The Development Of E-Module Based on Science Writing Heuristic (SWH) To Improve the Effectiveness of Teaching and Learning Activities

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ABSTRACT

The goal of this study is to create an e-module that utilizes the Science Writing Heuristic (SWH) and assess its feasibility and characteristics. This research follows the research and development (RnD) approach using the Thiagarajan 4D development model. Various methods were employed to collect data, including interviews, observation, questionnaires, and documentation. The e-module was developed in the form of digital Flipbooks, which present students with a step-by-step learning process based on the Science Writing Heuristic. The quality of the e-module was evaluated by expert validators and student feedback. The final product is an e-module based on the Science Writing Heuristic (SWH) in HTML five format. The e-module received high scores from material and media experts, with a score of 0.93 and 0.82 respectively. Student responses were also positive, indicating its potential as a valuable learning resource. Further testing is required to determine its effectiveness in larger classroom settings.

Keywords: E-Module, Science Writing Heuristic, Students, Effectiveness.

INTRODUCTION

The improvement of education standards is necessary for the advancement of science and technology, which has a significant impact on development. Because education is the fundamental component of high-quality human development, it is crucial in producing human resources capable of independent and critical thought. Learning innovations must be integrated to produce new learning that provides better learning outcomes and increases the efficiency and effectiveness of learning renewal (Erkol et al., 2010). The integration of technology has a broad view, namely in facilitating the learning process and improving teacher performance in teaching students. The aim of educational technology is to tackle educational challenges and enhance the quality of learning. Research has confirmed that online learning resources, as a learning medium, offer a range of benefits (Wijayati et al., 2008). Students can use these resources to gather information and improve their knowledge base. The interactive and accessible nature of online resources fosters independence in learners (Astuti & Susilastuti, 2023). One such resource is the e-module, which is a contemporary learning tool that provides information on a particular topic and can be accessed through the internet. The e-module has the same structure and features as printed modules, but with added flexibility in presentation and system components. E-modules have advantages in terms of presentation, which is more practical as the file size is relatively small and easy to carry, so students can study them anywhere and anytime as long as there is a gadget (Saryanto et al., 2023).

The instructional materials employed in these schools were still insufficient, according to the findings of preliminary study that took the form of interviews with teachers (Heinich et al., 1993). Students' study tools consist solely of printed books with a collection of information that must be memorized and have no relevance to their everyday life. It is feared that it might impair students' capacity for critical thought. The instructor has never created modules, worksheets, or other teaching resources to aid in the learning process. Ideally, in the learning process, students have adequate learning facilities where the teaching media used are able to support student learning activities. Colloid material is a subject that tends not to involve mathematical calculations like other material taught in the even semester (Solihudin, 2018). The concepts in colloidal material are mostly concrete, require conceptual understanding, are real, and can be found in everyday life. So that learning can become attractive and be predicted to increase student learning outcomes, it is essential to have learning models and media that can be tailored to the properties of colloidal material. According to

preliminary study, teachers typically present material in a conventional manner, which makes learning tedious and reduces the number of pupils who pay attention to what is being said (Stephenson & Sadler-McKnight, 2016). It is also known that the colloid test score is still low, below the standard, this shows that students do not fully understand colloid material, so their learning outcomes are low. The results of the pre-research further revealed that practicums could not be carried out as they should because school facilities and infrastructure for practicums were still inadequate, so that practicums were rarely carried out (Wahyuni et al., 2018). Even during a pandemic, no practicum was carried out at all. Even though the experimental learning method is an important part of learning chemistry. Some research literature highlights the significance of experiments in science learning because they give students the chance to directly examine and test as well as learn generalization skills or connect, examine, and solve problems, which are the main objectives of science education (Herawati & Muhtadi, 2018).

This allows students to construct theories and effectively communicate concepts. The learning process in education is expected to form scientific character or attitudes, meaningful knowledge, and relevant skills. Hence, the aspiration is for learning to stimulate the inventive faculties of students, encouraging them to think creatively (Warren, 2009). This necessitates contextualizing the learning process and aligning it with the available material. However, regrettably, the predominant approach to learning remains reliant on rote memorization, with little emphasis on theoretical comprehension and practical application (Hidayati, 2012). Students studying chemistry must not only acquire factual and conceptual knowledge but also cultivate the capability to discern and utilize this knowledge to address real-world issues in science and technology. The study of chemistry is thus intimately linked to both its products, i.e., chemical knowledge in the form of facts, theories, principles, and laws, and its process, i.e., scientific inquiry. Therefore, chemistry boils down to science, which combines reasoning skills with skills or processes that integrate with the learning environment so as to provide a good learning experience for students. These two things must be supported by the creativity of the teacher and the quality of school facilities and infrastructure. to enable learning activities to be carried out properly (Hollingsworth & Lim, 2015).

Students' understanding of chemistry is largely determined by their ability to interpret and interconnect the three levels of chemical representation, commonly known as multiple chemical representations, which is part of higher-order thinking skills. This ability can be channeled through the application of an appropriate learning approach with a writing format that describes the correct understanding of concepts based on multiple chemical representations (Robinson, 2013). One approach to learning chemistry that can be applied and used as a reference in solving this is the SWH approach. SWH-based learning is learning that can guide students in developing greater understanding and ideas. This SWH approach can be applied as an alternative format used to assist students in writing practicum reports and as a learning approach used by educators to help design activities related to experiments or investigations in the laboratory (Sari & Hidayat, 2016). SWH learning is a technique to direct teachers and students in laboratory activities based on an epistemological framework, and it can help students improve their conceptual understanding since this method can direct them in locating the concept of the results of their thinking. The SWH approach's writing structure substitutes questions, knowledge claims, evidence, techniques, data descriptions, and reflection on changes in students' thinking for the five traditional report formats of objectives, methods, observations, findings, and conclusions.

METHODOLOGY

This study employs a developmental approach to research, utilizing a 4D development model that adheres to the framework devised by Thiagarajan, Semmel, and Semmel. The model comprises four stages of development: define, design, develop, and disseminate. However, due to time and cost constraints, the researchers were only able to reach the 3D development model, which includes define, design, and develop stages. The study focuses on students, and a limited number of nine students were selected as small-scale trial subjects. The selection process was based on their level of understanding, classified as high, medium, or low, with each level represented by three students. The data collection techniques utilized include interviews, documentation, and questionnaires. The data analysis technique aims to evaluate the validity and feasibility of the SWH-based e-module, which is the product developed in this research. Data analysis techniques to be used, namely: expert assessment, student response questionnaires.

RESULT AND DISCUSSION

According to the findings of interviews with teachers and students, the preferred mode of instruction is still the lecture technique. Another problem is that the learning media used only uses worksheets. The worksheets used are also less effective for use as learning resources because the worksheets presented are not attractive; on average, they are printed on opaque paper, and the images presented are not clear. There is also a lot of material that is not found in the contents of the worksheet. Fewer pupils use learning resources (such as textbooks) than you might expect. Learning resources used by teachers and students have not led to learning

that can improve students' critical thinking; learning that is carried out only emphasizes memorization, does not emphasize experimentation or investigation, and does not provide problem-solving activities that can develop students' thinking skills. Based on this, the researcher created learning materials in the form of a SWH-based colloidal chemistry e-module in the hopes that students will take on a greater active role and exercise critical thought when comprehending ideas and how to apply them in daily life. The define, design, and develop phases make up the three stages of the module learning model used in this study, which is a version of the Thiagarajan learning model. The first phase of this study is called Define, and it entails five steps: front-end analysis, learner analysis, concept analysis, task analysis, and formulation of learning objectives (detailing instructional objectives). The design and development stages (the stage of developing a learning module) are guided by these five stages.

The average assessment of material experts in each aspect gets a very valid category. The feasibility of the content component received a score of 0.93 in a very good category. Five factors determine whether a piece of information is feasible: whether it aligns with KI and KD, whether it's accurate, whether it's been updated, whether it meets students' needs, and whether it promotes knowledge expansion. As for suggestions for improvement in this aspect, namely the criteria for updating material with picture or illustration indicators so that there are more pictures so that the e-module is more interesting and students understand the material more easily. The second aspect is the feasibility of presentation with the acquisition of a validity value of 0.92 in a very valid category. Presentation feasibility includes presentation techniques, the presentation of learning, and presentation support. In this aspect, the validator provides suggestions for adding supporting presentations, such as an explanation of SWH and the stages of SWH. The third aspect is the aspect of language feasibility with the acquisition of a perfect validity score, namely the language feasibility aspect, which includes the clarity of information in the use of language and readability related to the suitability of sentence structure with linguistic rules. Language serves as a mediator for students so they can comprehend the meaning of the material provided in the e-module, thus it must be clear, simple to understand, and free of double meanings.

The SWH stage is the following component, and it has acquired a validity value of 0.88 for a very valid category. Aspects of the SWH stages include presenting problems as a basis for learning, implementing SWH learning activities in e-modules, and integrating SWH learning steps in e-modules. The validator provides criticism and suggestions. The criticism given is that the writing basis in the module is still not visible. Researchers are advised to better understand the SWH basis and strengthen its application in the module so that the characteristics of the SWH can be seen. The average assessment of media experts in each aspect is valid to very valid. The valid category is obtained in two aspects, namely the e-module presentation aspect and the e-module display quality aspect, with the same value of 0.66. The graphic feasibility aspect obtained a score of 0.83 in a very valid category, while a perfect score of 1 was found in the aspects of images, illustrations, videos, and aspects of software engineering. The validator's suggestions in the media experts' evaluation of the e-module cover layout, the clarity of the video's audio, and the replacement of the e-module's background with a complementary hue.

The created SWH-based e-module can be deemed valid and practicable to test on students based on the findings of evaluations and improvements performed by professional validators. Valid teaching materials are teaching materials that meet predetermined standard criteria so that they can be used in the learning process. Based on the outcomes of the student evaluation, it is revealed that the component of content quality attains a score of 84% in the excellent range. As per the feedback received from the students via Google Form concerning criticism and recommendations for e-modules, it was disclosed that the e-modules' contents facilitate students in comprehending the subject matter and grasping colloidal concepts due to the presence of captivating videos and engaging discussions that are relevant to everyday life. Consequently, students can easily identify and address existing problems. These findings are consistent with the results of prior research, which demonstrated the content's suitability and appeal in terms of design, color schemes, illustrations, and animations in the journal. As a result, students are encouraged to actively participate in the process of learning chemistry. This opinion is also in accordance with the opinion of Warren (2009), which states that the appearance of an e-module becomes more attractive when it is equipped with good, complete, and clear content.

The second aspect is the display aspect, with the acquisition of a percentage value of 83% in the good category. The responses from some students regarding the appearance of the e-module were that it was very attractive and the language used was clear and easy to understand, but there were criticisms and suggestions that the font size be slightly enlarged and the e-module cover be even more creative. The next aspect is the usability aspect, which gets the highest percentage of 94% in the very good category. Students' responses regarding the benefits of this e-module are that it can add insight into students' knowledge and help students learn anytime and anywhere, because students feel that the existence of an e-module can reduce the burden of carrying textbooks from home, which are felt to be many and heavy to bring. The fourth aspect is interest in learning, with a percentage score of 73% in the good category. Some students claimed to be interested in the

e-module being developed because it contains material related to everyday life and is presented with lots of interesting pictures and videos, which makes students interested and increases their interest in learning it. The last aspect is the use aspect, with a score of 86% in the very good category. Students admit that it is very easy to operate this e-module because the table of contents is made interactive so that students can easily and quickly go to the intended page. The SWH-based e-module that was constructed had a positive response from students, as evidenced by the overall percentage value of the students' evaluation of the SWH-based e-module, which was 82.67%. Based on the analysis of expert validation data and student response data, it is known that the SWH-based e-module's quality receives scores of 0.93 and 0.83 in the same category, i.e., very valid, from material experts and media experts, respectively, while students received a score of 82.67% in the good category. These results indicate that the SWH-based e-module that has been developed can be an alternative teaching material that can support learning activities by both teachers and students.

The front and back covers are made with simple but attractive colors and appearances. A good cover is one that can influence and interest people to read the contents of the book as a whole. Therefore, a book must meet several elements, namely, a title with an attractive and striking font selection, an explanatory sentence that is short and easy to understand, an author's name, a publisher's identity, an attractive picture, and a synopsis of the contents of the book. on the back cover, and there is a book identity on the back of the book. The front cover of the developed e-module contains the module title, school level, class, identity of the author, and agency identity and logo, while on the back cover, the top part of the cover is taken from the front cover, which is reduced in size, and then in the middle of the cover, a description of the contents is presented. of the module, the purpose and characteristics of making the module, and at the bottom of the cover, the agency's identity and logo. The preface contains a brief description of the characteristics and advantages of the developed e-module. The table of contents page contains a description of the content pages available in the e-module. The purpose of presenting the table of contents is to make it easier for the reader to open the intended page automatically because this e-module is presented with a table of contents menu, such as a link that can be clicked directly to the intended page.

The introduction in the e-module contains module identity, basic competencies (KD), indicators, instructions for using the module, an introduction to the science writing heuristic (SWH), and SWH stages. In the preliminary stage, an introduction and SWH stages are added with the aim that users know in advance what SWH is that characterizes the e-module and what formats and stages are applied in the e-module. Concept maps: this section contains concepts that can assist students in connecting concepts and the flow of discussion in the material to be studied. The topic opener is an introduction that contains opening material. The topic opener aims to stimulate students' interest in the discussion in the module as well as increase their critical thinking. At the beginning of the opening of the topic, the learning objectives to be achieved are presented, and perceptions are presented using a SWH format video. Beginning Question: At the end of the video, there are instructions so that students can develop the question that is the problem (should the cough medicine be shaken before taking it ?) contained in the video. Procedures: Students are directed to describe procedures for solving problems by collecting evidence that includes identifying data. observation, namely predicting what will happen when gathering evidence. At this stage, after students watch the video, they are directed to contemplate or remember the phenomena around them. Claims: what students can claim in solving these problems Evidence: Students are directed to provide evidence for these claims. After that, compare the results obtained with those of other friends.

Contains material to be studied, such as the colloid system, the properties of colloids, and the manufacture of colloids. Examples of questions and questions for strengthening concepts are presented and arranged systematically according to the SWH format. Contains practical work or experiments carried out by students after studying colloid material. The practicum is related to everyday life and uses simple tools that are in students' lives. The practicum report format is prepared according to the SWH format's systematics. It's not much different from the format applied to perception in the topic opener it's just that in the topic opener, students collecting evidence are directed to observe a video and remember the phenomena around them. Meanwhile, in the LKPD format, data or evidence collection is carried out directly from the experimental results. The quiz serves to practice questions while deepening mastery of the material. Evaluation questions serve to deepen mastery of the material and serve as a benchmark for how far the material has been mastered by students. Summary, contains a summary of the material that has been presented and studied by students. The glossary contains an explanation of the meaning of each term and lists difficult and unfamiliar words used, arranged alphabetically. The bibliography is used by students in searching for information to deepen the material.

CONCLUSION

The features of the SWH-driven electronic module comprise of the content being presented in a manner that aligns with the SWH-based learning model, with learning activities following the Beginning Question, Test, Observation, Conclusion, Evidence, Evidence, and Reflection stages. The e-module is available in HTML 5

format, enabling easy access via smartphones, laptops, and computers. The e-module's quality, evaluated by material and media experts, is of high validity, scoring 0.93 and 0.82, respectively. In the limited trial, 82.67% of students provided positive feedback, categorizing the e-module as "good" (B), so with the SWH-based e-module that has been developed, it is hoped that students can increase their active role and critical thinking in understanding the concept and its application in everyday life. A SWH-based e-module needs to be tested on learning on a large or wide scale to find out the benefits and weaknesses of the teaching materials being developed. SWH-based e-modules need to be further developed with other chemical materials.

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