

## **Design of Hydroelectric Power Plant Demonstration Tools for Mentality Retarded Students**

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### **Abstract**

*Children with disabilities often have difficulty understanding abstract concepts, requiring concrete and visually accessible learning media. The purpose of this study was to design and evaluate the feasibility of a Hydroelectric Power Plant (PLTA) demonstration tool as a science learning tool for children with intellectual disabilities. This study used a Research and Development (R&D) approach based on the Borg and Gall model. The developed PLTA demonstration tool uses simple and safe components, such as a water pump, dynamo, USB module, quick connector, and LED lights. Data were collected through expert validation conducted by Special School (SLB) teachers to assess the feasibility of the media and learning materials. The results showed that the demonstration tool met the feasibility criteria in terms of appearance, practicality, quality, and relevance to learning objectives. The media feasibility score reached an average of 95%, categorized as "very feasible," while the material feasibility scores also reached 95% in the same category. These findings indicate that the developed hydroelectric power plant demonstration tool is highly feasible and effective in supporting science learning for children with intellectual disabilities.*

**Keywords:** Teaching Aids, PLTA, Special Needs Children

### **Abstrak**

Anak-anak penyandang disabilitas sering kesulitan memahami konsep abstrak, sehingga butuh akan media pembelajaran yang konkret dan mudah diakses secara visual. Adapun tujuan penelitian ini adalah untuk merancang dan mengevaluasi kelayakan alat peraga Pembangkit Listrik Tenaga Air (PLTA) sebagai media pembelajaran sains untuk anak-anak penyandang disabilitas intelektual. Studi ini menggunakan pendekatan Penelitian dan Pengembangan (R&D) berdasarkan model Borg dan Gall. Alat peraga PLTA yang dikembangkan menggunakan komponen sederhana dan aman, seperti pompa air, dinamo, modul USB, konektor cepat, dan lampu LED. Data dikumpulkan melalui validasi ahli yang dilakukan oleh guru Sekolah Khusus (SLB) untuk menilai kelayakan media dan materi pembelajaran. Hasil menunjukkan bahwa alat peraga memenuhi kriteria kelayakan dalam hal penampilan, kepraktisan, kualitas, dan relevansi dengan tujuan pembelajaran. Skor kelayakan media mencapai rata-rata 95%, dikategorikan sebagai "sangat layak," sedangkan skor kelayakan materi juga mencapai 95% dalam kategori yang sama. Temuan ini menunjukkan bahwa alat percontohan pembangkit listrik tenaga air yang dikembangkan sangat layak dan efektif dalam mendukung pembelajaran sains bagi anak-anak penyandang disabilitas intelektual.

**Kata kunci:** Alat Bantu Pengajaran, PLTA, Anak Berkebutuhan Khusus

## Introduction

Every child has the right to receive a proper education, including children with special needs (CSN). According to Law No. 20 of 2003, Article 5, Paragraph 2, citizens with physical, emotional, mental, intellectual, or social disabilities are entitled to special education [1]. Learning media play an important role in the learning process. The presence of media introduces a change in instructional practices, as media serve as a source of learning that enables students to develop their potential and understand learning concepts comprehensively and equally [2]. Based on an interview with a science teacher at SLB Bulkesra Banda Aceh regarding the topic of electrical energy, the teaching and learning process is still carried out using conventional methods. The learning media currently used are limited to static images of electrical energy, and there is still a lack of instructional teaching aids. In Special Schools (SLB), teachers are required to adjust teaching strategies and media to match students' needs. Children with special needs have diverse disabilities, both physical—such as hearing impairment and visual impairment—and mental, such as intellectual disability and autism. [3].

This research focuses on students with intellectual disabilities who are physically similar to regular students but have cognitive limitations [4]. They often experience difficulties in remembering, understanding, and abstract thinking; therefore, learning must be based on concrete objects to improve comprehension [5]. To address this issue, more creative and imaginative learning resources are required, because the learning process for children with special needs differs significantly from that of regular students. Learning must be designed to be enjoyable and engaging so that learning feels like play [6]. The use of tools and materials in teaching aids needs to be adjusted to the characteristics of students, especially children with special needs (ABK) with the category of intellectual disabilities. Therefore, teaching aids for children with intellectual disabilities use materials that are large enough, brightly colored, and safe to touch, which are considered to help students understand concepts through direct experience [7]. Designing science teaching aids includes the stages of designing, selecting, and making appropriate teaching aids to teach a concept, principle, and theory of science. In designing teaching aids, it is necessary to pay attention to the concept underlying the use of the tool or the working principle of the tool. There are three feasibility criteria for choosing good teaching aids, namely practical, pedagogical, and cost feasibility [8].

Elin Rahmawati's research entitled "The Potential of Fun Fraction Set Teaching Aids in Improving Understanding of Fraction Concepts for Mentally Disabled Students" has the purpose of this research is to improve the understanding of fraction concepts for mentally disabled students and interactive multimedia as an innovation in the use of fun fraction set teaching aids in online learning for mentally disabled students [9]. Suparman's research entitled "Improving Counting Ability in Children with Mild Mental Retardation Through Card Game Media", the purpose of this research is to improve the learning achievement of counting in mentally disabled children, this research uses a comparative descriptive method. [10]. Very Hendra Saputra's research entitled "Design and Construction of a Mobile-Based Mathematics Game Application for Mentally Disabled People", the purpose of this research is to create an educational game for recognizing numbers and arithmetic to increase the interest and motivation of mentally disabled

students in recognizing and calculating numbers. This research uses the development method used, namely the Multimedia Development Life Cycle (MDLC) [11]. K Ampek's research entitled "Design of Interactive Learning Media for Science Subjects for Children with Mild Mental Retardation in Class VIII at Amanah Bunda Special Needs School, Sitapung, Nagari Balai Gurah, Ampek Angkek District, Agam", the aim of this research is to design interactive learning media for science subjects regarding human growth and development, this research uses the research and development (RND) method [12].

Previous research conducted by Annisah Nur Aini with the title "Electrical Circuit Demonstrators as an Effort to Improve Learning Outcomes of Deaf Students of Junior High School Grade IX," the purpose of this research is to describe the form of development of electrical circuit demonstration tools, determine the feasibility, and determine the practicality and effectiveness of the products developed, this research uses the research and development (RND) method [13]. Nurfianti Amiruddin's research with the title "Development of Simple Science (Physics) Practical Tools for Deaf Children" the purpose of this research is to produce simple science practical tools for deaf children on the material of heat transfer by radiation. This research uses the research and development (RND) method [14].

Rahmat Saputra's previous research entitled "Design of Automatic Lighting Installation Teaching Aid Using PHOTOCHELL Sensors and Motion Sensors in Lighting Installation Subjects at SMKN 2 Sinabang", the purpose of this research was to determine the feasibility of teaching aids and student learning outcomes regarding the design of automatic lighting teaching aids using photochell sensors. This research used the research and development (RND) method [15]. Jumiati's previous research entitled "Design of a Micro Hydro Power Plant Miniature as a Teaching Medium for Vocational High School Students", the purpose of this research was to determine how to design a micro hydro power plant miniature to determine whether it is suitable for use as a teaching medium. This research used the research and development (RND) method [16].

This study's teaching aids differ from those in prior research. The 3 studies above designed teaching aids for mentally retarded children and 2 for deaf children. When viewed from teaching aids related to the field of electrical engineering, previous research conducted by Rahmat and Jumiati, between the two previous studies there are differences between this study and the previous study, where the previous study designed teaching aids for vocational high school students, while this study designed teaching aids for students with special needs. The purpose of this study is to find out the design results and the feasibility of hydroelectric power plant teaching aids for students with special needs.

## Method

This study uses the Research and Development (R&D) method with a quantitative approach [17]. The development model used refers to the steps of Borg & Gall but is only limited to the 6th stage. This limitation is made because 7, 8, 9, and 10 are usually used for development research with higher expenditures and broader research subjects and a larger budget [18]. Therefore, the researcher limited the steps to the sixth stage only. The purpose of this study is to test hydroelectric power plant demonstration tools in science subjects.

Steps in the research flow for designing a miniature hydroelectric power plant.

1. Potential Problems

The first step in collecting data and information was to observe students at the Bulkesra Special Needs School in Banda Aceh. At that time, there was no use of miniature hydroelectric power plant demonstration tools for science. Therefore, the researcher sought to design a demonstration tool for a hydroelectric power plant in science.

2. Data Collection

Once potential and problems have been identified, the next step is to gather information to form the basis for product planning. In this study, data collection was conducted through observations and interviews with teachers competent in science, particularly those experienced in working with students with special needs. Observation activities focused on the learning needs of students with special needs, including cognitive abilities, learning characteristics, concentration levels, and the need for visual, concrete, and easy-to-operate learning media. In addition, researchers also identified the classification of students with special needs who were targeted for the use of teaching aids, such as students with intellectual disabilities, to ensure the suitability of the design and function of the teaching aids. Interviews with teachers were conducted to obtain information on the extent of students' initial understanding of the concepts and basic components of hydroelectric power plants, including an introduction to the main parts of the teaching aids. Interview results showed that most students were familiar with several components that would be used in designing demonstration equipment, such as dynamos, water wheels, lamps, and pulleys. However, students still had limited understanding of the working concept of hydroelectric power plants, so demonstration equipment that was designed to be simple, safe, and interactive was needed. In addition, the researchers also conducted a literature review through scientific journals, books, and relevant references that discussed the design of miniature hydroelectric power plants.

3. Design of Teaching Aids

Before making a demonstration tool, it is necessary to have a design that will be used. The initial design of the hydroelectric power plant can be seen in Figure 1.

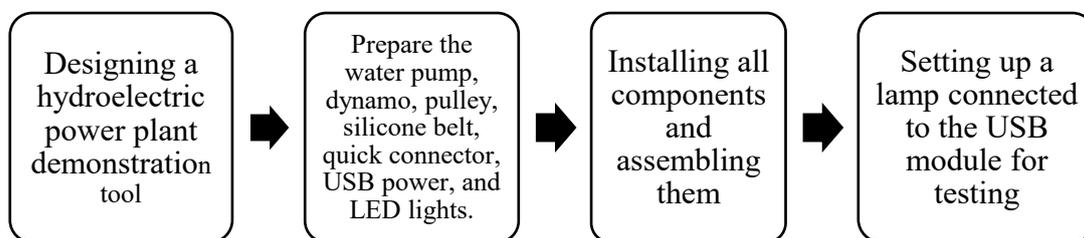


Figure 1. Initial Design of Hydroelectric Power Plant.

The tools and materials that will be used in the tool design and testing are shown in Table 1 below.

Table 1. Tools and Materials Used

No	Tools	Materials
1	Screwdriver	Dynamo
2	Cutting Pliers	Pullover
3	Soldering Iron	LED Light
4	Acrylic	Water Pump
5	Cutter	Cable
6	Ruler	USB Module
7	Pencil	Silicone Belt
8	Glue	Quick connector

#### 4. Validation of Teaching Aids

Validation is a procedure carried out to assess the feasibility of a product design before it is used in learning. In this study, validation was conducted by experts through assessments of both material and media aspects. The validation process involved four teachers from SLB Bulkesara Banda Aceh, consisting of two material experts and two media experts. The material experts were tasked with assessing the suitability of the material and its relevance to the learning content, while the media experts assessed the appearance, durability, and ease of use of the teaching aids.

#### 5. Testing of Teaching Aids

Teaching aid testing is a trial process carried out on a hydroelectric power plant teaching aid designed by researchers. The aim is to determine the teaching aid's suitability for use. This testing includes both materials and suitability. The teaching aid testing will be conducted by teachers at the Bulkesra Special Needs School in Banda Aceh.

This research was conducted at the Bulkesra Special Needs School in Banda Aceh, involving teachers who are competent and experienced in teaching science to students with special needs. The study population consisted of all 20 teachers at the Bulkesra Special Needs School in Banda Aceh. The research sample was determined using a purposive sampling technique, involving four teachers who specifically teach science subjects. Sample selection was based on professional considerations, teaching experience, and the teachers' understanding of the characteristics and learning needs of students with intellectual disabilities. This approach provides an element of recency because the data obtained are sourced from respondents who have direct relevance to the development and evaluation of miniature hydroelectric power plants as adaptive and contextual science learning aids for students with intellectual disabilities.

In this study, a validation sheet was used as an instrument used in the study. The validation sheet is divided into 2, namely material validation and media validation. On the material validation sheet, there are 13 questions about the relationship between teaching aids and learning designs in science subjects, especially the material on recognizing electrical energy, and on the media validation sheet, there are 13 questions about the suitability of hydroelectric power generation teaching aids for students with special needs, with alternative answer choices (1) Very inappropriate, (2) Not appropriate,

(3) Neutral, (4) Appropriate, and (5) Very appropriate. This validation sheet is filled in by ticking the answers filled in by the teacher.

In this study, the data analysis technique used was quantitative data analysis. Quantitative data analysis uses data obtained in the form of assessment results from teachers through validation sheets. This study will use data analysis using validation sheets[19]. The percentage of suitability of teaching aids can be seen using the following equation:

$$Percentage = \frac{Total\ score}{Maximum\ Score} \times 100\% \quad (1)$$

Description

P = Percentage Value

F = Total Value AND

N = Maximum Total Value

## Result and Discussion

This study involved students of the Special Needs Senior High School (SMALB) Bulkesra Banda Aceh for the 2025–2026 academic year. Students have diverse disability characteristics, including blindness, deafness, mental retardation, physical disability, and autism, spread across grades X, XI, and XII. An overview of student distribution based on disability category and grade level is presented in Table 2.

Table 2. Student Data Based on Disability Category and Grade Level

Disability Category	Class X	Class XI	Class XII	Amount
Blind	3	3	2	8
Deaf	3	1	2	6
Mentally Impaired	2	4	7	13
Physical Impairment	-	1	-	1
Autistic	-	1	1	2
Total	10	13	7	30

Based on the table above, the mentally retarded category is the largest group of students, with 13 students. This served as the basis for selecting the research subjects, as mentally retarded students require concrete and visual learning media to aid their understanding of electrical energy concepts, particularly in the electrical energy topic.

### a. Research Results

The design of the hydroelectric power plant converts water energy into mechanical energy and electrical energy. The design of the hydroelectric power plant demonstration tool uses main components, including a water pump, water wheel, pulley, silicone belt, dynamo, USB module, quick connector, and LED lights. The design results of the hydroelectric power plant demonstration tool can be seen in Figure 3.

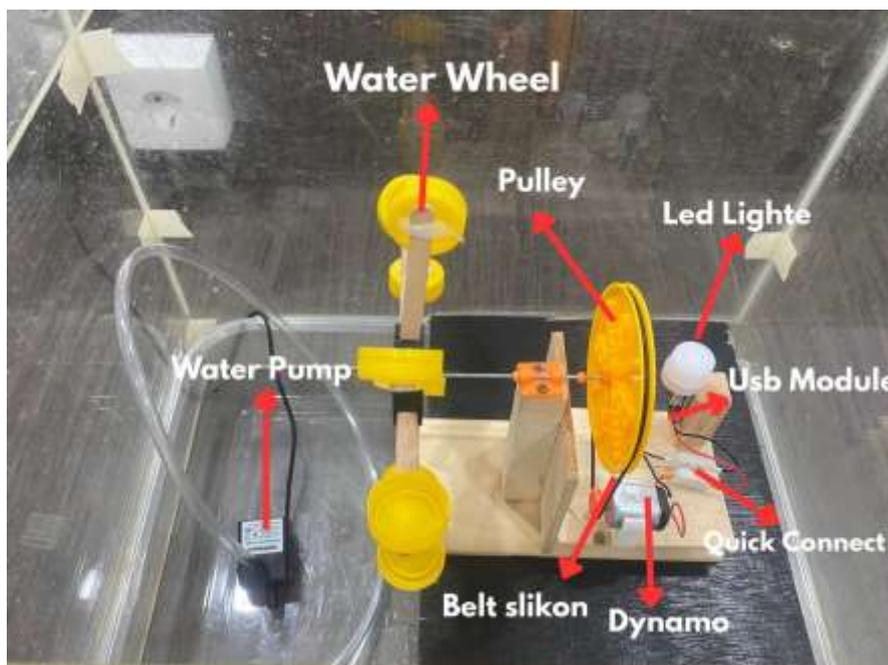


Figure 2. Results of the Teaching Aid Design

How the hydroelectric power plant demonstration device works: First, the water pump functions to flow water from the reservoir towards the water wheel. The water flow hits the water wheel blades, resulting in rotation. This rotation of the wheel is a form of conversion of mechanical energy into electrical energy. Next, the rotation of the wheel is transmitted to the pulley via a silicone belt. This transmission system functions to increase the rotation speed which will be transmitted to the dynamo. The dynamo works as a generator that converts mechanical energy into electrical energy based on the principle of electromagnetic induction. The electric current generated from the dynamo is then channeled through a quick connector to the USB module. The USB module functions as a voltage regulator so that the electrical output is more stable and can be used for small electrical loads. One of the loads used is an LED light, which is an indicator that the electrical energy is successfully generated by the system [20].

#### b. Results of Testing Hydroelectric Power Plant Demonstration Equipment

The testing of the teaching aids was done in 2 validation aspects, namely media and material validation. This validation was carried out by 4 teachers at SLB Bulkesra Banda Aceh, where 2 teachers were material experts and 2 teachers were media experts. The purpose of the media and material validation trial was to determine the suitability of the hydroelectric power plant teaching aids for students with special needs and whether they could be used in the teaching and learning process, especially in science subjects. In testing the teaching aids, the researcher explained and practiced in detail how the hydroelectric power plant teaching aids worked to validators who were experts in science subjects, then one of the validators explained the working system of the hydroelectric power plant teaching aids to his students. After explaining and practicing with several students, the validators then assessed the hydroelectric power plant teaching aids. The validation for testing the hydroelectric power plant teaching aids is as shown in table 3.



Figure 3. Testing of Teaching Aids

Table 3. Material Validation Results

No	Indicator	Aspect Question	Criteria	
			Validator 1	Validator 2
1	Learning Objectives	Enhancing students' knowledge of electrical energy.	5	5
2		Assist students in implementing electrical energy.	5	4
3		Increase student ability.	5	5
4		Align with learning objectives.	5	5
5	learning materials	Helps explain of electrical energy more concretely.	4	5
6		Presents material in accordance with the concepts	5	4
7		The material presented aligns with the curriculum.	5	4
8		Serves as a learning aid, especially in science subjects.	5	5
9	Time	Helps speed up the explanation of electrical energy material	4	5
10	Benefits	Facilitates the delivery of electrical energy materials.	5	5
11		Assists in the learning of electrical energy materials.	5	4
12		Differentiates hydroelectric power plants from other power plants.	5	4
13		Helps students understand the benefits of the trainer	5	5
Amount			<b>63</b>	<b>60</b>
Percentage			<b>97</b>	<b>92</b>
Percentage of amount			<b>95</b>	

Based on the validation results conducted by 2 material experts, it shows that the material is quite complete. The purpose of the material validation test results is to ensure that the content of the material and the concept of hydroelectric power plants delivered through the teaching aids are in accordance with the applicable science or natural science education curriculum in SLB, especially at the high school level and the type of special needs of students. Next, a media validation test is carried out to determine whether the hydroelectric power plant teaching aids are suitable or not for use by children with special needs. The validation of the hydroelectric power plant teaching aid media is as shown in table 4.

Table 4. Media Validation Results

No	Indicator	Aspect Question	Criteria	
			Validator 1	Validator 2
1	Concept Applicability	Explains the working concept of a hydroelectric power plant more realistically.	5	5
2		Explains the concept of a hydroelectric power plant accurately.	5	5
3	Appearance	The shape of the demonstration equipment is attractive to students.	4	5
4		The layout of the indicators and components of the demonstration equipment is precise.	5	5
5	Durability	The materials used in teaching aids are durable.	5	4
6		They do not require special maintenance.	4	5
7		They are long-lasting.	4	4
8	Size	They are easy to transport into the classroom.	5	5
9		They are easy to store and use.	5	5
10	Material	The tools and materials used are readily available.	5	5
11		The tools and materials are affordable.	5	4
12	Operation	The demonstration equipment is simple to operate.	4	5
13		The demonstration equipment explains the concept of hydroelectric power generation.	5	5
Amount			<b>61</b>	<b>62</b>
Percentage			<b>94</b>	<b>95</b>
Percentage of amount			<b>95</b>	

The validation results show that the use of teaching aids is quite efficient, but it is necessary to ensure that the components work stably so that it does not require a long time for preparation and can also add component marker labels to make it easier for students to identify. The results of the validation graph by media and material experts can be seen in Figure 4. Figure 4 shows the results of the validation test of the hydroelectric power plant demonstration tool for children with special needs, which has been assessed as very suitable for use as a demonstration tool in science subjects, especially electrical energy material. The validation results show that in terms of media, the hydroelectric power plant demonstration tool is in accordance with the provisions of the theoretical concept of electrical energy with a percentage result of 95%. In terms of material, the demonstration tool is also in accordance with the existing theoretical basis with a percentage result of 95%. This expert validation provides confidence that the use of hydroelectric power plant demonstration tools in science learning will provide significant benefits for children with intellectual disabilities. With the support of appropriate media and materials, students will more easily understand the basic concepts of electrical energy and can develop skills and assist teachers in the teaching and learning process. Therefore, the use of hydroelectric power plant demonstration tools as learning demonstration tools is highly recommended in the teaching and learning process for children with intellectual disabilities.

Based on the result above, this research was conducted to design and test the feasibility of a hydroelectric power plant demonstration tool for students with special needs, using the Research and Development (R&D) research model with research steps that broadly include the design of demonstration tools, concept preparation, determining tools and materials, testing tools, and then completing data collection. The results of the design of hydropower teaching aids for children with special needs using very simple tools in the form of 1 water pump, 1 dynamo, a USB module, a quick connector, and LED lights as lighting, after all the equipment is adequate, the teaching aid design is made, then the teaching aid validation is carried out by expert teachers in the field of science, and testing the teaching aids is the final step taken to test the tool to see whether it is suitable for use and in accordance with the material being studied.

The working principle of the hydroelectric power plant demonstration device begins with the process of flowing water from a reservoir using a water pump. The pump flows water through a hose to a vertically mounted water wheel. The water pressure coming out of the end of the hose hits the water wheel blades, causing the wheel to rotate continuously. The greater the water drop that falls onto the turbine, the greater the electrical energy generated from the rotation of the dynamo [19]. The rotation of this water wheel is a form of converting the potential and kinetic energy of water into rotational mechanical energy. This principle is similar to the working system of a real hydroelectric power plant, where the water flow is used to rotate the turbine as the main driver of the electric generator. Furthermore, the mechanical energy from the waterwheel is transmitted to a mechanical transmission system consisting of a shaft, pulley, and a silicon belt. This transmission system functions to increase the rotation speed that will be transmitted to the dynamo by utilizing the difference in pulley ratios. This principle of increasing rotational speed is important to ensure that the dynamo can produce sufficient electrical voltage even though the water energy source comes from a small discharge. The

transmission system also helps stabilize the rotation so that it produces more consistent power. The mechanical energy that reaches the dynamo is then converted into electrical energy through the principle of electromagnetic induction; namely, when the coil on the dynamo rotates, an electrical potential difference will be created [20]. The dynamo acts as a mini generator that converts kinetic energy into electrical energy [21]. The electrical current generated by the dynamo is channeled through a quick connector to a USB module, which functions as a rectifier and voltage regulator to make the output voltage more stable. This module allows the electric current to be used for various small electrical loads safely and efficiently. As proof of the system's success, an LED light is used as a load. When water flows and the waterwheel rotate, the dynamo generates electricity, the USB module stabilizes the voltage, and the LED light turns on. This shows that the demonstration system has successfully converted water energy into usable electrical energy. In addition, the water that falls after turning the waterwheel will return to the reservoir, so the system can work circulative with the help of a water pump to circulate the water back to the waterwheel. This model illustrates the basic principles of hydroelectric power generation in a simple way, making it very effective for use as a learning medium, including for students with special needs.

Based on the research results, the hydroelectric power plant teaching aids for students with special needs at SLB Bulkesra Banda Aceh have gone through a validation process by media and material experts. In the media test, the experts gave a percentage value of 95%, while the material test obtained a percentage value of 95%. Therefore, overall, the hydroelectric power plant teaching aids for students with special needs are "very suitable" for use in science subjects, both in terms of media and material. The validation carried out by media and material experts provides confidence that the hydroelectric power plant teaching aids are able to convey appropriate and easy-to-understand material with the support of appropriate media. Thus, the hydroelectric power plant teaching aids can be a good choice to help students understand the concept of electrical energy better.

The results of this study are different from the results of Elin Rahmawati's research; the results of the student test are included in the very effective category with an average value of 81.4 and a percentage of student learning completion of 80% [9]. In Suparman's research, the initial average value of fourth-grade mentally retarded students in mathematics was 42.50, while after carrying out classroom actions, the average value of students in arithmetic became 65.83 [10]. Very Hendra Saputra's research, based on the results of validation by material and media experts to see the feasibility of the media, obtained an average score of 42.5, which indicates that the media is suitable for use as a learning medium, and based on the black box test, the application function has run well. The results of this game research can also be operated on Android-based cellphones [11]. K Ampek's research, the test subjects in this study were Class VIII Mild Mentally Retarded Children. The results of the research on interactive learning media in science subjects obtained an average validity test value of 0.80 with very valid criteria, a practicality test average value of 0.89 with very high criteria, and an effectiveness test average value of 0.80 with very effective criteria [12].

Based on the review of previous research, it can be concluded that most studies emphasize the effectiveness of learning media or improving learning outcomes for students with intellectual disabilities through conventional or digital approaches. However, these studies have not integrated learning media designs based on the working systems of hydroelectric power plants packaged in miniature form as educational props, especially to support contextual engineering and science learning. Therefore, this study has innovations in the aspect of developing learning media in the form of miniature hydroelectric power plants that function not only as visual aids, but also as interactive props designed according to the characteristics and learning needs of children with special needs.

The results of this study are different from the results of Annisah Nur Aini's research. The product feasibility test obtained a percentage of 87.37% with a very feasible category. The results of the practicality test by students and teachers each obtained a percentage of 88.61% and 93.75% with a very practical category [13]. Nurfianti Amiruddin's research, based on the results of the feasibility test of the teaching aids, showed that the percentage for the design aspect of the tool was 93.18% with a very feasible category, for the suitability aspect of the tool was 93.18% with a very feasible category, for the quality aspect of the tool was 86.36% with a very feasible category, and for the operational aspect of the tool was 87.50% with a very feasible category. The results obtained in conducting the practicum were 77.27% with a feasible category. Based on the results of the student response test, the percentage obtained was 89.2%; the results of the teacher response test were 89.77% with very appropriate criteria; and the percentage results by media experts were 90.91% with very appropriate criteria [14].

based on the findings of Nurfianti Amiruddin's study, which concentrated on the creation of educational tools that were evaluated from a number of angles, such as design, material compatibility, tool quality, and usability. The test results demonstrated that the aids performed exceptionally well in practically every part of the evaluation, meeting the eligibility requirements. Additionally, students and teachers responded well to the use of the aids in practicums, which also produced rather decent results. The results of this study are different from the results of Rahmat Saputra's research, related to automatic lighting demonstration tools using photocell sensors; the feasibility test obtained a percentage value of 83% with a very feasible category [15]. In Jumiati's research, related to micro hydro demonstration tools, the feasibility test obtained a percentage value of 93% with a very feasible category [16]. The research conducted by Rahmat Saputra and Jumiati focused on the design of demonstration tools for vocational school students. The results of the study showed that the demonstration tools were suitable for use in learning and were able to improve vocational school students' understanding of the concept of electrical automation systems and micro hydro demonstration tools.

Compared to previous studies, this study has its own uniqueness and advantages for children with intellectual disabilities, not for children with hearing impairments as in previous studies. Furthermore, the results of this study show a feasibility level of 95% with a very feasible category, which means it has a higher feasibility value than previous studies. Thus, the teaching aids designed in this study not only meet the criteria for excellent feasibility but are also more relevant to the learning needs of students with

intellectual disabilities, thus potentially providing a more effective and inclusive learning impact.

Hydroelectric Power Plant (PLTA) teaching aids for students with special needs have several advantages, especially in supporting concrete and visual learning processes. These tools can help students directly observe the process of converting energy from water to electricity, allowing abstract concepts to be understood through real-life experiences. Furthermore, these teaching aids can increase students' motivation to learn, especially for children with intellectual disabilities. However, hydroelectric power plant teaching aids also have several disadvantages. Using the tool requires the assistance of a teacher who understands how the tool works, thus requiring special training for educators. Some students with special needs may need more time to understand the step-by-step process of how a hydroelectric power plant works.

## Conclusion

Researchers have successfully designed a miniature hydroelectric power plant as a teaching aid for science at the Bulkesra Special Needs School in Banda Aceh. The design demonstrates the working principles of a hydroelectric power plant in a simple and engaging manner. Furthermore, the use of this miniature can help students with intellectual disabilities understand the concept of electrical energy more concretely, increase their attention span, and facilitate the teaching process for teachers. Based on the results of the validation of media experts and material experts, the hydroelectric power plant demonstration tool was categorized as "Very Suitable" for use by students with special needs in science subjects.

There are still numerous issues that need to be fixed, despite the fact that this study makes a significant addition to the documentation of the usage of hydroelectric power generating teaching aids. By including an LCD screen and a current sensor, it is intended that more research may be done to improve the tool's design and make it more instructive. With these enhancements, it is anticipated that the tool will be widely used by kids with special needs as well as those with intellectual disabilities.

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