

# Development of a Physics Textbook with Discovery Learning Based on the Danau Maninjau EduPark on Learning Outcomes of High School Students

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## ARTICLE INFORMATION

Received : 2023-01-22  
Revised : 2023-08-12  
Accepted : 2023-09-28

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## KEYWORDS :

Buku Ajar, Discovery Learning, EduPark, Danau Maninjau, Hasil Belajar

## ABSTRACT

*The obstacle for teachers in learning physics is developing student books encouraging students to learn actively. This study aims to develop a textbook with the help of a discovery learning model based on the Danau Maninjau EduPark. This development follows product development from Plomp, consisting of three stages: initial analysis, prototype development, and assessment phase. This research was conducted at one of the high schools in Kab – religion and involved 32 students. The instruments used were validity, practicality, and description questions totaling seven items. The pre-test and post-test were analyzed with the N-Gain equation. The results showed that the textbook with Discovery Learning based on EduPark Danau Maninjau was valid regarding content, construct, graphics, and language. In addition, the book is practical from the students' responses on a small and large scale. The resulting N-Gain value is 0.45, indicating that the book can effectively improve student learning outcomes. It can be concluded that the textbook Discovery Learning based on the Danau Maninjau EduPark has been tested to be valid, practical, and effective in increasing students' knowledge competence in learning physics. This research is also a reference for future researchers to develop the Maninjau Lake Edupark with other learning models. It is hoped that subsequent research will also be able to develop textbooks that align with the currently implemented independent curriculum.*



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## INTRODUCTION

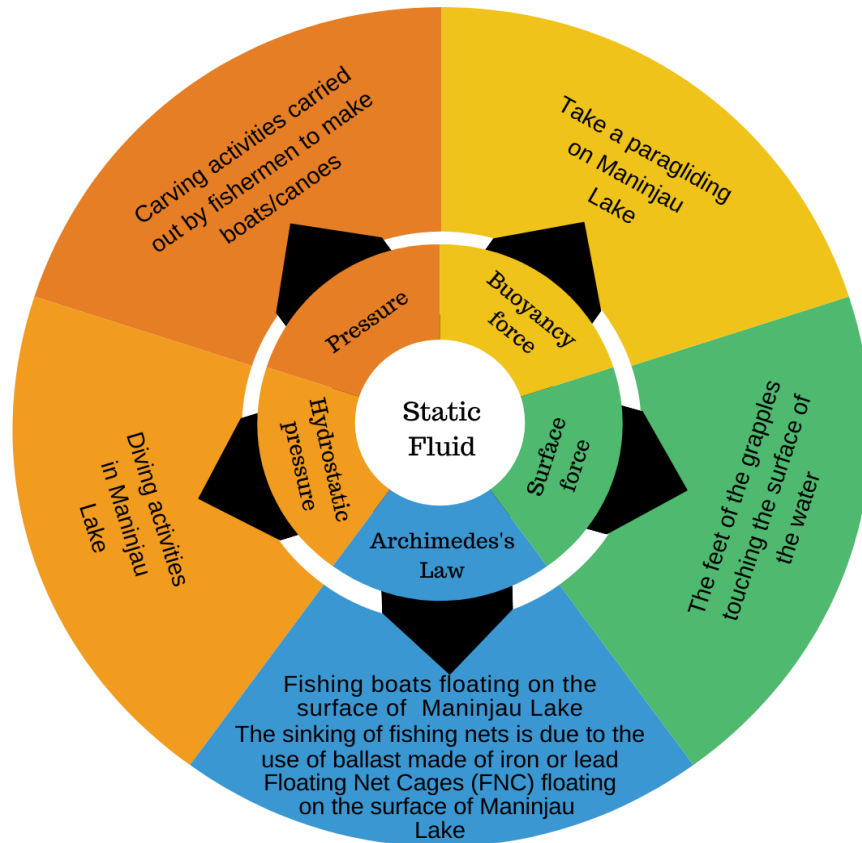
In learning physics, both teachers and students need handbooks (Vitrianingsih et al., 2021; Damayanti et al., 2018). Handbooks from several studies are referred to by different terms, such as teaching materials (Hartini et al., 2018), modules (Nisa et al., 2020), student books (Ndoa, 2022), and textbooks (Park et al., 2019). In this study, the term taken is textbooks. Textbooks are learning resources that contain learning objectives, materials, and practice questions to support student learning at school and home (Evenhouse et al., 2023; Utami et al., 2020). Textbooks are a learning tool to achieve learning goals (Fitriansyah et al., 2019; Fourilla et al., 2022) and are essential in the quality of a lesson (Putri, 2023). Textbooks

are helpful for students both before entering class and after entering class). Before entering class, students can read the material that will be studied at school or record practice questions they do not understand and plan to discuss with the teacher at school (Rikawati & Sitinjak, 2020). Textbooks can also deepen the material studied at school (Indariani et al., 2019).

Textbooks can improve student learning outcomes if they have specific characteristics. According to Prastowo (2014), there are four characteristics of good textbooks. First, textbooks can encourage students to be actively involved in learning. Second, the presentation of textbooks should be interesting and fun for students to increase student learning interest. Third, textbooks have a systematic relationship between one part and another. Finally, textbooks should provide authentic experiences to students. The characteristics of this last textbook are a unique objective in this study. Textbook development focuses on providing a direct experience of the surrounding environment (Novianti, 2022; Wibowo & Utaminingsih, 2021). Textbooks are expected to improve all students' abilities (Melawati et al., 2022). So, textbooks are beneficial, especially in improving student learning outcomes.

Textbooks can be designed for various purposes. One of the interesting textbooks is a student book designed using the Discovery Learning model. The primary purpose of textbooks is to improve the competence of attitudes, skills, and cognitive abilities of students (Saridewi et al., 2022). Besides that, textbooks can also improve students' skills in analyzing problems in the surrounding environment (Abduh & Istiqomah, 2021; Utami & Deshya, 2021). The Discovery Learning model has several syntaxes: stimulus, problem identification, data collection, data verification, and conclusions (Chusni et al., 2021; Ellizar et al., 2018). The stimulus presented in the student book aims to stimulate students' minds on a problem related to static fluids. Next, students are asked to identify problems related to static fluids. The book directs students to collect data according to the problems identified. Then, students verify the results of the analysis with the hypotheses that have been made. Finally, students practice making conclusions from the findings. Therefore, student books with the Discovery Learning model are the teacher's first step in encouraging students to become scientists.

Textbooks with Discovery Learning have the main characteristic of being authentic. What is meant by authenticity is that the presentation of textbooks can train students to identify problems that exist around EduPark Danau Maninjau. In other words, after learning, students realize the benefits obtained for their lives now and in the future. EduPark Lake Maninjau is an educational tourism location for students because of the beautiful views and many natural phenomena that amaze visitors. The results of the static fluid material analysis at EduPark Lake Maninjau can be seen in Figure 1.



**Figure 1.** Analysis of Static Fluid Material at the EduPark Danau Maninjau

There are pressure, hydrostatic pressure, Archimedes' law, buoyant force, viscosity, surface force, and Pascal's law in static fluid matter. However, the material analysis results from the EduPark Danau Maninjau show five sub-materials: pressure, hydrostatic pressure, Archimedes' law, buoyancy, and surface tension, as shown in Figure 1. In the concept of pressure, one application is found, namely the manufacture of boats or canoes. Meanwhile, hydrostatic pressure can be seen in diving activities at Lake Maninjau. Archimedes' concept found that there are three activities, namely the floating of floating net cages, the sinking of fishing nets, and floating fishing boats.

Furthermore, the concept of surface force is shown in the phenomenon of the feet of the scabbard touching the surface of the water but not sinking—Lastly, the concept of buoyancy in paragliding from Lake Maninjau Hill. So, many natural phenomena related to physics concepts still need to be taught to students.

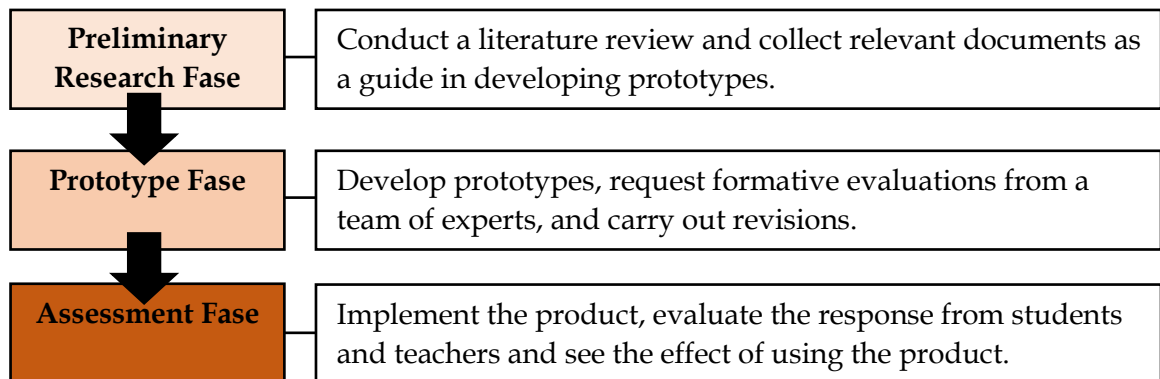
Teachers are expected to be able to involve students in learning so that students actively learn. Students can usually be active if they understand concepts and directly find the meaning of learning (Brinus et al., 2019; Kinasih & Sinaga, 2020). This is a challenge for teachers in designing lessons (Latif, 2020) and student books (Al Fatah & Amirudin, 2022). The observation results show that teachers in schools only rely on textbooks, so they have not presented natural phenomena directly related to the material being taught. Apart from that, teachers also need to explore students' initial knowledge regarding daily activities. Students living around Lake Maninjau often help their parents catch fish, ride boats, swim, etc. Teachers should connect Discovery Learning learning with students' lives. This can foster students' curiosity and interest in studying physics. Teachers guide students to learn

about natural phenomena around them by providing textbooks so that they can improve student learning outcomes.

This research shows novelty in the study of developing EduPark teaching materials. The object used as learning material is still rarely used, namely Lake Maninjau. This research is a solution and innovation to the previously presented problems. The research aims to determine the validity of textbooks using discovery learning based on EduPark Danau Maninjau by a team of experts, the practicality of textbooks using discovery learning based on EduPark Danau Maninjau from student responses, and the effectiveness of textbooks using discovery learning based on EduPark Danau Maninjau on student learning outcomes in fluid material Static.

## METHODS

This study uses the Research and Development method by applying the Plomp development model (Plomp, 2013). This model has three phases, namely the initial analysis phase, the prototype phase, and the assessment phase. In each phase, several activities that must be carried out can be shown in Figure 2.



**Figure 2.** Plomp Development Model

This study's initial stage was carried out to determine its importance. The results of the initial analysis show that the teaching materials used by the teacher do not present natural phenomena. In addition, the life of students who live in the lake area supports students to understand the concepts of physics, especially static fluids. Therefore, students need books as learning resources that can improve their learning outcomes. The second stage that must be done is product development. The results of the initial analysis become a guide in product development. This stage produces a product as a textbook prototype with the Discovery Learning model. In addition, at this stage, an assessment was also carried out by a team of experts. After being repaired, the product was tested on a small and large scale so that each process asked for responses from students. The assessment stage is the final stage of product development. Typically, products that have been validated and practical are tested extensively, and their effects on student learning outcomes are measured.

The instruments used in this research were validity sheets, practicality sheets, and pre-post test questions. The validity sheet is used at the prototype stage to determine whether the product is appropriate to the content and suitable for learning. Similar to the validity sheet, a practicality sheet is also needed at the prototype stage. Practicality tests should be tested on students on a small scale and a large scale. Both validity tests and practicality tests were analyzed using a Likert scale. The criteria for the results of the validity and practicality test analysis can be seen in Table 2. Pre-test and post-test instruments are needed to

determine whether student competence has increased after using the student book. The pre-post test instrument is in the form of a description of 7 questions. The effectiveness test results were analyzed by calculating N-Gain. A description of the N-Gain gain can be seen in Table 1. Meanwhile, the equation applied in calculating N-Gain can be seen in equation 1 N-Gain (Hake, 1999).

**Table 1.** N-Gain Category

Score <g>	Category
$(\langle g \rangle) > 0.7$	High
$0.7 \geq (\langle g \rangle) < 0.3$	Intermediate
$(\langle g \rangle) \leq 0.3$	Low

$$\langle g \rangle = \frac{\% \langle S_{post} \rangle - \% \langle S_{pre} \rangle}{100 - \% \langle S_{pre} \rangle} \tag{1}$$

Information:

<g> = increase in knowledge competency (average N-Gain)

<S<sub>pre</sub>> = the average value of the pre-test

<S<sub>post</sub>> = the average value of post-test

**Table 2.** Validity and Practicality Test Result Categories

No	Value	Criteria	
		Validity	Practicality
1	$80\% < X \leq 100\%$	Very valid	Very practical
2	$60\% < X \leq 80\%$	Valid	Practical
3	$40\% < X \leq 60\%$	Enough valid	Enough practical
4	$20\% < X \leq 40\%$	Not enough valid	Not enough practical
5	$0\% < X \leq 20\%$	Not valid	Not practical

This research was conducted at a high school in West Sumatra. The number of students involved was 32 people. The research time lasts for four weeks in May 2021.

## RESULTS AND DISCUSSION

### Results

#### *Validation Results*

Products that have been developed need to be validated by a team of experts first. In this research, three components are validated: product content validation, product construct validation, product graphic validation, and product language validation. The developed validity instruments were given to 6 validation teams. The MU validator assesses three components: content, construct, and graphics, while the AB validator only validates the linguistic component. Each component is further broken down into clear indicators to obtain a valid student book. The results of validating student books can be seen in Table 3.

**Table 3.** Results of Content, Construct, Graphical, and Language Validation

No	Validation Component	Validator Score			Mean	Category
		MU	RA	AB		
1	Content	82.14	100.00	0.00	91.07	Very valid
2	Construct	90.63	95.83	0.00	93.23	Very valid
3	Graphic	82.50	92.50	0.00	87.50	Very valid
4	Language	0.00	80.36	94.64	87.50	Very valid

Content validation obtained an average of 91.07 with a very valid category. Product development consists of 3 materials: static fluids, simple vibrations, and Newton's laws. The aspects assessed in the static fluid concept are activities and phenomena that show community activities using the static fluid concept in the Lake Maninjau area, as shown in Figure 1. In the simple vibration material, three aspects are assessed based on the phenomena in Lake Maninjau, while in Newton's law material, four aspects show physical phenomena. The results of the validation analysis of the contents of student books from the expert team are valid. So, textbooks with Discovery Learning can be suitable for students to use in learning physics based on the components of quality and breadth of content.

Construct validation obtained an average score of 93.23 with a very valid category. The results of this validation are based on two teams of experts in the field of textbook construction. The construct component consists of 15 assessment indicators. Construct validation focuses on the writing structure and the textbooks' suitability to the curriculum. Two teams of experts also assessed graphic validation with an average score of 87.50. There are seven indicators assessed in the graphic component. This validation is also crucial to attract students' interest in physics. Apart from that, language validation also obtained an average score of 87.50 in the very valid category. This shows that the textbooks that have been developed can be understood by students linguistically. Overall, the results of textbook validation are very valid.

*Practical Results*

The practicality test is carried out in the same phase as the validity test. However, the practicality test is determined by the student's response after using the textbook. The practicality test aims to determine student satisfaction in using the book. In addition, with the practicality test, some deficiencies must be corrected so that it is possible to revise it before carrying out the effectiveness test. This research has two practicality tests: practicality in small groups and field tests. The practicality test in the small group was given to 8 students, while the field test was given to 22 students. The practicality of the test results can be seen in Table 4.

**Table 4.** Practicality test results

No	Aspect	Score		Category
		<i>Small group</i>	<i>Field test</i>	
1	Interest	95.00	98.84	Very practical
2	Usable	92.86	93.49	Very practical
3	Easy to use	93.75	95.40	Very practical
4	Efficient	93.75	83.98	Very practical
<b>Mean</b>		<b>93.84</b>	<b>91.93</b>	<b>Very practical</b>

Overall, student responses were perfect, with an average score of 93.84 in the small group and 91.93 in the field test. Table 4 visually presents the four aspects tested: interest, usability, ease of use, and efficiency. In the small group test, the highest aspect is interest.

Likewise, with the field test, the interest aspect shows the highest score. The interest aspect contains five assessment indicators starting from the appearance of student books, color composition, materials, and activity guides that can increase students' interest in learning. The usable component consists of six indicators, while the easy-to-use component is detailed in 9 indicators. In the efficient component, two indicators are assessed: the time it takes students to understand textbooks and books can function as independent learning materials and as a complement. So, textbooks with Discovery Learning based on the Danau Maninjau EduPark can be used by students to explore physics concepts.

*Effectiveness Test*

Testing the effectiveness in the assessment phase is very important to determine the effect of textbooks with the Discovery Learning model based on the Danau Maninjau EduPark. The instrument is in the form of description questions given before treatment (pre-test) and after treatment (post-test). The material tested in both tests is the concept of static fluid with seven questions. The questions were distributed to 32 students. The results of the pre-test and post-test analysis in the form of minimum values, maximum values, average, and N-Gain are shown in Table 5.

**Table 5.** Pre-test and Post-Test Results

Statistics	<i>Pre-Test</i>	<i>Post-Test</i>
Minimum Value	45.0	70.0
Maximum Value	95.0	97.0
Mean	70.0	83.5
<b>N-Gain &lt;g&gt;</b>	<b>0.45</b>	

Table 5 presents statistical data for the effectiveness test with an N-Gain of 0.45. According to Hake (1999), this value is medium. In other words, using textbooks with the Discovery Learning model based on the Danau Maninjau EduPark can improve student learning outcomes even though the increase is not drastic. The difference between a student's minimum pre-test and post-test score is 35 points, while the maximum difference between a student's pre-test and post-test score is 2 points. Before using the student book, the average student pre-test was only 70. After using the student book, there was an increase of 13.5 points more than the pre-test. Based on the results of this analysis, the application of textbooks with the Discovery Learning model based on the Lake Maninjau EduPark can effectively improve students' understanding of concepts.

**Discussion**

This research develops a product as a textbook with Discovery Learning based on EduPark Danau Maninjau. Using the Plomp development model, three steps have been followed: initial study, prototype development, and assessment (Alim et al., 2020; Dhanil & Mufit, 2021). This development aims to produce a valid and practical product for physics learning, especially static fluid material. A team of three experts determined the validation results, while the product's practicality was determined from student responses from both small and large groups. Apart from that, the effect of product use is also measured by comparing the pre-test and post-test results and displayed as an N-Gain value.

The validity test aims to determine whether textbooks using Discovery Learning based on EduPark Danau Maninjau are valid according to the applicable system. To review these parameters, an instrument is needed, which has been grouped into four parts: content validation, construct validation, graphic validation, and language validation. Each of these

parts is further broken down into indicators that can assess the product more completely. Content validation refers to the content in the book (Sudiana & Parmiti, 2023), including the truth of the Lake Maninjau EduPark phenomena with physics concepts that are directly connected. Construct validation leads to the book's structure (Aima & Rahima, 2020). In product development, the curriculum applied is the 2013 curriculum. The curriculum explains KI, KD, learning indicators, Discovery Learning model syntax, material descriptions, and relevant references. This is adjusted to the curriculum used by the school at the time of the research. The analysis results show that developing textbooks using Discovery Learning based on EduPark Danau Maninjau is valid. This aligns with Rifai's (2021) research on developing e-books scientifically based on valid Rumah Gadang tourist destinations from substance, learning design, language, and layout.

Graphic testing is also important in product development, such as books. This relates to the layout of the book to attract students to read, explore, and master the contents of the book (Hanif, 2020). In this study, the book's attractiveness has been proven by the validation results from a team of experts. The book presentation is not only verbal but also equipped with illustrations and pictures that are relevant to the concept of static fluid. Finally, test the validity of the product in terms of language. Language is very important because students' books become the teacher's right hand in conveying material that may not be understood directly in class (Bin-Tahir et al, 2020). Books that are developed must use Indonesian and standard. This aims to avoid multiple student interpretations (Suryani et al, 2022; Yazid et al, 2022). Even if we use another language, it should give a special explanation. In addition, the language used must adapt to the students' times and development. By paying attention to these things, the Discovery Learning textbook based on EduPark Danau Maninjau is valid based on the assessment of language experts.

The product development phase also needs to know student responses before it is widely used. In this phase, the practicality test was carried out in small and large groups (Cahyani et al, 2021; Annajati & Wikarya, 2023). Questionnaires were given to eight students after using textbooks with Discovery Learning based on the Danau Maninjau EduPark. In general, four components are assessed, namely interest, usability, ease of use, and efficiency. The four components received positive responses from students. The practicality test in the large group is almost the same as in the small group. The difference is that there are more respondents than before, namely 22 students. Likewise, with the small group test, students responded well to the book because it had innovation in the form of EduPark Danau Maninjau. Perhaps they realize that the phenomena around them are none other than physics concepts taught by teachers at school. Therefore, students are explicitly aware that student books with the Discovery Learning model based on EduPark Danau Maninjau are very interesting, easy to use, and efficient for improving learning outcomes. This is in line with Fahlevi's (2021) research on practicality testing of electronic modules in online learning to improve students' science process skills.

The effectiveness test is the final stage in the assessment phase (Hignasari & Supriadi, 2020; Hardianto et al, 2020). The analysis shows that textbooks with Discovery Learning based on EduPark Danau Maninjau can significantly improve student learning outcomes. However, this increase is insignificant because it is in the moderate category. The material being tested is the static fluid concept, which is quite authentic to the Danau Maninjau EduPark. In the first question, students were asked to determine the mass of one of the boats floating on Lake Maninjau, initially empty and then filled by five students. The second question relates to the density of *keremba*. On the third and fifth questions, students are asked to calculate the hydrostatic pressure of Lake Maninjau divers who will take fish videos. In the fourth question, students are asked to determine the magnitude of the upward force and



the density of ballast fishermen use. In the sixth question, students are asked to calculate the ship's total mass, while in the last question, students are asked to calculate the net force of a stick experiencing surface forces on Lake Maninjau. All of these questions raised real problems in the Danau Maninjau EduPark. So, textbooks with Discovery Learning based on EduPark Danau Maninjau can effectively improve student learning outcomes. This research is the same as research by Hediansah and Surjono (2019), who developed an Android-based physics book with moderate effectiveness test results (N-Gain: 0.26).

## CONCLUSION

The textbook with Discovery Learning based on the Danau Maninjau EduPark is valid from the content, construct, graphic, and language components. In addition, the book is very practical from the results of student responses from both small and large groups. The N-Gain value (0.45) shows that textbooks with Discovery Learning based on EduPark Danau Maninjau can improve student learning outcomes. Some of the limitations in this research are that the material tested in the pre-test and post-test only focused on the concept of static fluids, the curriculum used was still the 2013 curriculum, and the participants used were only one class. This research contributes to teachers' use of this student book in teaching static fluids. This research is also a reference for future researchers to develop EduPark Danau Maninjau with problem-based, project-based, and other models. It is hoped that subsequent research can also develop student books that are by the independent curriculum being implemented at this time.

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