



Designing Numeracy Literacy Assessment Media for High School Using Formative Websites on Rectilinear Movement Material

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Abstract

There needs to be innovation and creativity from educators in designing assessment processes that support learning, one of which is through the use of digital media. In physics learning which often involves abstract concepts and numeracy skills an engaging and up-to-date assessment strategy is necessary. This study aims to develop a website-based Formative assessment media to measure students' initial numeracy literacy in Straight Motion material. The research uses the ADDIE model with five stages: analysis, design, development, implementation, and evaluation. The media includes a home page display and interactive questions aligned with numeracy literacy indicators. Expert validation obtained a score of 16 out of 20 for material aspects and 18 out of 20 from the second validator for media aspects. The media also received a score of 81 out of 84 for appearance and 80 out of 84 for content from a second validator. These findings indicate that the Formative-based website media meets the "very good" criteria and is an effective, innovative alternative for evaluating physics learning at the high school level.

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INTRODUCTION

National education is an important part of efforts to improve the quality of Indonesian people. The government continues to develop curriculum policies, including the Independent Learning curriculum which emphasizes academic freedom (R. M. Sari, 2019). This policy aims to create superior human resources aligned with the Pancasila student profile. Therefore, strengthening literacy and numeracy skills is an important need for Indonesian students (Muliantara & Suarni, 2022). Educators are required to be more creative in designing learning and assessments that focus on developing students' basic competencies, including literacy and numeracy as the foundation for successful learning.

Numeracy literacy refers to the ability to understand and use mathematical concepts to solve problems. It includes recognizing and applying symbols, analyzing information presented in graphs or tables, and using the results for logical decision-making (Salsabilah & Kurniasih, 2022). This ability is important so that students can make logical decisions in everyday life.

Physics is a branch of science that studies various natural phenomena and the interactions that occur in them (Wea et al., 2021). However, the low interest in reading in Indonesia has had an impact on low literacy and numeracy skills, which ultimately affects students' ability to apply physics concepts. To overcome this, the government encourages schools to improve reading skills as a basis for essential numeracy literacy in solving everyday physics problems (P. Sari et al., 2024). Therefore, the integration of numeracy literacy in physics learning is a strategic step to improve conceptual understanding in depth and contextually. Numeracy literacy skills are key for students in using mathematical concepts to solve physics problems. One of the physics materials that is considered to be the most frequently misconception is in the material on straight motion. This happens because in the material on straight motion there are too many formulas used and most students still memorize the formulas in books or those given by educators without finding out the origin of the formula (Triastutik et al., 2021). Many students face challenges in understanding the

concept of Straight Motion, which is one of the basic materials in physics. This difficulty appears in various forms, starting from understanding the questions. Students often have difficulty identifying known information and determining what is asked in the question. In addition, the use of physics symbols is an obstacle in itself. Many students are not used to writing the appropriate symbols or understanding their meaning in the context of physics. This is compounded by difficulties in using formulas, including determining the correct formula, understanding the form of the equation, and manipulating the formula to suit the needs of problem solving. Not only that, many students also experience obstacles in performing numerical calculations. The inability to complete the correct calculations prevents them from reaching the desired answer.

Until now, the assessment is still carried out in writing or PBT (Paper Based Learning) then the assessment results are corrected manually by educators using paper. With this assessment method, students get bored, are not serious about working, and provide opportunities for cheating when (Primaniarta, 2020). The assessment process using written tests or conventional methods is often complicated, time-consuming, and tends to be less efficient (Salsabila et al., 2022). The development of information system technology has made it easier to access information in a fast, efficient, and flexible way, because data storage facilities, both online and offline, are now increasingly integrated and can be accessed anytime and anywhere. Therefore, an educator is required to be able to keep up with the times. In terms of assessing students, an educator is no longer limited to conventional offline methods, but can also do it online (Kajian, 2021). The use of online assessment media is considered efficient in making questions and making it easier for educators in the assessment process, because educators do not need to manually correct each student's answer. Therefore, educators need to have creative innovations in implementing learning evaluations, by utilizing existing media or applications (Khalisatun Husna et al., 2023).

With the existence of assessment media to measure initial abilities based on the Formative website, it is hoped that the quality of physics learning in high school can improve, especially in

terms of literacy and numeracy. This media is also expected to be a model of learning innovation that is relevant to the needs of education in the digital era.

Previous studies on digital assessments in physics have mostly measured cognitive performance, but have not specifically integrated numeracy literacy in kinematics, particularly Straight Motion. Moreover, the use of web-based platforms that assess numeracy literacy while providing instant feedback is still limited.

Therefore, this study develops a Formative website-based assessment media as an innovative tool to measure students' initial numeracy literacy in Straight Motion material. This research contributes by presenting an interactive media that integrates numeracy literacy into physics assessments and supports the implementation of the Independent Curriculum in the digital era.

METHODS

The type of research used is Research and Development (R&D). The purpose of this research and development is to create a product that can improve the quality of education, both in terms of the process and learning outcomes. In its development, this study adapts the ADDIE model which includes five stages, namely: analysis, design, development, implementation, and evaluation.

During the development stage, the media underwent a validation process involving two lecturers in the field of physics education who had relevant academic backgrounds and teaching experience. More specifically, the first lecturer had expertise in compiling questions or assessment instruments, while the second lecturer had experience in developing learning media, such as creating modules and other teaching tools. The validation tool used was a closed questionnaire covering aspects of content accuracy, suitability with numerical literacy indicators, clarity of instructions, use of language, media design, and interactivity features. Each aspect of the assessment was translated into a Likert scale to obtain an objective picture of the quality of the media developed.

The validation test was conducted on students who had studied Linear Motion material with the aim of measuring the suitability and clarity of the assessment media in actual classroom conditions.

The readability test was conducted on 30 students in one class, and the results showed that students had no difficulty in understanding or using the website as an assessment medium. In addition, students provided feedback through a questionnaire that focused on ease of use, clarity of questions, and attractiveness of the medium, so it can be concluded that this medium has good readability and is suitable for use in learning.

This study applies quantitative descriptive analysis techniques in processing and analyzing the data obtained. The media eligibility criteria are classified into four categories, namely extremely bad, not good, good, and very good, as adapted from Mardapi (2016). Data for this analysis were obtained from a closed questionnaire filled out by experts at the validation stage. Determination of the characteristics of the eligibility of the assessment media to measure initial capabilities is carried out by grouping the results into one of the four criteria, thus providing a clear picture of the quality of the media based on the predetermined indicators.

Table 1. Score interval

No	Score interval	Criteria
1	$X \geq X_i + 1,5 SD_i$	Very Good
2	$X_i \leq X < X_i + 1,5 SD_i$	Good
3	$X_i - 1,5SD_i \leq X < X_i$	Not Good
4	$X < X_i - 1,5SD_i$	Extremely bad

Keterangan :

X = Respondent Score

X_i = Ideal Score

SD_i = Ideal Standard Deviation

$$X_i = \frac{1}{2} (X_{high} + X_{low})$$

$$SD_i = \frac{1}{6} (X_{high} - X_{low})$$

RESULTS AND DISCUSSION

At the Design stage, the researchers developed a blueprint, constructed test items, and designed the website-based *Formative* media. The product consists of two main components: the home page and the question page. The home page was designed with attention to aesthetics and user-friendliness, using attractive color combinations to

increase student engagement. Meanwhile, the question page was structured systematically and interactively by integrating content, language, and visual design. Each slide presented only one item to

maintain student focus. In total, 30 questions were presented in separate slides, enabling students to work more carefully and systematically.

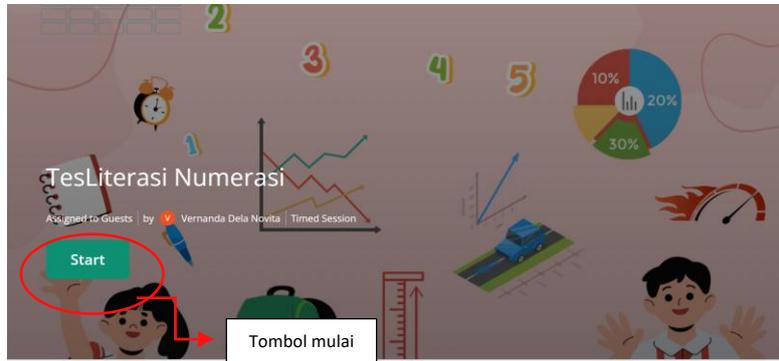


Figure 1. Student home page

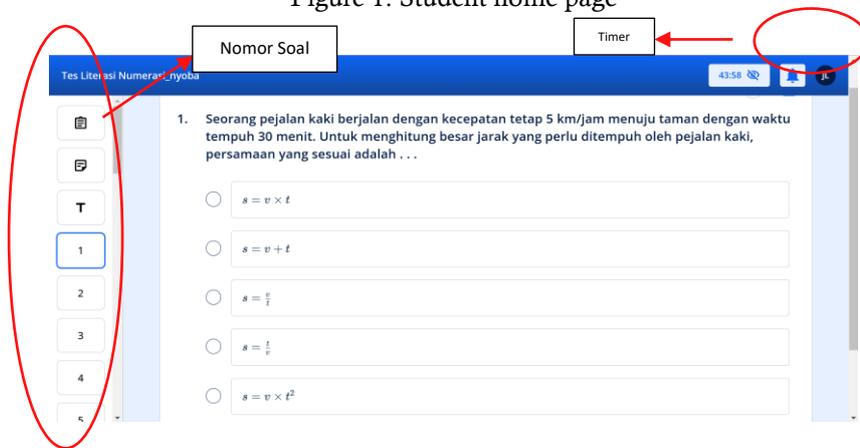


Figure 2. Question View

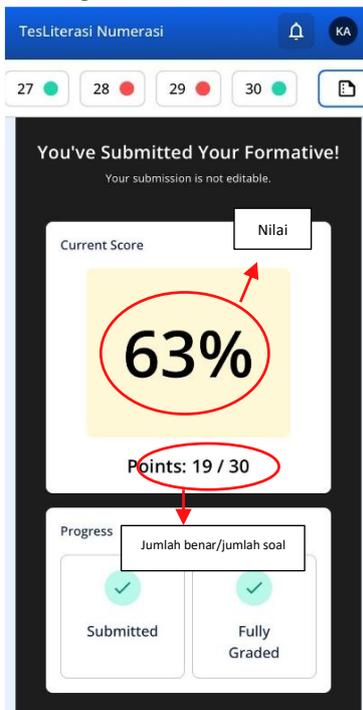


Figure 3. Results View

Each question slide in the website-based assessment media only contains one question to ensure that students' focus remains on each question asked. Thus, students can give their full attention to each question without being distracted by other information. This approach also makes it easier for students to think deeply and respond better to each question given. In addition, this arrangement minimizes the possibility of confusion or misunderstanding in understanding the questions, because each slide only displays one clear and focused question. This also supports more structured and organized learning. There are a total of 30 questions in this assessment media, each of which is presented in the form of a separate slide, ensuring that students can work on each question more carefully and without rushing. With a clear division of questions, this media facilitates more effective and focused assessments.

In the Evaluation stage, this process is focused on identifying deficiencies and improving aspects that are not yet optimal in the Formative website-based assessment media. The evaluation was carried out by involving media experts and content experts who provided critical assessments of

the overall appearance and content of the media. Based on the evaluation results provided, several important notes were found that need to be considered for media improvement. First, the initial appearance was considered still not visually attractive, so it is recommended to make improvements to the interface design, such as the selection of colors, layouts, and graphic elements to be able to attract students' attention from the start. Second, in terms of content, the material presented is considered not deep enough, especially in terms of strengthening the concepts needed by students to answer questions correctly. Therefore, it is necessary to add and develop content so that it can cover a broader and deeper understanding. Third, the evaluation also showed the need to include indicators in each question or part of the media, so that students have a clear picture of what competencies or topics are being assessed. With indicators, the assessment process becomes more transparent and helps students to focus their attention on the learning objectives they want to achieve. The findings from this evaluation stage are an important basis for revising the media before it is widely used in the learning process.

Table 2. Content Expert Assessment Results

No	Aspect	Expert 1	Expert 2
1	Compliance of content with indicators	3	3
2	Freedom from conceptual errors	4	4
3	Current material (up to date)	4	3
4	Scope and depth of material	3	3
5	Compatibility with the concept of numeracy literacy	4	3
Total		18	16

Table 3. Media expert assessment results

No	Aspect	Expert 1	Expert 2
1	Media Characteristics	38	38
2	Linguistics	20	22
3	Media View	22	20
Total		81	80

The instrument validation process involved two experts, namely a physics education lecturer with expertise in teaching, assessment, and evaluation, and an expert in module development. In addition to expert validation, the instrument's readability was also tested in a class of 35 students. This validation covers two main aspects, namely the

material/content aspect and the media aspect. In the validation of the material content, the assessment is carried out based on five indicators. In the aspect of conformity with the learning indicators, both experts gave a score of 3, indicating that the material is quite appropriate but there is still room for improvement. In the aspect of freedom from conceptual errors,

both gave a perfect score, namely 4, indicating that there are no errors in the presentation of the concept. For the aspect of the currentness or actuality of the material, the scores given were 4 and 3, reflecting that some of the content is up to date, although there are still parts that need updating. In terms of the coverage and depth of the material, both experts gave a score of 3, indicating that the material already covers the core of the discussion but is not optimally deep. Meanwhile, in terms of conformity with the concept of numeracy literacy, the scores given were 4 and 3, indicating that the material sufficiently supports strengthening students' numeracy literacy. Overall, the total score from the first expert's assessment on the material aspect reached 16 out of a maximum of 20, and from the second expert it reached 18 out of a maximum of 20. This shows that even though the material is good, there are still several aspects that can be improved to achieve maximum quality.

Meanwhile, in the media validation aspect, the assessment covers three main aspects: media characteristics, language, and appearance. In the aspect of media characteristics, both experts gave the same score, which is 38 out of the maximum score, which indicates that the media has met the expected characteristics such as being interactive, interesting, and in accordance with student needs. For the language aspect, the first expert gave a score of 20 and the second expert 22, which indicates that the use of language in the media is quite good and easy for students to understand, although there are slight differences in assessments between experts. The media appearance aspect also received a similar assessment, with scores of 22 and 20, reflecting that the media appearance is attractive, proportional, and supports understanding of the content, but there is still potential for improvement. The total score obtained from the first expert's assessment on the media aspect was 81 out of a total of 84, while from the second expert it was 80 out of a total of 84. This high score indicates that the developed learning media is very feasible to use. Thus, based on the overall validation results from both experts, both in terms of material and media, this assessment instrument is declared to meet the criteria of "very good" and is feasible to use and disseminate in the learning process.

Instrument testing on 60 students showed that out of 30 questions, there were 8 questions that fell into the "fairly good" category, namely 1 question from the first indicator, 4 questions from the second indicator, and 3 questions from the third indicator. Questions in this category were deemed not to meet the expected quality criteria, so none of them were used further. With this removal, only questions classified as good to very good were retained, so that the final instrument could be more valid and reliable in measuring students' numeracy literacy skills.

Various articles have discussed the use of website-based assessment instruments in learning. The articles written by (Niasari, 2022) and (Sugiharti, 2022) both use Google Form, which has advantages in ease of access and integration, but its appearance tends to be simple and less interactive. Meanwhile, Kahoot is used in the articles (Salti et al., 2023) and (Jannah & Pahlevi, 2020), which emphasize gamification features, user-friendly design, and time allocation in answering questions, although it has disadvantages such as dependence on internet connection and projection devices. The article (Sayekti & Wasis, 2021) uses a website based on the CodeIgniter framework, which makes it easy to create a website with ready-to-use features, but the results show that there are still students in the low category. (Saomi & Kade, 2021) discusses Quizizz as a game-based educational application that can be accessed for free via the web or smartphone, provides detailed student results reports and can be downloaded in Excel format, and has an attractive appearance. However, Quizizz has weaknesses such as short processing time which can affect student performance, and requires a strong internet connection so that there is no disconnection when working on questions. The article (Amiroh et al., 2020) through the Electronic Assessment Tool emphasizes the advantages in time efficiency and accessibility, although it is still limited in terms of expert assessment and trial coverage. When compared to these platforms, the Formative website offers much more comprehensive and in-depth features. This platform supports real-time assessment, provides a timer for each question, and allows teachers to insert mathematical equations, images, and tables directly into the questions. Not only that, the assessment results can be displayed immediately after students complete the quiz, and

the resulting data can be downloaded in the form of an excel document or converted into a spreadsheet format automatically, making it easier for teachers to analyze and document learning outcomes. The presence of real-time features helps students manage their time better and train their time management skills while taking tests. In addition, this media also allows direct insertion of equations into questions, especially for physics lessons that require precise displays of formulas and symbols. Presentation of questions equipped with these equations makes it easier to understand the context of the questions and supports more complete mastery of concepts. The formative website also supports instant feedback and tracking of student progress over time. With the completeness of these features, the formative website not only functions as an assessment tool, but also as an interactive learning media that encourages active student involvement and teacher work efficiency. Although it still requires a stable internet connection and initial understanding for users, the technical and functional advantages it has make the formative website one of the most superior web-based assessment platforms and worthy of being implemented in 21st century learning. In addition to the advantages that have been mentioned, the Formative website also supports a differentiated learning approach. Educators can compile questions with varying levels of difficulty, provide additional questions for students who complete tasks faster, or insert videos and additional explanations for students who need help. This capability is very important in student-centered learning, where the needs of individual students are the main focus. Thus, the formative website allows educators to provide more personalized and adaptive treatment to the diversity of student abilities in the class. Not only that, the Formative reporting system based on real-time data allows educators to reflect on the formative website on the learning process. Educators can identify which questions are most often answered incorrectly, which students need further intervention, and which competencies have or have not been achieved. This information is very helpful in planning remedial or enrichment quickly and precisely. Compared to traditional assessment methods, the speed and accuracy of this learning

outcome analysis provide significant advantages in making learning decisions. In terms of user experience, the formative website also allows direct integration with other learning platforms such as Google Classroom, Microsoft Teams, and other LMS. This certainly provides additional convenience for educators and students in accessing assessment media centrally, as well as simplifying the digital class management process. Educators do not need to move data manually, and students do not have to open many applications or websites separately. However, the use of formative websites still requires the right implementation strategy, especially in the context of schools with limited ICT infrastructure or internet connectivity. Therefore, training and technical assistance to educators and students needs to be carried out comprehensively so that this platform can be utilized optimally.

CONCLUSION

The development of assessment media using the Formative website on straight motion material was carried out through three main stages: preparation, creation, and completion. The instrument was designed to measure numeracy literacy, integrated into interactive website-based media, and validated by content and media experts. The validation results showed that the media met the good to very good criteria, indicating its feasibility for use in high school physics learning. Future research could also expand the focus of the study to different physics topics, so that students' numeracy literacy profiles can be mapped more comprehensively. Furthermore, further research could examine the factors influencing students' numeracy literacy skills, such as socioeconomic background, teachers' teaching strategies, and learning motivation, to gain a deeper understanding. Additionally, future research could develop interventions in the form of numeracy-based learning models integrated with the use of digital technology. Thus, research would not only focus on mapping initial abilities but also provide concrete solutions to enhance students' numeracy literacy in physics education.

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