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# Analysis of the Validity and Readability of Google Sites Learning Media with a STEM Approach on Mutation Material to Improve Student Critical Thinking Skills

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## Abstract

The use of technology is currently relevant to the implementation of the 'Merdeka Belajar' Curriculum, but has an impact on students' critical thinking skills and learning media needs. This means that educators need to provide innovation in learning that is linked to technology. This study purpose to analyze the validity and readability of Google Sites learning media with a STEM approach to mutation material. This study used research and development (R&D) methods but was limited to the implementation stage, namely small-scale testing. A small-scale trial was carried out on 20 students of class XII MIPA 2 at Gemuh 1 Senior High School. The instruments used in this study were validation sheets and media readability questionnaires. Product validity criteria are seen from the validator's assessment. Criteria for media readability are seen from the results of student questionnaires. The study results show that the validity of the media was declared very valid based on the assessment of media experts at 96% and material experts at 93.56%. The media readability value was declared very good based on student assessments of 88.64%, so it has the potential to improve high school students' critical thinking skills.

## How to Cite

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## INTRODUCTION

The implementation of the 'Merdeka Belajar' Curriculum in the educational process has brought changes in every aspect of learning which refers to government regulation No. 57 of 2021 concerning National Education Standards that 'merdeka belajar' has the relevance of using technology in realizing world-class education to produce students who have at least 4 skills that refer to competency standards. According to (Redhana, 2019) that a very important skill for students to have is critical thinking skills. Critical thinking skills are essential because they can be used to solve problems and make decisions (Dores et al., 2020). Students who have strong critical thinking skills can easily solve problems or issues (Suriati et al., 2021).

According to (Ay et al., 2015) Critical thinking skills consist of several parts, including; problem recognition, the ability to select the right information for problem solving, the ability to consider specific or non-specific conditions and select, formulated and hypothesized relevant information and justify the validity of the results. Critical thinking can train a student's mindset to know the strengths and weaknesses of his own thinking and then improve it (Smetanová et al., 2015). This shows that critical thinking skills can train students to become superior human beings in the future, where students can continue to grow and improve themselves.

Based on the results of interviews conducted at SMA Negeri 1 Gemuh, the biology learning process carried out has utilized technology as a learning medium in delivering material and the existence of practicums, but it has not been maximized so that it requires improvement of learning media. Technological developments require students to be able to operate digital media in learning (Muhammad et al., 2022).

Learning activities will not be separated from learning materials through learning media in accordance with curriculum. Technology-based learning media plays a large role in increasing the effectiveness and efficiency of the learning process (Kemendikbudristek, 2022). Teachers need to innovated learning tools such as learning media that have a great influence on fostering students' critical thinking skills. This is strengthened based on the results of interviews conducted by the author at SMAN 1 Gemuh that it is necessary to develop technology-based learning media innovations that can help provide teaching materials and projects, one of which is the development of Google Sites media. This is evidenced by the average summative test score which is still below the limit of learning completeness.

Google Sites learning media is a learning platform in the form of a website, consisting of pages and sub-pages that can be inserted with text, images, videos, documents, and collaborations from other platforms on Google such as YouTube, interactive edugames (Rasapta et al., 2022). One of the conveniences of using Google Sites for educational purposes is that students can access a variety of interesting and up-to-date content that is also easy to understand (Adzkiya & Suryaman, 2021). Google Sites is very easy to use because it has amazing features such as Google Docs, Sheet, Forms, Calendar, and Awesome Table (Putri, 2021).

Google Sites media was chosen as one of the answers to digital teaching media, the use of Google Sites can be used as a learning resource or to vary existing teaching media. The innovation from the development of Google Sites will be combined with one of the potential learning approaches so that students are actively involved in learning activities, namely the STEM approach (Mutakinati et al., 2018). This is in line with research (Ritonga & Zulkarnain, 2021) explained that learning using STEM can improve students' critical thinking skills. These skills can be seen from the active interaction of students and how students use their cognitive abilities to implement new ideas (Agboeze & Ugwoke, 2013).

The application of STEM in biology learning can be combined with problem-based or project-based learning models that allow students to improve their collaboration and communication skills, improve critical thinking skills, improve problem-solving skills, and find solutions to problems (Kim, 2021; Kokotsaki et al., 2016; Nurbekova et al., 2020). In general, applying STEM approaches in education can help students improve their cognitive, affective, and manipulative skills, as well as create, develop, and utilize technology (Kapila & Iskander, 2014). STEM-based learning can help students use knowledge in solving problems with technology.

Google Sites learning media is packaged with STEM learning consisting of four aspects adapted according to (Asmuniv, 2015) and has been modified, namely mutation material as a discipline, Technology for the application of Google Sites learning media and the use of infographic applications, Techniques to design technologists in the form of assignment of infographic projects for mutation materials, and Mathematics to formulate chromosomal formulas about abnormalities in the nature of living things. Through the

STEM approach in learning media, Google Sites is able to help students have an appropriate learning experience so that they can improve students' critical thinking skills (Handayani, 2020). The STEM approach is the answer to the importance of human resources who are able to compete globally because learning is tailored to the interests and needs in science, technology, engineering, and mathematics (Perignat & Katz-Buonincontro, 2019).

The quality of the developed teaching media has an important role in the development of learning products (Irawan & Hakim, 2021). One of the media standards that is said to be quality is valid media. Validity in research is defined as the degree of correctness of research results, which is influenced and assessed based on the research methods used. The validity standard of a media according to (Mustami, 2017) that the validity of a learning tool is said to be valid if the expert assessment shows that the product developed is internally consistent between each aspect assessed in the learning tool. Good learning media must have good quality, so that it can be read and understood easily. Therefore, with a good level of readability, it will affect readers in increasing their interest in learning and memory, increasing the speed of reading efficiency, and maintaining their reading habits (Zidatunnur & Rusilowati, 2021).

## METHOD

### Population and Sample

The study was conducted in February of the academic year 2023/2024. The population of the study the students of class XII at Gemuh 1 Senior High School, while the sample in the small-scale trial used was class XII MIPA 2 with total 20 students.

### Instrument

The instruments used in the study to produce Google Sites learning media with a STEM approach consisted of validation sheets for media and materials expert and media readability questionnaires.

### Procedure

The data collection techniques used in this study were through interviews, documentation, and questionnaires. The results of this study were the results of the validity and readability of Google Sites learning media with a STEM approach. The study was carried out based on the solution from the results of interviews conducted by Biology teachers at Gemuh 1 Senior High School.

### Data Analysis Technique

Data analysis in this study used descriptive analysis and statistical data analysis. The assessment scale on the questionnaire used a likert scale (1-5). The validity analysis used construct validation by 2 assessors using the formula in Equation 1.

$$\text{Validity value} = \frac{score\ obtained}{overall\ scoe} \text{ x } 100\% \text{ .....} (1)$$

(Sudijono, 2009)

The product validity test criteria have a percentage range which can be seen in Table 1.

**Table 1.** Media Validity Criteria

| Percentage | Criteria |
|---|---|
| 81.25% < P ≤ 100% | Very valid |
| 62.5% < P ≤ 81.25% | Valid |
| 43.75% < P ≤ 62.5% | Quite valid |
| 25% < P ≤ 43.75% | Not valid |

(Sugiyono, 2016)

Media readability analysis is used classical analysis with the formula in Equation 2.

P = f/N x 100% .....(2)

The criteria for the media readability test have a percentage range can be seen in Table 2.

**Table 2.** Media Readability Criteria

| Percentage | Criteria |
|---|---|
| 81.25% < P ≤ 100% | Very good |
| 62.5% < P ≤ 81.25% | Good |
| 43.75% < P ≤ 62.5% | Quite |
| 25% < P ≤ 43.75% | Not good |

(Sugiyono, 2016)

## RESULT AND DISCUSSION

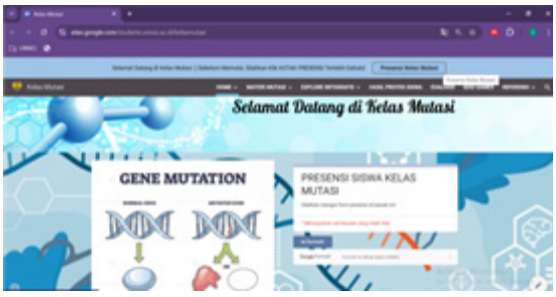
The validity of Google Sites learning media with a STEM approach was obtained from the results of validation by media experts and material experts. Media and material validation was carried out by FMIPA Lecturers at Semarang State University and High School Teachers. The results of the validity will be used for further media development, so that the media is better and valid before it is implemented in schools, suggestions and comments from media experts and material experts are used for the next stage of revision. Media validity tests were carried out based on assessment aspects adapted according to (Sadiman, 2010). The results of the validity by

the two validators can be seen in Table 3.

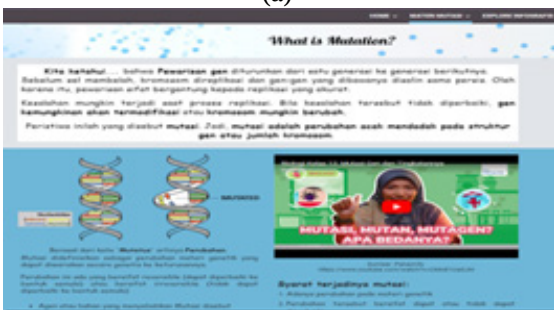
**Table 3.** Media Validity Assessment

| Assessment Aspects | Average Value (%) | Criteria |
|---|---|---|
| Additional information | 90 | Very valid |
| Consider user attitudes | 96 | Very valid |
| User relationship with the program | 96 | Very valid |
| Navigation | 100 | Very valid |
| Pedagogy | 98 | Very valid |
| Invisible features | 100 | Very valid |
| Average | 96 | Very valid |

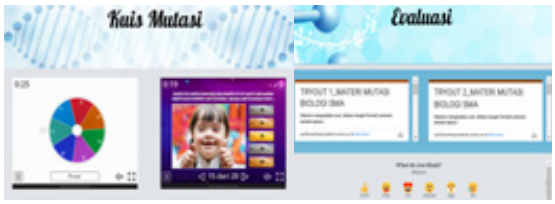
Based on Table 3, the media validation assessment by media experts shows an average result of 96% for each aspect of the assessment of the appraiser's agreement, including in the category of very valid. This is confirmed by research (Muhammad et al., 2020) stating that design is a quality factor related to website visuals that emphasizes the important requirements of a web-based media and must be placed consistently and aligned appropriately. The Google Sites media that has been developed is a product in the form of learning media with a website display that is packaged with learning elements with a STEM approach to mutation materials. The display of Google Sites media with a STEM approach is as follows:




(a)




(b)




(c)

**Figure 1.** (a) Home page; (b) Material page; (c) Quiz games and evaluation page

Based on Figure 1. The display of Google Sites media design includes layouts, home pages, learning outcomes and materials, infographic explore, evaluation, and references. Google Sites media can be inserted with text, images, videos, documents, and can be inserted with links to other platforms on Google such as google forms, YouTube videos, edugame quizzes. This is in line with research (Sari et al., 2019) explaining that the use of additional images and animations is necessary, but without disturbing the reader and paying attention to compatibility in the overall presentation of the illustration. The components of the presentation of web-based learning media must meet the requirements and criteria of learning media, including presentation techniques, presentation of supporting materials, presentation of teaching, and provision of text and image illustrations (Susilowati et al., 2021).

Media validation also needs to contain one of the indicators of attractiveness/motivation in the use of media so that students are more interested in the material to be delivered (Syaparuddin & Elihami, 2020). Media validator assessments based on indicators on validation sheets related to the developed Google Sites media are valid. This is in line with the results of the study (Puspitasari, 2019; Rambe & Ristiono, 2022) stated that the results of media validation on Google Sites media using sub-material of the human excretory system were declared valid so that they could be used in research. In addition, there is a material validation assessment which can be seen in Table 4.

**Table 4.** Material Validity Assessment

| Assessment Aspects | Average Value (%) | Criteria |
|---|---|---|
| Scope of learning | 95.71 | Very valid |
| Presentation of information | 96.66 | Very valid |
| Deepening of the material | 88.33 | Very valid |
| Average | 93.56 | Very valid |

The validity test of the material was carried out based on the assessment aspects adapted according to (Sadiman, 2010). The validation of Google Sites learning media materials was carried out to determine the suitability of the material applied to Google Sites media referring to the Independent Learning Curriculum for Senior High School. Based on Table 4, the validation assessment of material experts shows an average of 93.56% for each aspect of the assessment of the assessor's agreement, including in the valid category. This is in accordance with research (Li et al., 2023; Maryana et al., 2024) that one of the indicators used in material validation is related to the accuracy of the systematics of the use of language in accordance with the General Guidelines for Indonesian Spelling (PUEBI) and the language used is attractive, clear, and easy to understand. The diversity of learning materials must be relevant to the topics discussed and the grade level of the students who are the target of the delivery of the material.

The assessment aspect of material deepening obtained an average result of 88.33% with a very valid category. Based on the results of the analysis of the material validators, the deepening aspect of the material on Google Sites learning media received a low score among other aspects. This shows that the deepening of the material on the developed Google Sites media needs to be readjusted to the relevant sources and the truth of the concepts presented. Material concepts are systematically created from easy to difficult, simple to complex, and known to unknown (Wardhani et al., 2022).

Google Sites learning media with a STEM approach has ease of use, namely ease of assignment and evaluation, presented test questions that are integrated with google forms and interactive evaluations packaged in a quiz game. This can train students to learn independently related to understanding the material being studied. Apart from that, there is information content related to making infographics from the examples and video tutorials presented. According to (Adzkiya & Suryaman, 2021) one of the conveniences of using Google Sites for educational purposes is that students have access to a variety of interesting and up-to-date content that is also easy to understand.

Materials that are usually in the form of print media can be displayed in the form of digital media and are able to provide a varied, attractive, and interactive display because they are equipped with text, images, sounds and videos (Mastroleo et al., 2020; Tambunan & Sundari, 2020). The scope of the material used in the media is wide and in-depth so that it can be used as a source of student learning without depending on other learning resources. The conclusion from the results of media validation and material validation is that the Google Sites learning media developed was very valid to be applied in the next stage of research.

After conducting a validity test on Google Sites learning media with a STEM approach, this study also tested media on a small scale (weed analysis) with the aim of finding out the readability of the media that has been created before being implemented in a large-scale trial. The results of the media readability test can be seen in Table 5.

**Table 5.** Media Readability Test Results

| Assessment Aspects | Average Value (%) | Criteria |
|---|---|---|
| Aspects of learning media | 88.00 | Very good |
| Material aspect | 86.60 | Very good |
| Benefit aspect | 89.33 | Very good |
| Average | 88.64 | Very good |

Based on Table 4, the results of media readability analysis in small-scale trials obtained an average score of 88.64% which is included in the very good category. The media readability assessment consists of several aspects that are adapted according to (Anam, 2021) including the learning media aspect, material aspect, and benefit aspect. The learning media aspect obtained an average score of 88.00% with very good criteria. The Google Sites learning media presented provides convenience for students, namely learning reference sources in the media can be used without the need to think about storage (Sembung et al., 2022). Students can leverage the Google Sites platform to create or design engaging web-based teaching materials that students can access anytime and anywhere via smartphones or other devices. This is in line with the idea that developments in the field of information technology open up opportunities for the world of education, namely providing online educational resources that can be accessed anytime and anywhere (Nalasari et al., 2021).

The material aspect obtained an average result of 86.60% with the category of very good. Google Sites learning media as digital media has more value than print media, because Google Sites learning media supports more interactive

learning by utilizing features and technological sophistication in helping to increase students' interest and knowledge (cognitive) of subject matter (Prasetya et al., 2020).

The benefit aspect obtained an average score of 89.33% with very good criteria This is in line with research (Sofiasyari et al., 2023; Syaparuddin & Elihami, 2020) that the teaching materials developed have a pleasing display design and were equipped with images and videos that are in accordance with the material, so that it can motivate students to be more interested in the material to be delivered. The practical benefit of using Google Sites learning media in the learning process is that the media can clarify the presentation of messages and information related to the material so that it can facilitate and improve the learning process and outcomes (Sembung et al., 2022).

The use of Google Sites learning media with a STEM approach developed can be known from the validity results and readability results of small-scale trials. Google Sites media is able to provide ease of learning for students, is able to help understand the material easily, and is able to increase interest in learning and increase the knowledge (cognitive) of high school students studying mutation material. In addition, this teaching medium is also known to be very easy to understand and use. After revision and readability testing, Google Sites learning media with a STEM approach can be implemented on a large scale at 1 Gemuh Senior High School.

## CONCLUSION

Based on the results of the study, it can be concluded that Google Sites learning media with a STEM approach developed based on expert validity assessments is declared to be very valid by media experts with an average of 96% and material experts with an average of 93.56%, so that it can be used with little revision. The results of the media readability test obtained an average student response of 88.64%, with a very good category. The conclusion of this study was that the Google Sites learning media developed is valid, and has convenience for users, so that it has the potential to improve students' critical thinking skills.

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