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Designing and Evaluating Jotform-Based Instrument for Assessing Students' Multiple Representational Skills

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Abstract

Phenomena in physics are often presented in various forms, such as equations, verbal, graphs, tables, and images, which require multiple representation skills in understanding and describing natural phenomena correctly. Effective development of students' multiple representational skills requires prior assessment of their existing representational abilities. This study aims to develop a JotForm-assisted multiple representation ability assessment instrument for Phase F students on linear Motion material and to examine its design qualitatively. The research uses the 4D model, to produce a prototype that is ready to be tested. Data were obtained through documentation and interviews, including literature review, curriculum analysis, and needs identification. At the design stage, it begins with selecting the question material to be used, preparing a multiple representation assessment instrument, creating a design with JotForm, and compiling guidelines. A qualitative review of the instrument design was conducted by two experts in physics learning and physics learning evaluation and 4 practitioners from SMA 4 Surakarta and SMA 3 Boyolali. The review results showed that the assessment design, which consisted of 15 questions, was suitable for further development.

How to Cite

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INTRODUCTION

Physics is a structured discipline, which means that its study requires a framework that emphasizes character development and soft skills aligned with the competencies needed in the 21st century (Hidayatullah et al., 2021; Kurniawan et al., 2024). Innovation and Problem-solving are important skills that students must have (Samani et al., 2019). This component needs to be improved and instilled so that student learning outcomes are better by learning objectives (Widyastuti et al., 2023). A problem can be addressed once students have comprehended and examined it (Greiff, 2023), in the form of phenomena that are presented again in various forms such as equations, verbal, graphs, tables to images (Dinar et al., 2022). Students are required to have the ability to understand and redescribe phenomena that exist in the universe commonly called multiple representation abilities (Saputra et al., 2024; Putri et al., 2020; Nurhayati & Anita, 2017). The merdeka curriculum provides hope for educational transformation that focuses on character development and competency-based soft skills, as well as empowering students with innovation, problem-solving, and multiple representation abilities to understand complex phenomena of physics and the universe.

Physics concepts are often depicted in multiple representations, or multiple representations (Ate et al., 2025), which refer to scientific activities that depict the same concepts and processes in multiple ways, such as verbally, graphically, and numerically. (Aisyah et al., 2021; Ramadayanty & Risdianto, 2021). The effectiveness of physics pedagogy depends on the integration of multiple representations, which transform mathematical abstractions into coherent, measurable, and accessible conceptual constructs for learners (Rasyid et al., 2025). The use of multiple representations is considered the key to successful mastery of certain scientific concepts (Hasbullah et al., 2019). For example, in the Linear motion material, a lot of data is presented in various forms such as graphs, pictures, diagrams, and mathematical narratives (Fatimah, 2023). Many students have misconceptions about Linear motion, such as the assumption that heavy objects fall faster than light objects in free fall, or that distance and displacement are the same concept (Arifah et al., 2020). In the topic of Linear motion, many forms of data require multiple representation skills to build students' understanding of the concept of linear motion (Ainsworth, 1999). Multiple representation in physics makes it easier for students to understand a concept by presenting information in various formats, thus helping students overcome misconceptions and deepen their understanding of concepts.

The notion of meaningful learning, as experienced by students, is not solely derived from the explanations provided by teachers regarding learning concepts; the role of effective assessment is also a contributing factor (Kostiainen & Johanna, 2025). A good assessment is defined as one that directly examines student performance and can draw valid conclusions about the quality of the performance outcomes (Wiggins, 1990). As posited by (Sambell, 2019), the term "valid assessment" is defined as "evaluation that is relevant to the criteria". The selection of an appropriate assessment design has been demonstrated to be a crucial factor in stimulating meaningful learning behaviours in students (Rawlusyk, 2018). However, there is a problem where educators still struggle to determine appropriate instruments for learning evaluation, particularly for early-stage assessment (Kostiainen & Johanna, 2025).

Initial assessment in learning is a very important activity, it is still rarely carried out (Risan & Shavard, 2025). It allows students to recall what they have learned in the past rather than it being just a routine activity. The problem is that teachers do not have a clear understanding of initial ability assessment. Inadequate training is the main cause of its ineffective implementation in the classroom (Schildkamp et al., 2020). Similar studies have found that initial assessments are considered ineffective because educators lack information and training related to good assessment practices (Noor et al., 2020). The developed instrument measures some representational abilities, but is unable to measure others (Alifah & Istiyono, 2023). This means that the instrument can only identify multiple representational abilities in several forms of representation and may miss more complete forms of representation.

The importance of multiple representation skills in education is still not a priority for schools in Indonesia. Several studies that support this are (i) students at SMPN 12 Pontianak tend to only be able to explain a phenomenon in only 1 form of data (Annisa et al., 2023). (ii) students at SMAN 7 Pontianak in 2014 still had quite low representation skills, as evidenced by the low physical representation skills, which were 15%. (iii) only 32% of students at SMAN 1 Warmare were able to answer correctly and perfectly for questions with multiple representations (Hasbullah et al., 2019). Several of these studies provide information that multiple representation skills in

Indonesia are still quite low.

In the context of educational assessment, the utilisation of a test instrument is imperative for the evaluation of students' initial competencies (Alifah & Istiyono, 2023). The accurate evaluation of students' multiple representation abilities in the classroom can serve as a valuable reference point for educators, informing the design of suitable learning materials aimed at enhancing not only multiple epresentation skills but also other closely related cognitive abilities (Any et al., 2022). It is evident that the utilisation of physics assessment tools is intended to evaluate students' competencies. Multiple representation has been identified as a significant component in efforts to enhance students' competencies in this domain. It is imperative to recognise that the efficacy of learning activities is contingent upon a meticulous evaluation of students' extant multiple representation abilities.

In implementing the merdeka curriculum, teachers must conduct an initial assessment of students' cognitive and non-cognitive abilities. Initial ability assessment is an important part of implementing the [h4.1]merdeka curriculum. This assessment aims to identify the characteristics, competency conditions, strengths, and weaknesses of students' initial abilities (Okta Susilawati et al., 2023). The purpose of the initial assessment is to quickly identify students' abilities so that learning can be adjusted to the diversity of students' abilities and conditions. Teachers can adjust effective learning methods, models, and media to students' abilities in the initial assessment. Teachers can find out which students already understand, somewhat understand, or do not understand the concept being studied.

Teachers can adjust the learning approach to meet the needs of each student. Initial assessments are carried out continuously to integrate student development, progress, and improvement (Aghnina et al., 2023). Initial assessments are used to spread students' strengths and weaknesses and have special terms to explain teacher activities which are the basis for determining actual needs in learning (Munfaridah er al, 2021; Muh A et al, 2022). The initial approach can be used by teachers to identify and determine the difficulties experienced by students in understanding the material (Choiroh, 2021). Initial assessments are carried out at the beginning of learning to help educators understand the conditions, needs, and potential of students. Through this assessment, educators can identify initial abilities, difficulties faced, and potential possessed by students. This information allows educators to design more effective and appropriate learning strategies so that the teaching and learning process becomes more optimal.

Technology is developing rapidly with quite an influence technology is developing rapidly with a significant influence Technology is developing rapidly with a significant influence in the world of education, which is able to overhaul the learning system, especially the use of media in learning (Budiyono, 2020). In practice in the field, educators have not maximized the use of technology products and have not maximized their integration into learning (Hardiyanti & Alwi, 2022). Research by Kuncahyono & Setyawan (2021) states that teachers have not maximized the technology that has been provided and facilitated by schools to facilitate the learning process, especially as an assessment medium. Monotonous assessments cause students to lose motivation. To improve the concept of learning, learning is designed by involving electronic media that are relevant to current technological developments.

The website is one of the right innovations that can be used as an assessment medium because it can be accessed anytime and anywhere as long as it is connected to an internet connection. Jotform is one of the media that can be used as a website-based assessment, so it can be accessed from various media, both PCs, laptops, and smartphones (Sakroni et al., 2023). The use of Jotform as a platform in assessment media is considered beneficial because it allows users to run the program without installation (Pratama & Mansur, 2023). Therefore, to make the assessment process interactive, it is necessary to develop Jotform-assisted assessment media.

The JotForm application is an online platform for creating forms that allow anyone to collect data, store information, and manage donations easily. (Makkulau, 2021). The existence of this Jotform website is expected to make the process of requesting learning process results more effective and efficient, and can reduce errors in receiving data (Ayundasri et al., 2022). The Jotform operating system makes it easy for users to drag and drop to create a form and does not require users to write a single line of code. In using Jotform, users can create and publish forms, integrate them into user sites, and receive responses quickly. Jotform has additional features, such as online payments, integration with various applications and services, and the ability to change the layout and design.

Another advantage in terms of flexible accessibility, allows users to access forms from vari-

ous devices and at any time. Thus, Jotform not only offers convenience in creating forms but also ensures that the forms can be accessed and used easily by respondents (Kusainun, 2020). Jotform can be a popular solution for individuals and organizations in creating efficient and effective online forms. This study developed a multiple representation assessment instrument for high school physics using the Jotform website platform. With interactive and multimedia features, students are actively involved in learning, gain interesting experiences, and deepen their understanding of physics. Flexible online access makes it easy for students and teachers to use, while direct monitoring supports the evaluation of student abilities. Jotform also provides automatic data processing for the analysis of assessment results, which is expected to improve physics learning in high school positively. Based on this explanation, this study aims to describe the design of an initial assessment of multiple representation abilities for phase F students on straight-motion material assisted by the JotForm website. The difference from previous studies is that the initial instrument for multiple representation ability developed is specific to the Linear motion material in Physics learning in Phase F. Initial physics assessment instruments for measuring students' multiple representation abilities have been developed quite a lot, but are still not very popular for use (Danday et al., 2020). Educators still use conventional methods in the assessment process where paper and stationery are the main materials (Iqbal et al., 2022). This is not quite right or appropriate, because it costs a lot and is less effective in the evaluation process (Samsiadi & Humaidi, 2022). Assessment using conventional methods takes longer to process data because it cannot be done in real-time (Winda et al., 2021).

METHOD

The multiple representational prior skills assessment for students developed is part of a development research using the 4D model and a mixed approach. This research resulted in the design of a pre-skills assessment that included a defining stage (Define) and a designing stage (Design) before proceeding to the developing stage (Develop). The steps in this stage include preparation, creation, and completion, as illustrated in Figure 1.

Qualitative data in this study was collected through in-depth interview techniques conducted with two experts in the field of physics learning evaluation and four practitioners in physics learning. The interviews aimed to gain a more comprehensive understanding of the effectiveness of the instruments developed and their relevance in the context of physics learning. Furthermore, the data obtained were analyzed using Miles and Huberman's interactive data analysis procedure, which includes three main stages, namely data reduction, data presentation, and conclusion drawing and verification. This approach allows for systematic identification of patterns, key findings, and data validation to produce more accurate and in-depth conclusions.

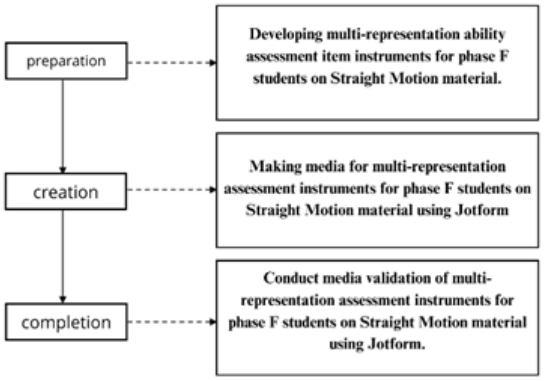

Figure 1. Procedure of making

RESULT AND DISCUSSION

The results of the preparation of a multiple representation assessment instrument (for Phase F students of Linear motion material) assisted by JotForm can be accessed through a URL link or QR code that the teacher will share with students as respondents. students can use android or IOS devices and can access them from various media including PCs, laptops and smartphones. The design display of the multiple representation assessment instrument presented in JotForm is specifically described in the following discussion.

a. Home page

The home page of the assessment media contains the media title, description, and "next" button used to move to the identity page as shown in Figure 2. Point a is used to move directly to the selected page. Point b shows the remaining time to complete the form. Button c is used to go to the next page.

Figure 2. Home page display

b. Identity Page

The identity page display consists of fields that can be filled in with names for point a, point b to be filled in with the participant number, point c filler is asked to select participant's class and date of the student exam and there is a next button to enter the instrument page and a back button to return to cover page can be seen in Figure 3.

Figure 3. Identity page display

c. Tes Page

The problem page display contains assessment questions that must be done by students as many as 15 questions can be seen as in Figure 4.

Figure 4. Tes item page

An example of a multiple representation problem is presented in Figure 5.

An object moves straight with the equation of position as a function of time expressed as follows: $x= 5+10t+t^2$. X is expressed in meters and t in seconds. The (+) sign is agreed as the direction of motion of the object to the right and the (-) sign as the direction to the left. The most appropriate motion diagram to represent the position of the object every second while moving in time $0 \leq t \leq 8$ seconds is ...

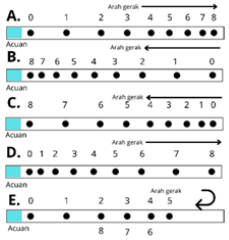

Figure 5. Example of a problem with multiple representations

a. Review Page

The display of the review page contains student identity and questions along with answers that have been answered by students which can be seen in Figure 6.

Figure 6. Review page

On the review page there are two, namely "back to form" which functions to return to the question page and "submit" which functions to submit the form answer as in Figure 7.

Figure 7. Button "back to form" and "submit"

Qualitative Review Results

The design of this multiple representation assessment instrument has been reviewed by experts in the field of evaluation and practitioners of physics learning and teaching. The results of the review can be used as suggestions/inputs for the improvement or revision process before the instrument is tested and disseminated in schools. The components that were reviewed qualitatively were question instruments and media, with the results of the review described as follows. Review of the components of the question instrument

a. Material Aspects

The material on the instrument media is in accordance with the Capaian Pembelajaran (CP) of SMA / MA Physics subjects / C package programs in Phase F Class XI on linear motion material. The selection of Linear motion material presented in the items in the assessment media is essential material in the curriculum currently used in educational units, namely the merdeka curriculum[h6.1]. Experts and practitioners suggest choosing concepts in Linear motion material that can be presented in various forms of single or group data presentation.

b. Measurement Aspects of Multiple representation Ability

The items presented in the assessment instrument can measure students' multiple representation abilities in the components of reading various forms of data, changing the form of data and explaining various forms of data. Not

all components of multiple representation ability are measured and presented on the assessment instrument based on the results of discussions and interviews with experts and practitioners.

c. Problem Construction Aspects

The questions in this assessment instrument are arranged with a challenging level of difficulty, requiring students to apply their knowledge independently. The questions are designed in such a way that students are not given too explicit instructions, but still measure deep conceptual understanding. In addition, the question formulation avoids the use of double negation to minimize the potential for misinterpretation.

Multiple-choice questions are almost identical, equivalent or comparable in length or number of words. This is done to keep students from relying on the length of the answer as the main measure of correctness. In this multiple representation assessment, each question or problem is not directly related to the answer of the previous question. Each question is independent, as the answer to the question does not depend on the information provided from the previous question. In this assessment, pictures in the items can support the question, clarify the context, and help students answer more optimally.

d. Language Aspects

Each question statement uses simple, communicative sentences that are easily understood by students. The sentence structure is presented correctly, clearly, and in accordance with applicable language rules, and cannot be interpreted in different ways (multiple interpretations).

Review of Media Components

a. Media Aspects

The design of the JotForm-assisted multiple representation assessment instrument that has been developed can be accessed easily and the navigation flow is clear. The instructions for using the assessment instrument are arranged to make it easier for students to use. The instructions and functions of each navigation button in the assessment media can be easily understood, with the navigation flow presented in Figure 8. Filling and sending answers in the assessment media can be done easily and simply. The timing of the instrument is made efficient with scroll bars and image zoom controls that can be used properly. The layout of each slide on the assessment media is appropriate.

Figure 8. Navigation flow of the multiple representation assessment instrument

b. Display aspect

The cover or home page of the assessment instrument is quite attractive. The background presented uses a background that is quite attractive with a blue and orange background. Screen display, images and text in the assessment instrument have good quality. The writing in the assessment media can be read well.

c. Language aspects

The use of language in the assessment instrument is in accordance with the General Guidelines for Indonesian Spelling. The sentences used have used sentences that are simple, clear, and can be easily understood by students, and do not contain double meanings (ambiguous). The use of terms in this assessment instrument is correct and consistent in describing concepts or the like.

Discussion

Qualitative review of multiple representation assessment instruments for Phase F Class XI students on Linear motion material assisted by JotForm includes aspects of questions and media. The review of the instrument on the material aspect includes a review of the Physics Learning Outcomes of Phase F Class XI on linear motion material which is considered essential. The multiple representation ability to be measured in the material aspect consists of problems related to the components of reading, converting,

and explaining various forms of data. In the construction aspect, the review is carried out by scrutinizing the design of the questions based on a challenging level of difficulty, avoiding the use of too explicit instructions and double negation, and maintaining the equality of multiplechoice lengths so that students do not rely on the length of the answer to determine the truth. Each question stands on its own and comes with a picture that helps clarify the context without requiring information from other questions. The language used in the questions is simple, easy to understand, and in accordance with grammatical standards, avoiding multiple interpretations that can confuse students.

Meanwhile, the media validation assessed that the assessment instrument was easy to access and operate, with clear instructions and efficient navigation, such as well-functioning scroll and zoom controls. The layout of the media is structured and attractive, with quality images that support students' understanding. The overall appearance of the media uses an attractive background, and the language used follows the General Indonesian Spelling Guidelines, is simple, clear, and consistent in the use of terms.

This instrument has various advantages, such as the flexibility of access that allows students to use PC, laptop, or smartphone devices without requiring a JotForm account. In addition, users can easily access it through a URL link, and the interface is designed to be user-friendly. The included timer and timer settings help prevent cheating, increase efficiency, and support the validity of the assessment process. It also provides a variety of question types, providing flexibility in question design, and output that can be exported to Excel, making it easier for teachers to process grades.

However, it also has some drawbacks. The instrument requires an internet connection, which may be an obstacle for some users. The features on the free account are limited, so users must upgrade to a premium account to utilize additional features. In addition, there are no markers to indicate which questions have been completed or not, and it cannot send automatic answers when time runs out if the questions are mandatory.

Multiple representation assessment has also been developed in previous studies, one of which is a multiple representation assessment on thermodynamic material. The study (Toni Adi Saputra, 2024) used indicators of students' ability to convert one form of representation to another, for example from verbal representations to graphs or tables, to effectively measure the concept of multiple representations. This research provides problems that require students to convert between representations, thus honing their overall understanding of physics concepts.

Research related to JotForm has been conducted in the world of education where the study (Leksana, 2017) In the study, JotForm was utilized as a data storage system (database) in E-learning-based learning during the Covid-19 pandemic. The platform helps manage data more efficiently, supports the distance learning process, and ensures smooth academic interaction even in physically limited situations. This research shows the potential of JotForm as a flexible and effective tool to support various educational needs, both in multiple representation evaluation and learning data management.

Based on the previous research that has been described, this research presents an update in the development of the concept of multiple representations. The indicators used are more comprehensive, including the ability to read various forms of data, convert data to other formats, and explain the data effectively. This innovation is applied with the help of the JotForm platform, which plays a role in facilitating the creation and processing of questions efficiently, thus supporting a more flexible and structured evaluation.

CONCLUSION

The conclusion describes the answer to the hypothesis and/or research objectives or scientific findings obtained. The conclusion does not contain a repetition of the results and discussion, but rather a summary of the findings as expected in the objectives or hypotheses. If necessary, at the end of the conclusion, things that will be done related to further ideas from the research can also be written. The conclusion is written in a complete paragraph, not point by point. Based on the discussion that has been described, it can be concluded that the JotForm-assisted multiple representation assessment media for Phase F Grade XI students on linear motion material in the material components is in accordance with the Physics Learning Outcomes in the merdrka, can measure multiple representation abilities effectively, and has been compiled with a construction that supports student understanding without overly explicit instructions. The language used is simple and free from ambiguity. The results of a qualitative review of the assessment instrument design show that the instrument is easy to access and operate with efficient navigation and an attractive appearance. Its advantages include

flexible access, time setting features, and output that makes it easier to process values. The obstacles faced are dependence on internet connections and limited features on free accounts.

As a suggestion, Physics teachers are advised to use this JotForm assisted multiple representation assessment instrument as an evaluation tool that enriches students' learning experiences, considering the validity of the questions that are in accordance with the achievements of the merdeka curriculum [h7.1]and the media's ability to measure various forms of data representation. In addition, schools are expected to provide technical support, such as providing stable internet access, so that this media can be used without obstacles, especially in areas with inadequate networks. For further developers or researchers, it is recommended to continue to improve this instrument, for example by adding a feature to mark questions that have been filled in, questions that have not been filled in and questions that are still considered doubtful. This can increase student comfort in working on questions and ensure the efficiency of the assessment process.

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