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# Developing a Genially-Based Physics E-Module Using the ADDIE Model: Boosting High School Student's Learning Outcomes on Static Fluids

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***Abstract***. Physics concepts are often perceived as abstract and difficult, highlighting the urgent need for interactive digital learning media that align with 21st-century educational demands. This study aims to develop a Genially-based physics e-module on static fluid material for high school Phase F, validate its quality, and evaluate its effectiveness in classroom learning. This research and development (R&D) study applied the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model. The subjects involved 117 eleventh-grade students from SMA Batik 2 Surakarta, selected using a cluster random sampling technique. Data were collected through validation questionnaires and a pretest-posttest design to measure learning outcomes. The results showed that the developed e-module achieved high validity, with scores of 90/100 from expert lecturers and 96/100 from physics teachers, complemented by "Very Good" ratings across one-on-one, small-scale, and field trials. Furthermore, the e-module was proven highly effective, as evidenced by a significant increase in students' average scores from 43.75 on the pretest to 81.25 on the posttest, yielding a high-category N-gain score of 0.89. In conclusion, the Genially-based physics e-module serves as a valid and highly effective digital learning resource that substantially enhances students' conceptual understanding and supports independent learning in physics education.

**Keywords:** Effectiveness; Genially; Learning E-Module; Static Fluids



## INTRODUCTION

Education is essentially a dynamic process aimed at transforming human potential and sharpening students' insights through targeted learning experiences (Ramayulis, 2015). In the modern era, this educational process involves the collaboration of various groups to create a supportive learning environment that helps students become more thoughtful and responsible in their actions (Ummah, 2021). However, achieving these ideal educational goals in physics learning presents significant challenges, as students often struggle to comprehend complex and abstract natural phenomena. To bridge this gap, contemporary education requires a paradigm shift toward digital learning innovations. Integrating interactive multimedia into the classroom is no longer just an option, but an essential strategy to help students visualize abstract concepts, thereby fostering deeper engagement and better conceptual understanding in physics education.

The rapid advancement of science and technology has fundamentally transformed educational paradigms across various disciplines. In the context of 21st-century education, teaching is no longer merely about imparting knowledge; it is about equipping students with essential skills such as critical thinking, communication, collaboration, and creativity (Trilling & Fadel, 2009). To achieve these competencies in physics education, the integration of Information and Communication Technology (ICT) has become imperative. Digital learning tools and interactive technologies play a crucial role in physics by providing visual representations of abstract physical phenomena that are otherwise difficult to observe in traditional classrooms. Consequently, the strategic use of digital media and interactive platforms does not only make learning more effective but also significantly strengthens students' conceptual understanding of complex physics principles, bridging the gap between theoretical formulas and real-world applications.

The implementation of modern education in Indonesia dynamic forces continuous curriculum adaptations to meet 21st-century demands. Currently, the Indonesian education system has transitioned to the Merdeka Curriculum, which strongly emphasizes developing student competencies like critical thinking, creativity, collaboration, and communication through digital integration (Suryani et al., 2023; Haidar, 2024). In line with Law Number 20 of 2003, which defines a curriculum as a structural guideline to achieve specific educational goals (Latifah et al., 2020), the Merdeka Curriculum provides teachers with the autonomy to innovate using information technology. This policy encourages a shift from conventional teacher-centered methods to technology-driven environments. Consequently, utilizing interactive learning media becomes highly critical under this curriculum framework, as it serves as a policy-backed solution to foster independent learning, engage digital-native students, and ensure that physics classrooms align with national educational standards.

In the context of high school physics education, the utilization of digital media is highly critical, particularly for abstract and conceptual topics such as static fluid mechanics. This domain encompasses complex concepts including hydrostatic pressure, Pascals law, Archimedes principle, buoyancy, and the operational mechanisms of fluid based technologies. Diagnostic data from Aziza (2015) underscores specific student learning hurdles across various physics subtopics, indicating difficulty rates of 26 percent in Temperature and Heat, 25 percent in Optics, 21 percent in Static Fluids, 17 percent in Elasticity and Hookes Law, and 11 percent in Kinematics. Furthermore, subsequent research indicates that more than 60 percent of students consistently fail to grasp static fluid principles due to a severe lack of dynamic visualization and ineffective conventional teaching methods (Astuti, 2021). The abstract nature of these physical concepts poses significant cognitive barriers, making poor conceptual understanding a major challenge in this discipline (Rizkita & Mufit, 2022). Recent diagnostic studies reveal that students face profound misconceptions specifically within static fluid mechanics. Concepts such as hydrostatic pressure, Pascal’s law, and Archimedes' principle often trigger severe learning difficulties because students struggle to visualize invisible force distributions and fluid behaviors.

To address these localized pedagogical barriers, traditional textbook approaches, static digital worksheets, or standard slideshows are no longer sufficient because those media remain linear and fail to simulate continuous fluid displacements. New innovations are urgently needed through the deployment of interactive multimedia platforms that offer distinct pedagogical advantages over conventional e module tools. The Genially platform serves as an ideal solution by enabling seamless integration of interactive infographics, dynamic animations, embedded video simulations, and adaptive gamified quizzes within a single interface. While conventional digital platforms like standard PDFs or Canva presentations often limit student engagement to passive scrolling, Genially provides superior pedagogical benefits through its deeply non linear architecture, multi layered interactive layers, and pop up definitions. This active multimedia scaffolding allows students to manipulate variables such as depth and fluid density and instantly observe the physical consequences, thereby transforming the learning experience into a highly interactive environment that stimulates critical thinking and refines students independent problem solving skills (Lestari & Parmiti, 2020; Utami, 2023; Yuliati et al., 2020).

This study addresses the identified gap by developing an interactive cloud based multimedia solution that transforms abstract physics concepts into dynamic observable representations. By leveraging the advanced features of the Genially platform, this approach bridges the pedagogical limitations of conventional digital textbooks and provides high school students with an immersive learning environment. Based on the background described above, the objectives of this study are to explain the results of the development of Genially based physics e modules on static fluid material for high school phase F, explain the results of e module product validation, and explain the feasibility of e module products in terms of their effectiveness.

## METHOD

This study developed a Genially based physics learning e module on static fluid material using the Research and Development (R&D) method, with the ADDIE (Analysis Design Development Implementation Evaluation) model developed by Robert Maribe Branch. According to Branch, the ADDIE model is a systematic learning design model that emphasizes needs analysis, design, product development, implementation, and evaluation to produce effective learning products that are tailored to the characteristics of learners. Development research itself is an effort to develop effective products for use in schools and not to test theories (Sa'adah & Wahyu, 2022). Therefore, this study aims to produce a physics learning e module that is ready for use in the classroom learning process.

To ensure methodological transparency and research rigor, the five phases of the ADDIE model were executed systematically at SMA Batik 2 Surakarta. First, the Analysis phase involved a diagnostic needs analysis targeting physics teachers and grade XI students via paper based questionnaires, investigating learning hurdles and curriculum requirements for high school phase F. Second, the Design phase focused on drafting the e module blueprint, structuring interactive learning activities based on the 5M scientific approach consisting of observing, questioning, gathering information, analyzing information, and communicating within the student worksheets. Third, the Development phase transformed the blueprint into a functional digital prototype on the Genially platform. The product was subsequently subjected to expert appraisal by expert lecturers and physics teachers using closed validation instruments based on structured score ranges to evaluate content accuracy, instructional design, and media language. Fourth, the Implementation phase was conducted using a cluster random sampling technique, selecting three homogenous classes consisting of XI 1, XI 2, and XI 3 with a total of 117 students as potential users. The instructional procedure allowed students to independently access the cloud based e module via smartphones or laptops using web links and QR codes. Fifth, the Evaluation phase measured pedagogical outcomes using a pretest and posttest design to test the e module effectiveness. The evaluation instruments consisted of validated physics test items targeting conceptual understanding on static fluids, which were analyzed using the quantitative N gain score.

The final product of this research is a physics learning e module developed through the Genially website specifically discussing static fluid material for senior high school phase F students, which has undergone a process of validation, testing, and implementation in the classroom. It is hoped that this e module can help students in learning physics, especially static fluid material. Based on the background described above, the objectives of this study are to explain the results of the development of Genially based physics e modules on static fluid material for high school phase F, explain the results of e module product validation, and explain the feasibility of e module products in terms of their effectiveness.

## RESULT AND DISCUSSION

The research subjects were teachers and students of class XI at SMA Batik 2 Surakarta, with the population being all class XI students, who were considered homogeneous. The sampling technique used was random cluster sampling, resulting in a research sample of 3 classes: XI-1, XI-2, and XI-3. In this study, there were several types of research data, as described below:

a. Pre-research Data

The pre-research data used was a needs analysis aimed at teachers and students, in the form of qualitative data obtained from interviews with physics teachers and quantitative data from questionnaires distributed to 11th grade students at Batik 2 Surakarta High School. This analysis aimed to identify learning problems at the school, the learning module needs of teachers and students, the regulations and facilities available at the school, and the aspects that needed to be developed in the e module.

b. Research Data

The data used in this research is divided into two categories: data to determine the validity of the developed product and data to determine the effectiveness of the e-module product, which can be described as follows:

1) E-Module Validation

The e module learning assessment uses a closed questionnaire consisting of several questions with predetermined answer options (Priadana and Sunarsi, 2021). After the e module product is completed, it will be validated by two validators, comprising one expert lecturer as the primary subject matter specialist and one physics teacher from SMA Batik 2 Surakarta as the field reviewer.

The validation instrument utilizes structured questionnaires designed to evaluate specific operational validation indicators across three core dimensions: material sustainability (encompassing material suitability, conceptual accuracy, and completeness of content), media design (evaluating e module design visualization, image and video quality, and overall presentation functionality), and instructional language (assessing compliance with EYD, terminology accuracy, and sentence structural writing). In addition to the quantitative scores, the validation process integrated qualitative feedback in the form of constructive revision notes and pedagogical suggestions provided by both validators to structurally refine the e module prototype before executing subsequent student trials. The assessment criteria results can be seen in Table 1.

**Table 1.** Validation Assessment Criteria

| Score Interval | Criteria |
|---|---|
| $81.25 < X$ | Very Good |
| $68.75 < X \leq 81.25$ | Good |
| $56.25 < X \leq 68.75$ | Fair |
| $43.75 < X \leq 56.25$ | Poor |
| $X \leq 43 .75$ | Very Poor |

After the product has been validated by expert lecturers and physics teachers, the e module product will then be tested by students as prospective users in stages, starting from one on one testing, small scale testing, and field testing. During the testing phase, quantitative data will be generated from students' answers on the assessment questionnaire covering the aspects of material, media, and language. The criteria for the test results can be seen in Table 2.

**Table 2.** Test Evaluation Criteria

| Score Interval | Criteria |
|---|---|
| 35.75 < X | Very Good |
| 30.25 < X≤ 35.75 | Good |
| 24.75 < X≤ 30.25 | Fair |
| 19.25 < X≤ 24.75 | Poor |
| X ≤ 19,25 | Very Poor |

2) Effectiveness of E-Modules

Products that have undergone validation and testing will then be implemented for learning to determine their effectiveness. This stage uses quantitative data in the form of student answers on the pretest and posttest.

c. Research Supporting Data

During the research stage, supporting data was needed in the form of test instruments to be used for pre-tests and post-tests, which had been validated and tested on students who had learned about static fluids, to determine the suitability of the questions used, considering the validity, reliability, discriminating power, and level of difficulty of the questions. The results of the research that has been conducted can be described as follows:

1) Pre-research Data Results

The pre-research stage was the first step, namely analysis, which aimed to identify problems in the learning process, the needs of students and teachers in learning, formulate learning objectives, review the material to be taught, and determine the components that needed to be developed. The analysis stage was carried out by distributing a needs analysis questionnaire to physics teachers and grade XI students at Batik 2 High School in Surakarta.

Based on the results of the needs analysis with teachers at SMA Batik 2 Surakarta, during physics learning activities in the classroom, there was a lack of enthusiasm from students when learning using printed books. In addition, teachers also needed the development of learning media to support the teaching and learning process in the classroom. With supporting facilities and infrastructure, e-modules could be a solution to the obstacles faced, taking into account the content and ease of access for students and teachers. The needs analysis with teachers at SMA Batik 2 Surakarta was conducted using paper-based methods.

Furthermore, the analysis related to student needs also showed that there is a need for the development of learning media, namely 90.6% of students felt that they would be helped if there were interesting and easy-to-understand e-modules as learning resources, and 70.9% of students felt that there was a need for changes and developments in learning media as suggestions for learning activities in the classroom. In addition, 94.0% of students were interested in using modern e-modules that keep up with developments in science and technology. To present these baseline diagnostic findings with optimal clarity, the qualitative and quantitative data from this needs analysis stage are systematically summarized in Table 3.

**Table 3.** Summary of Pre-research Needs Analysis Results

| Stakeholder | Data Type | Assessment Focus | Key Findings and Metrics |
|---|---|---|---|
| Physics Teachers | Qualitative (Interviews) | Classroom engagement and teaching materials | Low student enthusiasm during instructional activities when utilizing conventional printed textbooks; urgent requirement for interactive learning media to support classroom teaching backed by available school infrastructure. |

| | | | |
|---|---|---|---|
| Grade XI Students | Quantitative (Questionnaires) | Perceived utility of physics e modules | 90.6% of students stated that they would be significantly assisted by the availability of interesting and easy to understand e modules as alternative learning resources. |
| Grade XI Students | Quantitative (Questionnaires) | Necessity of media development | 70.9% of students explicitly expressed a critical need for structural changes and modern developments in classroom learning media. |
| Grade XI Students | Quantitative (Questionnaires) | Technological interest | 94.0% of students demonstrated high interest in utilizing modern electronic modules that align with rapid advancements in science and technology. |

d. Research Data Results

1) E-Module Product Validation

The validation assessment was conducted by the supervising lecturer as an expert and a physics teacher from Batik 2 Surakarta High School as a reviewer. The validation was carried out by reviewing three aspects, namely material, media, and language. The following is a description of the validation results from both validators:

a) Expert Lecturer Validation

The expert lecturer validation score was 90 out of a maximum score of 100. The final score of 90 was calculated through a quantitative percentage transformation, dividing the total empirical score obtained across all indicators by the cumulative maximum score of the instrument and multiplying by 100. Specifically, the expert lecturer awarded a cumulative score of 90 out of a total maximum score of 100, yielding an exact final value of 90. Based on the assessment criteria, the learning media product can be categorized as very good, with the comprehensive detailed breakdown, percentage calculations, and indicator level interpretations shown in Table 4.

**Table 4.** Expert Lecturer Validation Results

| No | Aspect | Criteria | Score |
|---|---|---|---|
| 1 | Material | Material Suitability | 11 |
| | | Concept Accuracy | 14 |
| | | Completeness of Content | 11 |
| 2 | Media | E-Module Design Visualization | 14 |
| | | Image and Video Quality | 8 |
| | | E-Module Presentation | 14 |
| 3 | Language | Compliance with EYD | 4 |
| | | Terminology Accuracy | 7 |
| | | Sentence Writing | 7 |
| | Total average score | | 90 |
| | Category | Excellent | |

b) Physics Teacher Validation

The validation score from the physics teacher was 96 out of a maximum score of 100. Similar to the previous expert assessment, the final score of 96 was calculated through a quantitative percentage transformation, dividing the total empirical score obtained across all indicators by the cumulative maximum score of 100 and multiplying by 100. Specifically, the physics teacher awarded a cumulative score of 96 out of a total maximum score of 100, yielding an exact final percentage value of 96.00 percent. Based on the assessment criteria, the learning media product can be categorized as very good, with the comprehensive detailed breakdown, percentage calculations, and indicator level interpretations shown in Table 5.

**Table 5.** Teacher Validation Results

| No | Aspect | Criteria | Score |
|---|---|---|---|
| 1 | Material | Material Suitability | 12 |
| | | Concept Accuracy | 14 |
| | | Completeness of Content | 12 |
| 2 | Media | E-Module Design Visualization | 16 |
| | | Image and Video Quality | 8 |
| | | E-Module Presentation | 16 |
| 3 | Language | Compliance with EYD | 4 |
| | | Terminology Accuracy | 7 |
| | | Sentence Writing | 7 |
| | Total average score | | 96 |
| | Category | Excellent | |

There is a notable difference between the validation score obtained from the expert lecturer (90) and the physics teacher (96). The higher score from teachers indicates strong practical usability. While the expert lecturer heavily scrutinized the theoretical framework, rigorous content depth, and structured instructional design, the school practitioner focused more on the direct applicability of the e module in real classroom scenarios. The physics teacher observed that the interactive features on the Genially platform, the accessible integration via QR codes, and the simplified 5M scientific workflows are highly aligned with the current curriculum field demands and existing school infrastructure. This comparative divergence highlights that the developed digital resource successfully bridges high academic rigor with functional operational utility for secondary school environments.

2) Product Testing

After validation, the e module underwent a product trial involving 11th grade students as potential users. This stage consisted of one on one trials, small scale trials, and field trials. To demonstrate research credibility and methodological transparency, the testing procedure was executed systematically in stages. In the one on one test, students were asked to navigate the e module independently while think aloud protocols were observed to identify initial design flaws. In the small scale trial, a small group accessed the media via web links to evaluate instruction flow, and the final field test exposed the refined e module to the entire sample layout to assess technical stability and readability. Table 6 summarizes the trial results including the specific sample size allocation and a summary of qualitative feedback obtained from students during each trial stage.

**Table 6**. Summary of Test Results

| No | Test | Sample Size (N) | Total Score | Maximum Score | Category |
|---|---|---|---|---|---|
| 1 | One-on-one test | 3 | 36.33 | 44 | Very Good |
| 2 | Small-scale trial | 10 | 37.89 | 44 | Very Good |
| 3 | Field Test | 104 | 38.49 | 44 | Very Good |

3) Product Effectiveness

To measure the effectiveness of learning using the Genially-based Physics e-module, a pretest was conducted before learning and a final evaluation was conducted by administering a posttest. A comparison of the pretest and posttest results showed a significant increase in student learning outcomes, as can be seen in Table 7.

**Table 7**. Pretest and Posttest Results

| Stage | Number of Students | Minimum Score | Maximum Score | Average Score |
|---|---|---|---|---|
| *Pre-test* | 117 | 0 | 87.5 | 43.75 |
| *Posttest* | 117 | 62.5 | 100 | 81.5 |

The increase in pre-test and post-test scores was then measured using the N-gain score, and the results are shown in Table 8.

**Table 8**. N-Gain Effectiveness Test Results

| Test | Test Type | N-Gain Score | Effectiveness Level | Decision | Conclusion |
|---|---|---|---|---|---|
| Effectiveness | N-Gain | 0.89 | High | Accepted | The digital learning module is effective in learning |

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