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Validity Analysis of Guided Inquiry-based E-Module for Learning Hydrostatic Pressure

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Abstract: This study aims to analyze the level of validity of the guided inquiry-based e-module on the material of liquid pressure as a teaching material that supports the active involvement of students in the learning process. The research method used is the research and development method (R&D) with a development model that refers to the 4D model (Define, Design, Develop, and Disseminate), limited to the development stage. The validity assessment instrument is ini the form of a validation sheet filled out by four experts, consisting of material experts, media experts, and learning experts. The aspects assessed include the appropriateness of the content, language, presentation and graphics. The validation results show that the developed e-module obtained an average score of 91% from media experts, 89% from material experts, 94% from language experts, and 92% from learning experts. Based on the research results of media experts material experts, and learning experts, it can be concluded that the guided inquiry-based e-module with an average rating of 92% is in the "very valid" category, making it suitable for use as a teaching material in science learning, especially on the topic of liquid pressure. These findings indicate that the guided inquiry-based e-module can be an innovative in improving the quality of science learning in junior high schools.

Keywords: e-module; Guided inquiry; Hydrostatic pressure.

Introduction

Science education serves as a fundamental bridge that enables students to understand both of themselves and their environment while applying scientific concepts to daily life. This discipline plays a crucial role in developing essential 21st century competencies, particularly: critical thinking, creativity, collaboration, and communication skills (Syukrimansyah et al., 2017) in response to 21st century challenges, the Indonesian government has introduced the *Merdeka* Curriculum as a transformative educational initiative. This curriculum represents a strategic innovation designed to revitalize and enhance the nation's educational quality through progressive reforms (Kemendikbudristek, 2022). The *Merdeka* Curriculum introduces an innovative learning paradigm centered on competency development and character building, with students positioned as the focal point of all educational activities. This progressive approach represents a significant transformation in Indonesia's educational framework (Suriyadi, 2019; Redhana, 2019). The Merdeka Curriculum's student-oriented approach fosters a dynamic learning environment through diverse instructional models. This mandated methodology enables varied pedagogical implementations that cater to different learning needs and preferences (Sufyadi et al., 2021), such as guided inquiry model (Sanjaya, 2014).

An interview conducted at an Islamic middle school in Bojonegoro revealed a significant need for technology-integrated learning resources among both teachers and students. Currently, educators face challenges in developing effective instructional materials, primarily relying on conventional textbooks

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and YouTube content, which have yielded unsatisfactory learning outcomes.

These findings highlight the necessity for implementing guided inquiry learning models, particularly for experimental topics like hydrostatic pressure. The inquiry-based approach effectively cultivates students' abilities to investigate and analyze information systematically while developing critical, logical, and analytical thinking skills (Sudrajat, 2015).

The analysis of questionnaire data revealed the need to develop a guided inquiry-based e-module tailored to students' learning requirements. This module should enhance student focus during learning activities, and facilitate independent learning by enabling students to effectively utilize information from diverse sources. (Astuti & Setiawan, 2013).

One significant challenge in science education is the suboptimal learning process, where students often remain passive, leading to difficulties in conceptual understanding. The guided inquiry method addresses this issue by actively engaging learners in the educational process. In this approach teachers provide initial information and strategic direction for problem-solving. Students develop their own solution strategies while receiving guidance on procedural planning. Educators maintain an active supervisory role as students design their methodologies (Sanjaya, 2014).

The guided inquiry can provide opportunities for students to carry out a scientific process with the guidance of teachers. It can help students become more independent in their learning process. According to (Thursinawati, 2012), guided inquiry involves scientific steps, aiming to form the character of students as a scientist. The stages in the guided inquiry are presenting questions or problems, making hypotheses, designing experiments, conducting experiments, analyzing data, and making conclusions (Trianto, 2007).

Learning media integrated with Information and Communication Technology (ICT) are classified as electronic learning media. These digital resources can take various forms, including electronic modules (e-modules). Specifically designed to deliver instructional content, e-modules effectively stimulate students' cognitive and affective development while enhancing their learning interest and motivation (Vina Serevina, Sunaryo, Raihanati, I Made Astra, 2018). E-modules serve as valuable instructional tools that facilitate teaching and learning processes, particularly in asynchronous digital learning environments. These digital resources effectively support indirect instruction by enabling flexible, technology-mediated education independent of real-time interaction. According to (Irdawati et al., 2023), e-modules can improve learning outcomes. E-modules assist teachers in providing guidance to students. (Diantari, 2018), stated that the e-module as a digital learning tool allows students to learn independently.

This study aimed to develop a guided inquiry-based e-module that meets three key criteria: validity, practicality, and effectiveness. The e-module was created using Canva, an innovative online platform that facilitates the development of digital learning media. (Suryani & Listia Apriliyanti, 2023) This Canva-based e-module can be used by teachers to support the learning process and increase students' interest.

Method

This study was conducted at an Islamic middle school in Bojonegoro, employing a research and development (R&D) approach based on the Four-D model. The Four-D model comprises four sequential stages: define, design, develop, and disseminate, providing a systematic framework for the development and implementation of educational interventions (Thiagarajan. 1974).

Define: The process comprises five key analytical components: front-end analysis, learner analysis, concept analysis, task analysis, and learning objective analysis. This systematic stage serves to identify and establish the essential learning conditions required to achieve the specified Learning Objectives (LO).

Design: The guided inquiry-based e-module was developed according to the established topic and learning objectives identified during the Define stage. Its design incorporates both the guided inquiry learning syntax and standard module components to ensure pedagogical effectiveness (Hadiansah, 2022).

Develop: The study established product validity through expert judgment across four domains: (1) learning media specialists, (2) subject matter experts, (3) linguists, and (4) practicing educators. Following validator recommendations, the e-module underwent revisions prior to implementation. Readability assessment was conducted with both science teachers and students. All validation data were analyzed using Aiken's V coefficient (Aiken, 1985) to determine statistical validity (Table 2), by calculating the content-validity coefficient based on the assessment of experts. The validity and readability test assessment questionnaire used are compiled based on the Likert scale as shown in Table 1.

Table 1. Questionnaire Assessment Criteria

Criteria	Scores
Strongly Agree (SA)	4
Agree (AA)	3
Disagree (DA)	2
Strongly Disagree (SDA)	1

From: (Azwar, 2023)

Table 2. Experts'Assessment Percentage Criteria

V Values	Validity
V < 0.40	Invalid
0.41 ≤ V < 0.60	Moderate
0.61 ≤ V < 0.80	Valid
V ≥ 0.81	Strong

From : (Aiken, 1985)

The data from the validity and readability tests were analyzed using Aiken's V validity index (V):

$$V = \frac{s}{[n^*(c-1)]} \quad (1)$$

Notation:

$S = \sum n_i \ (r - l_o)$

V = Aiken Validity Index

n = numbers of *raters.*

c = numbers of *criteria.*

n_1 = numbers of *raters* who selected criteria i.

r = the i criterion.

l_o = lowest criterion.

Results and Discussion

Natural Sciences is a collection of knowledge obtained through a systematic data collection process, which involves experiments, observations, and drawing conclusions (deductions), in order to produce a reliable explanation of a natural phenomenon (Lepiyanto, 2017). The guided inquiry learning activities includes various scientific process skills (SPS), including observing, hypothesis formulation, identifying variables, using tools and materials, grouping data, analyzing data and communicating, and drawing conclusions. The main emphasis lies in the systematic development and application of science process skills (Rustaman, 2005).

1. Define

Front-end analysis

According to (Rustaman, 2005), observation is important for curiosity or encouragement to gain a deeper understanding of an object or phenomenon. Front-end analysis was conducted to identify problems students face in science learning. The data were gathered through teacher interviews, which revealed several key issues:

1. **Lack of in-depth conceptual understanding and process skills implementation**, leading to low student achievement.
2. **Insufficient hydrostatic pressure learning materials** in textbooks, hindering optimal learning.
3. **Non-interactive learning experiences** due to the abstract nature of hydrostatic pressure, which students find overly reliant on memorization and difficult to comprehend.
4. **Guided inquiry-based methods**, though included in lesson plans, have not yet been effectively implemented in teaching.
5. **Limited engagement**, with 46.9% of students finding the lessons uninteresting due to the overreliance on PowerPoint as the sole instructional media.

According to (Kusuma, 2018), The determination of learning media is important. The right media allows for effective visualization and contextualization.

Learner Analysis

Student analysis was conducted to identify and understand their characteristics in the learning process. The findings revealed that the guided inquiry learning model can be integrated into the e-module to help students independently discover concepts. Additionally, students showed a strong preference for teaching materials enhanced with visual and audiovisual elements, such as animations, images, videos, and audio—especially when presented in an engaging and attractive format. According to (Laili et al., 2019), the use of multimedia is superior in instilling concepts.

Concept Analysis

Concept analysis was conducted by evaluating the e-module containing teaching materials on hydrostatic pressure used by students. This analysis aims to identify and define the foundational concepts guiding product development, ensuring alignment with the established learning outcomes (Sutia, 2022).

Task Analysis

The concept analysis was performed through evaluation of an e-module containing hydrostatic pressure teaching materials used by students. This analysis serves to identify and define the core concepts that form the foundation for product development, ensuring alignment with established learning outcomes. (Pendidikan & Teknologi, 2022).

Formulation of learning objectives

Based on the analysis of selected learning outcomes aligned with Madrasah students' characteristics, the learning objectives for the instructional process were formulated.

2. Design

During the planning stage, the learning process can be optimized when supported by teaching materials that foster student independence. Teachers bear the responsibility of developing these materials, as they not only facilitate instructional delivery but also enhance students' comprehension of the subject matter. E-

modules serve as one such effective teaching resource. These systematically designed digital materials enable students to learn either with teacher guidance or independently, effectively supplementing or even substituting the teacher's role in the learning process when appropriate (Sari et al., 2018).

The E-Module Presentation Based on Guided Inquiry

The e-module development follows these structural components: Cover Page, Title Page (French), Foreword, Table of Contents, List of Figures, and Glossary (Gunadharma, 2011).

The design of the e-module is seen as follows:

Figure. 1 Cover

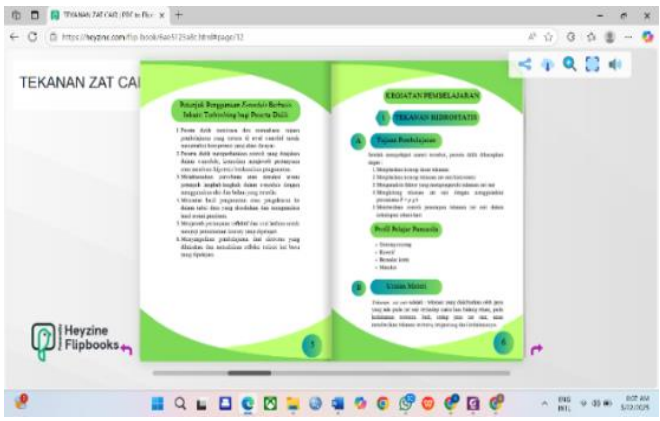

Figure 2. Initial Learning Activities

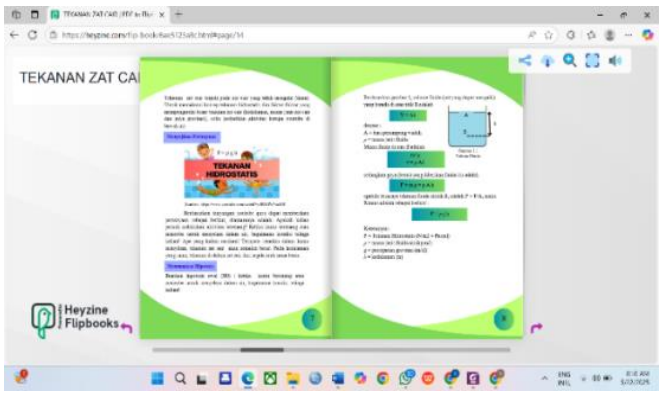

Figure 3. Presenting material from YouTube

Figure 4. Example questions and discussions

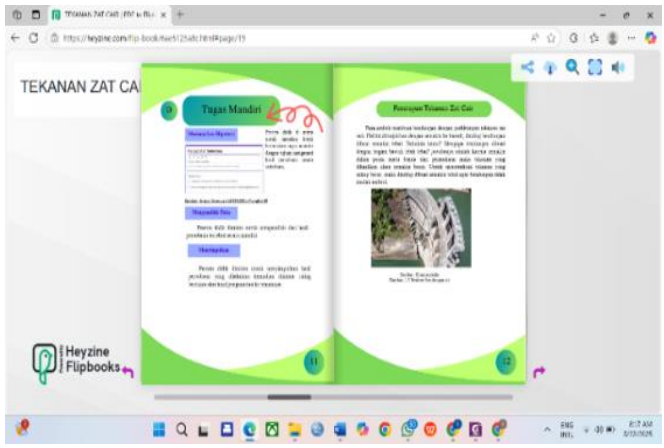

Figure 5. Independent assignment activity

3. Develop

Validation

The validation test serves to evaluate product designs and teaching materials through expert assessment. The guided inquiry-based e-module on hydrostatic pressure was evaluated by a panel of seven experts, comprising three university lecturers and four secondary school science teachers. Validity was assessed using Aiken's V index, with quantitative results presented in tables 3–6.

The media expert validated: Content quality; content accuracy; Evaluation methods; Overall presentation organization; Activity design; Student engagement elements; Visual presentation; Readability; and Compliance with ethical codes and copyright regulations (Sugiono, 2013). The validation by media experts (Table 3) demonstrated that the developed e-module meets validity criteria across all assessed components, with an overall average score of 0.91 (90%). These results indicate that the e-module development achieves a "very good" classification. (Arikunto, 2019).

Table 3. Results of validation by learning media expert

Aspects	V	Category
Content Quality	0.91	Very Good
Content Accuracy	0.88	Very Good
Evaluation Method	0.93	Very Good
Organization	0.86	Very Good
Presentation	0.86	Very Good
Student Engagement	0.95	Very Good
Layout	0.95	Very Good
Readability	0.90	Very Good
Ethics and Copyright	0.95	Very Good

Validation by the subject matter expert (Table 4) revealed an average score of 0.92 (92%), demonstrating that the developed e-module meets the criteria for "very good" instructional materials.

Table 4. Results of validation by subject matter expert

Aspects	V	Categories
Completeness	0.94	Very Good
Accuracy	0.87	Very Good
Updates	0.83	Very Good
Science Process Skill	0.90	Very Good
Systematic	0.92	Very Good

Validation by the linguistic expert (Table 5) achieved an average score of 0.94 (94%). It indicates that the e-module development qualifies as "very good" in terms of language quality.

Table 5. Results of validation by linguistic expert

Aspects	V	Categories
Layout	0.89	Very Good
Language usage	0.97	Very Good
Conciseness	0.97	Very Good

Validation by practitioner (Table 6) yielded an average score of 0.92 (92%), confirming the e-module's classification as "very good." The guided inquiry-based science e-module on hydrostatic pressure demonstrated excellent performance in initial testing. Student feedback collected via questionnaire provided valuable input for revisions. All student comments and suggestions from the preliminary testing were carefully considered and incorporated into Draft II improvements.

Table 6. Results of validation by practitioner

Aspect	V	Category
Formatting	0.94	Very Good
Content	0.93	Very Good
Learning Strategy	0.85	Very Good
Students' Worksheet	0.96	Very Good
Language and Typography	0.96	Very Good

Conclusion

The guided inquiry-based e-module for learning hydrostatic pressure has been validated as appropriate for instructional use. Validation by media experts, subject matter specialists, linguists, and practitioner yielded an average rating of 0.92, classifying the product in the "very good" category. This study was limited due to restricted implementation timeline, and suboptimal operationalization of some components. Future research should conduct practicality testing to evaluate classroom implementation, find out the effectiveness to measure learning outcomes, and extend trial periods to assess longitudinal impacts.

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Author Contributions

All authors actively contributed to every stage of this research, from problem formulation and data collection and analysis to writing and editing the manuscript. The first author was primarily responsible for the research design and writing the initial draft of the article. The second and third authors contributed to instrument validation, data analysis, and refinement of the final manuscript. All authors have read and approved the final version of the article submitted to the JPPIPA.

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Conflicts of Interest

The authors declare that there is no conflict of interest in conducting or reporting this research.

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