practical test is carried out. The validation results were used to revise the initial product. The characteristics of the resulting module such as (1) can be used by students independently so that it has clear and specific learning objectives (2) can be studied as a whole because it has a variety of additional information that students can use (3) easy to use by students easy to use because it uses single software with e-pub format supported by html and text formats and easy to update.

The results of the validation of the GSS-based digital module development for environmental pollution material are summarized in Table 2.

Table 2. Expert validation test of GSS-based digital module development

No	Indicator	Validator 1	Validator 2	Validator 3	Average	Category
1	Feasibility of material suitability	2,92	3,46	3,52	3,30	Very valid
2	Feasibility of presentation aspect	2,80	3,55	3,80	3,38	Very valid
3	Feasibility of linguistic aspects	2,92	3,33	3,68	3,31	Very valid
4	Feasibility of GSS aspect	2,80	3,20	3,52	3,17	Minor revision
5	Visual aspect feasibility	2,80	3,42	3,52	3,25	Minor revision

Based on the validation test, the GSS-based digital module has two indicators that were slightly revised to get a valid module for use in learning biology on environmental pollution material. Examples of suggestions from validators were followed up by revising the digital module listed in Table 3.

Table 3. Follow-up of validator input and suggestions

Description	Before revision	After revision
Improve the appearance of the chapters according to the GSS added to the module.		
Improve web interface to make it easier to read.		

Based on the input from the validators listed in Table 4, further improvements were made in the digital module as in Table 3. The follow-up recapitulation is as follows.

Table 4. Recapitulation of follow-up of expert review suggestions

No	Aspects assessed	After revision
1	Material suitability aspect	1. Replace some of the pictures that represent examples of environmental change material. 2. Adding a learning video in the environmental pollution section that is adapted to the context. 3. Improving the concept map related to environmental change material.
2	Presentation aspect	1. Adapt the content of the summary to the learning flow. 2. Adding some terms that have not been written in the glossary.
3	Linguistic aspects	1. Correct the spelling mistakes in the preface and content section. 2. Correct the parts that do not have spaces in the content and glossary sections.
4	GSS aspect	1. Adding aspects of indirect observation of the digital module 2. Improving the aspect of scale awareness 3. Improving the symbolic language aspect by adding graphs/tables 4. Adding aspects of cause and effect by showing parts of estimating natural phenomena.
5	Visual display aspect	1. Improved image layout and improved spacing. 2. Enlarge the display of videos loaded in the e-module so that learners who have limited storage space will have difficulty accessing. 3. Adjusting the module cover used including the color and font used. 4. Adjusting the font size on the title with the subtitle section. 5. Enlarge the size of the image so that it is clear to observe.

The validation test aims from this stage to describe the results of the module validation before the small group trial. According to the validation results and suggestions from the validators are used as guidelines for revising product deficiencies. The developed product is in the valid category. Assessment of teaching materials developed refers to 5 aspects, namely the feasibility of content aspects, feasibility of presentation aspects, feasibility of language aspects, aspects of learning independence and visual feasibility. The results of products that have been tested on material experts and media experts who are declared feasible can be disseminated (Syaferi et al., 2022).

Based on the results of the validator on the aspect of content feasibility, the average percentage is 3,30 with very valid criteria. According to the validator, the digital module presented reflects the learning flow. The material presented consists of definitions, examples and various activities carried out by students related to environmental pollution material. The selection of cognitive dimensions adapts to the revised Bloom's taxonomy. The selection of operational verbs of indicators determines the dimensions of knowledge mastered by students such as factual, conceptual, procedural and metacognition (Syafni et al., 2022) as well as using HOTS verbs which in Bloom's taxonomy include the ability to analyze, evaluate, and create (Febrina et al., 2019). In addition, the use of representative images and videos about environmental pollution can help students to learn independently, besides that this material is related to scientific knowledge, skills and attitudes and is around students (Anida et al., 2019). Adding a concept map that is presented aims to allows linear and non-linear presentation and navigation of educational materials and concepts (Schwab et al., 2016). Concept maps help material understanding and motivation for learning biology (Luzyawati, 2019).

The feasibility of linguistic presentation is in the very valid category. According to the validator, the digital module must systematize the presentation of material and concepts. In addition, writing errors need to be considered in the content section. The presentation aspect of the concept material presented has been coherent and consistent, besides the addition of a glossary helps students to find, difficult terms and revise the summary section to adjust the learning flow set. Media development pays attention to aspects of presentation techniques, presentation support, learning presentation and presentation completeness (Amintarti et al., 2019; Rachmadtullah et al., 2018). The presentation of digital modules using sigil software provides advantages such as making it easier to load images, videos, and sounds that can be changed, thus helping to present interesting, interactive, and active learning (Yahdiyani et al., 2022).

The results of the validator on the linguistic feasibility aspect get an average score of 3,31 with very valid criteria. According to the validator, the linguistic aspects of the digital module have sentences that represent the information to be conveyed, the terms used are in accordance with the Indonesia Dictionary (Kamus Besar Bahasa Indonesia, KBBI). The selection of effective sentences relates to the rules that apply by paying attention to spelling and punctuation. On the validator's note, the writing rules aspect needs to be improved in the writing of living species because it affects the consistency of nomenclature writing. The proper linguistic aspect is one of the indicators in testing the validity of the module (Safitri et al., 2020).

The GSS aspect is at a score of 3,17 with a minor revision category. In the Digital module, not all aspects are fulfilled so that there are 5 indicators that can be stated such as (1) indirect observation is implemented in the presentation of videos and images available in the module. The use of images and reading narratives that help visualize information (Izetbigovic et al., 2019), (2) Scale awareness is implemented by presenting a numerical scale as a quantity in accordance with environmental pollution material, (3) symbolic language using biological symbols, (4) logical inference is implemented in learner activities with inference from activities contained in digital modules, (5) Biological modeling is implemented through the physical meaning of sketches. GSS indicators are packaged in several sections in the module such as "let's explore" and "express your opinion" and "learning reflection" the addition of this section aims to solve the problems raised in the brief description and bring up the ideas and initiatives of students. Through GSS, students construct knowledge related to the regularity of things related to their own observations and experiences, thus providing meaning to the concepts learned (Septiani & Sumarni, 2015).

The results of the validators on the feasibility aspect of the overall visual appearance received an average score of 3,25 which indicated a minor revision in this aspect. Based on the results of the validators, various inputs were obtained related to the layout of the product developed including adjusting the background color and front display with the color used by the font. The choice of color determines physical and psychological attractiveness so that it makes it easier to convey understanding, unification and emphasis on the content to be highlighted (Listya, 2018), The addition of videos and images is related to visualization as an interpretative aspect that represents the entities/elements of the topic being studied (Utami et al., 2021).

The purpose of the revision is to make a comprehensive finalization or refinement so that the product is in accordance with the input obtained from the validator, then the digital module that has been developed can be used in the next stage, namely the practicality test based on the responses of students in the product trial stage.

CONCLUSION

Based on the validation test of the development of a module based on generic science skills on environmental pollution material for tenth grade students, it is concluded that the developed module is on a very valid score referring to the aspects of content, presentation, and language while the GSS and display aspects are in the minor revision category, this indicates that the digital module produced can be continued at the disseminate stage.

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