DOI: https://doi.org/10.33487/edumaspul.v9i1

EDUMASPUL
JURNAL PENDIDIKAN

Vol 09 No. 02 (2025) page 1369-1375

p-ISSN 2548-8201 | e-ISSN 236-0469
https://ummaspul.e-journal.id/maspuljr/

Validation of a Newton's Laws Learning Module Based on Educational Robotics Using a Guided Inquiry Model to Enhance Students' Learning Interest

Nia Nofrita Sari[1*]; Wawan Kurniawan[2]; M. Furqon[3]
Department of Physics Education, FKIP, Universitas Jambi[1,2,3]
nianofritasari159@gmail.com

Receive: 27/09/2025	*Accepted: 29/09/2025*	*Published: 01/10/2025*

Abstrak

Penelitian ini dilatarbelakangi oleh rendahnya minat belajar siswa pada mata pelajaran fisika, khususnya pada materi Hukum Newton, yang disebabkan oleh padatnya aktivitas siswa dari pagi hingga malam hari sehingga waktu dan motivasi belajar menjadi terbatas. Untuk mengatasi permasalahan tersebut, dikembangkan modul pembelajaran Hukum Newton berbasis *educational robotic* dengan menggunakan model inkuiri terbimbing (*guided inquiry*) sebagai pendekatan pembelajaran yang menekankan pada aktivitas eksploratif dan pemahaman konsep melalui pengalaman langsung. Model pengembangan yang digunakan dalam penelitian ini adalah ADDIE, yang dibatasi hingga tahap pengembangan (*development*). Subjek penelitian terdiri atas guru fisika, ahli materi, dan ahli media. Data diperoleh melalui wawancara dan *Focus Group Discussion* (FGD) untuk mendapatkan masukan serta validasi terhadap produk yang dikembangkan. Teknik analisis data dilakukan secara deskriptif kuantitatif terhadap hasil validasi dan kualitatif terhadap hasil FGD. Hasil validasi menunjukkan bahwa rata-rata penilaian ahli materi sebesar 88,8% dan rata-rata penilaian ahli media sebesar 90,75%, keduanya termasuk dalam kategori sangat valid. Berdasarkan hasil tersebut, modul pembelajaran Hukum Newton berbasis *educational robotic* dengan model inkuiri terbimbing dinyatakan sangat valid dan layak digunakan dalam proses pembelajaran fisika. Media ini diharapkan dapat meningkatkan minat belajar siswa melalui pengalaman belajar yang lebih menarik dan bermakna.

Kata Kunci: Model ADDIE; *Educational Robotic*; Modul Pembelajaran; Hukum Newton; Inkuiri Terbimbing; Minat Belajar Siswa

Abstract

This research was motivated by the low learning interest of students in physics, particularly in Newton's Laws, which is caused by the hectic schedule of students from morning until evening, resulting in limited time and motivation to study. To address this issue, a Newton's Laws learning module based on educational robotics was developed using the guided inquiry model as a learning approach that emphasizes exploratory activities and conceptual understanding through direct experience. The development model applied in this study was the ADDIE model, limited to the development stage. The research subjects consisted of physics teachers, material experts, and media experts. Data were collected through interviews and Focus Group Discussions (FGD) to obtain feedback and validation of the developed product. Data analysis was conducted using quantitative descriptive analysis for validation results and qualitative analysis for FGD results. The validation results showed that the average score from material experts was 88.8%, and the average score from media experts was 90.75%, both of which fall into the very valid category. Based on these results, the Newton's Laws learning module based on educational robotics using the guided inquiry model was declared very valid and feasible for use in physics learning. This medium is expected to increase students' learning interest through a more engaging and meaningful learning experience.

***Keywords*:** ADDIE Model; Educational Robotic; Learning Module; Newton's Laws; Guided Inquiry; Students' Learning Interest

Introduction

Physics is a branch of science that studies observable and measurable natural phenomena through a structured approach, so that physics is not merely a collection of knowledge such as facts or principles, but also involves a continuous process of discovery (Atsilah dkk., 2024). One important topic in physics education is Newton's laws. Newton's laws are one of the main foundations in physics that explain the relationship between force, mass, and acceleration. Newton's First Law explains the inertia of an object, Newton's Second Law discusses the relationship between acceleration, mass, and the force that affects an object, while Newton's Third Law explains the relationship between action and reaction forces on an object (Fatma dkk., 2023).

Based on interviews with physics teachers in Jambi, namely SMAN Titian Teras Jambi, the researcher found that there was a lack of interest in learning among students during the learning process. This lack of interest in learning was due to the students' busy schedule from morning to night, which caused them to feel bored and tired during learning. In addition to this factor, the learning methods used are not innovative enough; teachers only use the lecture method, making the learning process monotonous, which results in low student interest in learning.

Furthermore, based on interviews with physics teachers at SMAN Titian Teras Jambi, it was found that Newton's Laws are taught using textbooks as the main teaching material because they provide structured and easily accessible information. However, this limitation can reduce the variety of teaching methods and learning activities, so that students may not get a more interactive and interesting learning experience. This can have a negative effect on students' interest in learning, which ultimately affects their understanding of the physics concepts taught.

Previous researchers have also found similar problems related to students' interest in learning Newton's laws. From the results of a questionnaire conducted by Putri dkk., (2021), it was found that learning is still focused on printed books consisting of material, sample questions, and practice questions. Therefore, educators need other media to support learning to be more effective and increase students' interest in learning.

One solution to overcome some of the problems experienced by students is to improve the quality of learning. One effort that can be made to improve the teaching and learning process is to develop teaching materials. One type of teaching material that is currently gaining popularity is modules, which are available in both printed and electronic forms. Printed modules have the advantage of not requiring special or expensive equipment to use. In terms of usage, printed modules are easy to carry and their contents can be easily accessed by users.

The appropriate use of modules can be one of the main factors in creating effective and efficient learning. Modules are materials designed to support students in independent learning (Muldiyana dkk., 2018). These modules serve as a reference for providing feedback in the learning process and are structured and organized in a structured and focused manner. In addition, the syntax used in the preparation of modules is based on the guided inquiry model. The guided inquiry learning model emphasizes the active role of students, but educators still have a role in determining topics or discussions, formulating questions, and providing materials (Aprilia & Anggaryani, 2023).

Research conducted by Karlina et al., (2019) states that the guided inquiry model can increase students' interest in learning, as seen from the results of the questionnaire, which increased from 74 with a good rating to 82 with a very good rating. This can also be seen from the improvement in student learning outcomes, with classical mastery increasing from 23.3% to 80%. Therefore, the researchers developed teaching materials in the form of modules to help overcome students' difficulties in understanding the material and can be used as a guide for independent learning, compiled based on guided inquiry syntax.

In an effort to overcome these problems, the researcher offers a solution in the form of developing a Newton's Law learning module based on educational robotics. The use of modules developed with educational robotics technology provides opportunities for students to explore the concepts of force, mass, and acceleration directly. Through the use of interactive robotics technology, students can enjoy a more entertaining and directly involved learning process.

Educational robotics not only presents scientific concepts in a tangible way through printing and experimentation, but also encourages students to actively participate in the learning process. With this interactive robotic technology , students tend to be more enthusiastic throughout the learning process. These robotics-based activities also allow students to learn interactively and collaboratively, fostering an interest in

technology culture and the development of both motor skills and soft skills (Fitria, 2024). By utilizing robots as learning tools, students can develop practical skills in programming and engineering while understanding basic concepts in various disciplines.

Problem Statement

Based on the background, the research problem formulation is as follows:

1. What are the stages and processes of developing Newton's Law Learning Modules Based on *Educational Robotics* with a Guided Inquiry Model to Increase Student Interest in Learning?
2. How feasible are the results of expert validation of material and media for the development of Newton's Law Learning Modules Based on *Educational Robotics* with a Guided Inquiry Model to Increase Student Interest in Learning?

Research Objectives

The objectives to be achieved from this development are as follows:

1. To explain the stages and processes of developing Newton's Law Learning Modules Based on *Educational Robotics* Using a Guided Inquiry Model to Increase Student Interest in Learning.
2. To analyze the feasibility of the results of validation by subject matter experts and media experts on the development of Newton's Law Learning Modules Based on *Educational Robotics* with a Guided Inquiry Model to Increase Student Interest in Learning.

Research Benefits

This research is expected to provide theoretical and practical benefits, namely as follows:

Theoretical Benefits

This research is expected to serve as one of the materials or references for scientific studies in the field of educational robotics-based learning module development**.**

Practical Benefits

For teachers: The results of this research, namely Newton's law learning modules based on educational robotics, are expected to become one of the alternative teaching aids for Newton's law material.

For schools: The results of this study, namely the Newton's laws learning module based on educational robotics, are expected to be one of the learning innovations that support the school's vision in developing technology-based education.

For researchers: The results of this study, namely the Newton's law learning module based on educational robotics, provide valuable experience for researchers. Thus, it is hoped that researchers will be more motivated to explore this field in the future.

Method

The development model used by researchers is ADDIE, which consists of *Analysis, Design, Development, Implementation,* and *Evaluation*. In this study, only the development stage of ADDIE was used. According to Branch (2009) the stages of the ADDIE model can be seen in the figure below.

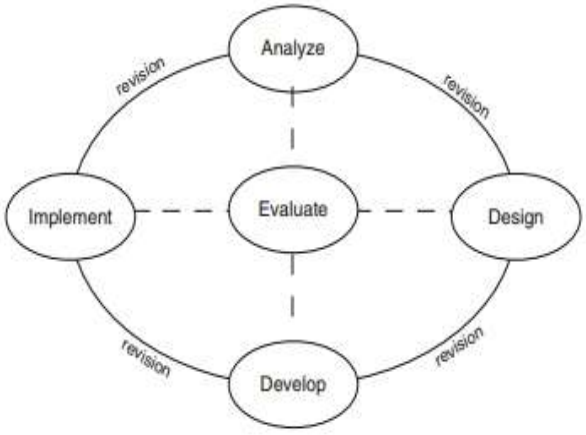

Figure 1 . ADDIE Stages

The research was conducted at Titian Teras State High School in Jambi. The first stage of this research was the analysis stage. The analysis stage consisted of several analyses, namely a needs analysis in the form of interviews with teachers and a needs analysis of student characteristics. The purpose of this analysis was to obtain a clear picture of the conditions, problems, and needs in the learning process. The results of this analysis could be used as a basis for researchers in designing learning that was relevant, effective, and in accordance with the needs and characteristics of students so that learning objectives could be achieved optimally. Next is curriculum analysis and content analysis, which aim to ensure that the learning is in line with the competencies applied in the curriculum and the needs of the students. Curriculum analysis is carried out to determine the competencies that must be achieved, while content analysis aims to adjust the content and depth of the material so that it is relevant and supports the achievement of learning objectives.

The second stage is the design stage, which consists of several steps. The first step is to design the structure and content of the module to produce a storyboard in the form of a preliminary design of the module product. The second step is to design a guided inquiry-based learning strategy and adjust it to the indicators of student learning interests.

The third stage is the development stage, which consists of content development, the creation of a prototype for the Newton's laws learning module, and finally, the validation of the module by media experts and subject matter experts.

The research subjects in the analysis stage were physics teachers who participated in interviews. In the design stage, the research subjects involved the development team as the party responsible for product design. Meanwhile, in the development stage, the research subjects included the development team, media experts, and subject matter experts who played a role in the validation process.

The data collection technique in the analysis stage was conducted through unstructured interviews with physics teachers, identification of student needs, and identification of learning needs to achieve the predetermined learning outcomes. In the design stage, data was obtained through Focus Group Discussions (FGD) with the development team. In the development stage, data collection was carried out through validity tests involving media experts and subject matter experts.

The data collection instrument at the analysis stage used interview sheets as the main tool. In the development stage, the instrument used was a validation questionnaire aimed at media experts and subject matter experts. The media validation questionnaire consisted of 15 statements grouped into five assessment aspects, namely integration, balance, font, color, and language used (Apsari & Rizki, 2018). In addition, the subject matter expert validation questionnaire consists of 13 statements covering three assessment aspects. The content suitability aspect includes indicators of the suitability of the material with the learning objectives analysis (ATP) and the accuracy of the material. The linguistic aspect covers the clarity of language, the effectiveness of language use, and language presentation. Meanwhile, the usefulness aspect covers the ease of understanding the material and the level of interest in the material (Nopiani dkk., 2021).

Results and Discussion

Analysis Stage

The first step in the analysis stage is to conduct a needs analysis, which includes interviews with physics teachers and a study of the characteristics and needs of 21st-century students. Based on the results of interviews with physics teachers, it was found that low student motivation is a major problem in the learning process. This is due to the students' busy schedule from morning to night, which causes them to experience fatigue and lose their enthusiasm to learn optimally. Analysis of the characteristics of 21st-century students shows that they have skills in digital literacy, creativity, critical thinking, collaboration, and information literacy. Therefore, digital-based learning media is needed that is able to present material in a real and interesting context, so that it can increase students' interest in learning and their involvement in the learning process. The results of the curriculum analysis show that the school where the research was conducted has implemented an independent curriculum, in which learning is directed so that students are active and motivated to achieve the learning outcomes that have been applied. Meanwhile, the results of the material analysis show that the subject matter used is Newton's laws, which include the concepts of force, the relationship between force and motion, and their application in everyday life. The material is systematically arranged, starting with an introduction to basic concepts in an applied context, so that it can help students understand the concepts while fostering their interest in learning physics.

Based on the results of the analysis that has been carried out, the Newton's laws learning module based on educational robotics with a guided inquiry model is expected to increase students' interest in learning and their understanding of physics material. This module is also expected to be an innovative learning medium that is in line with the independent curriculum outcomes and is able to foster creativity in students in the learning process.

Design Stage

The initial stage of the design phase involves developing the design, structure, and content of the learning module. The design, structure, and content of the module can be seen in the following table:

Table 1. Module Structure and Content

Module Structure and Content	
Module Identity	
Foreword	
Table of Contents	
Subject Overview	
Instructions for Use	• Introduction • Introduction to Roblock Devices • Introduction to mBlock Programming • Programming Algorithms • Concept Map
Newton's First Law	• Activity 1 • Materials • Exercises • Exercise answer guidelines
Newton's Second Law	• Activity 2 • Materials • Exercise • Answer guidelines for exercises
Newton's Third Law	• Activity 3 • Materials • Exercise • Answer guidelines for exercises
Summary	
Formative Tests	
Bibliography	

The next step is to design learning activities tailored to the learning model being implemented, namely the guided inquiry model. The stages or syntax of the guided inquiry learning model are presented in the following table:

Table2 Syntax of Guided Inquiry

Syntax	Activity
Orientation	At this stage, the teacher creates a responsive learning environment to encourage students to think critically in solving problems. The teacher guides students to identify the problems to be solved.
Problem Formulation	This stage directs students to a puzzle-like problem. Teachers ask questions, and students are encouraged to find the answers independently.
Formulating Hypotheses	At this stage, students propose hypotheses as temporary answers to the problems they face, which will then be tested for accuracy. Teachers guide students in determining relevant hypotheses.
Collecting Data	This stage involves searching for information to test the hypothesis. Data collection activities usually take the form of experiments or trials. The teacher gives students the opportunity to carry out predetermined experimental steps and sequence them according to the hypothesis that has been made.
Testing Hypotheses	At this stage, students determine the answer that best fits the data collected. Teachers guide them in analyzing the data and give each group the opportunity to present their analysis results.
Formulating Conclusions	In this final stage, students describe their findings based on the results of testing their hypotheses. Teachers guide them in drawing conclusion from their learning outcomes

Adapted from: (Wandini dkk., 2024)

Development Stage

In the development stage, researchers compile learning modules based on the initial design that has been made. Activities at this stage include design planning, module structure compilation, learning material development, learning activity planning, and evaluation. The resulting products consist of two types of modules, namely student modules and teacher modules. The difference between the two modules lies in their content, namely that the teacher module is equipped with guidelines and answer keys for each learning activity, while the student module does not contain answer keys so that students can discover concepts independently. The following are the covers of the student and teacher modules that have been developed:

Image 2 . Student Module Cover

Image 3. Teacher Module Cover

The image above shows the covers of the student and teacher modules that have been produced. The next step after creating the module covers is to create the module content, which consists of an introduction, table of contents, subject overview, and instructions for use. This includes material and learning activities on Newton's first law, Newton's second law, and Newton's third law, as well as a summary, formative tests, and finally a bibliography. The learning activities have been tailored to the learning objectives to be achieved. The following is an example of problem identification for Activity 1 on Newton's laws in the module content:

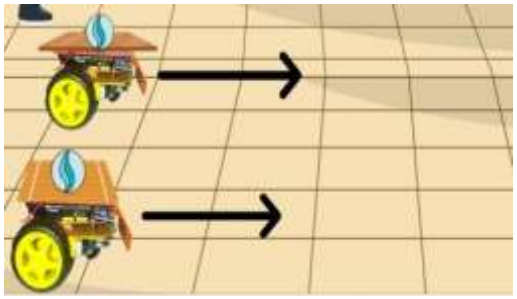
Image 4 . Problem Identification Activity 1

In activity one, students are given a problem in the form of a robot programming experiment to move forward while carrying a marble placed on the robot's surface. The surface on which the marble is placed has different types of bases (smooth and rough). The robot is programmed to move forward at a speed of 0.6 m/s for 3 seconds. Students are then asked to observe and explain the condition of the marble when the robot, which was initially stationary, starts moving, and when the robot stops suddenly. After identifying the problem, students are directed to formulate a hypothesis based on predictions of the marble's movement. Next, students collect experimental data by developing an appropriate programming algorithm and conducting the experiment. The following is the programming algorithm used in Activity 1:

Image 5 . Programming Algorithm for Activity 1

After the students complete the robot programming on mBlock, they then conduct experiments using the deprogrammed robot. In this experiment, the robot will carry a marble placed on two types of surfaces, namely rough and smooth surfaces. Students will observe the movement of the marble when the robot is initially stationary and then moving, and when the robot stops suddenly. From the observations, it is found that the direction of the marble's movement differs in each condition. When Roblock stops suddenly on a slippery surface, the marble appears to be thrown forward because there is no friction force holding it back ($\Sigma F = 0$). On a rough surface, the marble only slides forward slightly because there is a friction force that hinders its movement ($\Sigma F \neq 0$). Conversely, when Roblock, which was originally stationary, moved forward, on a smooth surface the marble

appeared to slide backward because it was not attracted by friction (ΣF = 0), while on a rough surface the marble only slid backward slightly because there was friction that pulled it forward (ΣF ≠ 0).

The following are the final validation results by subject matter and media experts on the Newton's law learning module based on educational robotics after the module was.

Table 3. Validation Data by Subject Matter Experts

Aspect	Validation Results	Criteria
Content Suitability	87.5	Highly Valid
Linguistic	87.5	Highly Valid
Usefulness	91.6	Highly Valid
Total Average	88.86	Highly Valid

Based on the validation data obtained by subject matter experts, the results show that the content and language aspects each scored 87.5%, while the usefulness aspect scored 91.6%. Thus, the average total validation results from subject matter experts indicate a highly valid category, meaning that the product is deemed suitable for use without significant revisions in terms of content and language.

Table 4. Data from Expert Media Validation

Aspect	Validation Results	Criteria
Integrity	85	Highly valid
Balance	87.5	Highly valid
Letter Form	93.75	Highly valid
Color	100	Very valid
Language	87.5	Very valid
Total Average	90.75%	Highly valid

The table above shows the results of validation by media experts, indicating that the aspects of integration received a score of 85%, balance 87.5%, font 93.75%, color 100%, and language 87.5%. Overall, the average total result of the media expert validation reached 90.75% with the criteria " " being highly valid. This indicates that the developed media has excellent display quality, visual element integration, and language clarity, making it suitable for use in the learning process.

Conclusion

This study used the ADDIE model to produce a Newton's law learning module based on educational robotics, designed using a guided inquiry approach aimed at increasing students' interest in learning. Based on the validation results, the subject matter experts gave an overall assessment of 88.86% with a very valid criterion. Meanwhile, the media expert validation results obtained a score of 90.75% with a very valid criterion. Based on these results, it can be concluded that the Newton's law learning module based on educational robotics with a guided inquiry model to increase student interest in learning has met the feasibility criteria in terms of both material and media, so it is declared to be highly valid and feasible for application in learning activities.

References

Aprilia, F. D., & Anggaryani, M. (2023). Pengaruh Model Inkuiri Terbimbing Berbsasis STEM Terhadap Keterampilan Proses Sains Peserta Didik pada Materi Gelombang Cahaya. *PENDIPA Journal of Science Education*, *7*(2), 241–248. https://doi.org/10.33369/pendipa.7.2.241-248

Apsari, P. N., & Rizki, S. (2018). MEDIA PEMBELAJARAN MATEMATIKA BERBASIS ANDROID PADA MATERI PROGRAM LINEAR. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *7*(1), 161. https://doi.org/10.24127/ajpm.v7i1.1357

Atsilah, M. B., Suhadi, Putri, J. K., Mabruroh, F., Sugiarti, & Pebralia, J. (2024). Pengembangan Three Tier Test Multiple Choice Untuk Mengidentifikasi Miskonsepsi Pada Materi Hukum Newton. *Jurnal Penelitian Pembelajaran Fisika*, *15*(2), 213–221. https://doi.org/10.26877/jp2f.v15i2.18045

Branch, R. M. (2009). *Instructional Design: The ADDIE Approach*. Springer Publications.

Fatma, A. F., Jufriadi, A., Hudha, M. N., & Sholikhan. (2023). Analisis Pemahaman Konsep pada Materi Hukum Newton. *Jurnal Terapan Sains & Teknologi*, *5*(2).

Fitria, T. N. (2024). Educational Robotics for Elementary Students: Teaching ' s Opportunity. *Journal of Contemporary Issue in Elementary Education (JCIEE)*, *2*, 40–55.

Karlina, K., Susilowati, E., Miriam, S., Studi, P., Fisika, P., Keguruan, F., & Pendidikan, I. (2019). Meningkatkan

Minat dan Hasil Belajar Peserta Didik Menggunakan Model Pembelajaran Inkuiri Terbimbing. *Jurnal Ilmiah Pendidikan Fisika*, *3*(2), 48–55.

Muldiyana, Ibrahim, N., & Muslim, S. (2018). Pengembangan Modul Cetak Pada Mata Pelajaran Produktif Teknik Komputer dan Jaringan Di SMK Negeri 2 Watampone. *Jurnal Teknologi Pendidikan*, *20*.

Nopiani, R., Made Suarjana, I., & Sumantri, M. (2021). E-Modul Interaktif Pada Pembelajaran Tematik Tema 6 Subtema 2 Hebatnya Citacitaku. *MIMBAR PGSD Undiksha*, *9*(2), 276. https://doi.org/10.23887/jjpgsd.v9i2.36058

Putri, N. K., Yuberti, & Hasanah, U. (2021). Pengembangan Media Pembelajaran Berbasis Web Google Sites Materi Hukum Newton Pada Gerak Benda. *Physics and Science Education Journal (PSEJ)*, *1*, 133–143.

Wandini, S. M., Gembong, S., & Pudjilestari, E. (2024). Penerapan Model Pembelajaran Inkuiri Terbimbing untuk Meningkatkan Kemampuan Komunikasi Matematis Siswa Kelas XI F SMAN 1 Nglames pada Materi Statistika Regresi. *Journal on Education*, *07*, 1582–1598. http://jonedu.org/index.php/joe

Curriculum Vitae

The author is a student of Physics Education at the University of Jambi, Indonesia. This research focuses on the field of science and educational technology. The author was directly involved in writing and developing Newton's law learning modules based on educational robotics using a guided inquiry model to increase student interest in learning, which is in line with the independent curriculum.