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Research Article

Development of an ESD-oriented Energy Teaching Module with A Differentiated Learning Approach

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Abstract.
In the modern era of dependence on energy resources, insufficient understanding of energy concepts can hinder an individual's ability to make wise decisions about energy use, address environmental problems, and contribute to sustainable development. The urgency of integrating education for sustainable development (ESD) into an educational curriculum that is adapted based on students' conditions is becoming increasingly clear. This research aims to develop a teaching module on energy concepts oriented toward ESD with a differentiated learning approach (teaching at the right level). The module development methodology follows the analysis, design, development, implementation, and evaluation (ADDIE) framework, focusing on the development stage. The development process involved in-depth analysis of the different ESD learning needs of students, so that the modules could be tailored to their level of understanding and learning styles. The results of this research are teaching modules that are innovative and relevant to global energy and ESD issues. This module has not yet undergone the implementation stage but has gone through a careful development stage. The benefits of teaching modules developed with a differentiated approach to energy concepts, within the ESD framework, can contribute to a better understanding of energy and sustainability issues throughout the world.

Keywords: differentiated learning, ESD, energy, teaching module

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1. Introduction

In a modern era characterized by increasing dependence on energy resources, a deep understanding of energy concepts is key to making wise decisions about energy use, overcoming environmental challenges, and effectively contributing to sustainable development [1,2,3]. However, it is important to acknowledge that understanding the concept of energy is still an unresolved problem at various levels of education [4]. This problem becomes more critical when we consider the complexity of the global energy issues we are currently facing [5]. In 2020, Indonesia introduced the concept of the Independent Curriculum, a differentiated learning approach which aims to provide independence

in the learning process for students [6]. With this approach, learning becomes more adaptive and inclusive, allowing each student to develop according to their own needs and interests. However, to realize the vision of the Independent Curriculum, appropriate and innovative learning materials are needed. The importance of integrating Education for Sustainable Development (ESD) in the Merdeka Curriculum becomes increasingly important, especially when we consider the complexity of energy and sustainability issues in the world today [7]. Apart from that, there is another component, namely the teaching module, which has an important role in increasing learning effectiveness [8]. This is the background to which this research was carried out. This research aims to develop an ESD-oriented energy concept teaching module with a differentiated learning approach, which is in accordance with the spirit of the Independent Curriculum.

Previous research in the context of energy education and ESD has provided valuable insights into how the integration of energy concepts can be carried out in the curriculum [9-13]. Some studies focus on developing energy-oriented teaching materials [14-17]. While others explore effective learning approaches in the ESD context [18-20]. However, there is a gap that needs to be addressed. Previous research tends to pay less attention to the diversity of students' levels of understanding and their learning styles, which is key to the adaptive Independent Curriculum approach [21-23]. In addition, there is still little research that integrates energy concepts in the context of global issues related to ESD, such as climate change and energy sustainability [24,25]. The knowledge gap that this research will fill is the lack of teaching modules that are ESD-oriented and use a differentiated learning approach in the context of energy concepts.

This research focuses on developing energy concept teaching modules oriented towards ESD with a differentiated learning approach. This research focuses more specifically on the module development stage, with the implementation and evaluation stages outside the scope of this research. The teaching module developed in this research is expected to fill this gap by providing innovative learning tools that can be adapted to various levels of student understanding. It is hoped that the teaching module developed can help increase students' understanding of energy and sustainability issues, which in turn can help them make wise decisions about energy use and contribute to sustainable development. In addition, this research contributes to the development of more effective and inclusive learning methodologies in the ESD context.

2. Method

In this research, the subjects studied were students in a high school environment by investigating their understanding of energy concepts. This research was conducted in Rembang. The selection of this location is based on considering variations in student characteristics, such as socioeconomic background and initial level of understanding of energy concepts. This research uses a research and development design and approach or is included in development research. The module development methodology follows the ADDIE framework, focusing on the design stage [26,27].

In developing this teaching module based on the ADDIE framework, the first step taken was a preliminary analysis [28]. The development process involves in-depth analysis of the different ESD learning needs of learners, so that the modules can be tailored to their level of understanding and learning style. Analysis is a strong foundation for developing energy concept teaching modules oriented towards ESD with a differentiated learning approach [29]. Preliminary analysis was carried out by analyzing the use of teaching materials in 5 schools in Rembang. The results of this analysis of teaching materials reveal that there is still a lack of ESD concepts in teaching materials, so it is very important to use teaching materials that are in accordance with the principles of ESD and differentiated learning approaches in the Rembang context. Rembang as a research location is a region that offers heterogeneous characteristics in terms of students' socioeconomic background and level of initial understanding of energy concepts [30,31]. The use of ESD-oriented teaching materials is becoming increasingly important in here, because it can help students understand the impact of energy use on their unique environment. In addition, differentiated learning also becomes relevant in this environment because students have different levels of understanding [32]. In this context, analysis The introduction highlights the urgent need to develop teaching modules that not only integrate ESD principles, but also implement a differentiated learning approach that enables the delivery of material appropriate to each student's level of understanding and learning style [33]. Thus, preliminary analysis shows that the development of teaching materials that are relevant to global energy issues and responsive to the characteristics of students in Rembang is a significant step and has a large potential impact in promoting a better understanding of energy and sustainability concepts among students. students in the area. Analysis of the initial conditions was then carried out using a literature study. Literature study by analyzing 82 articles discussing differentiated learning. The evaluation results of 82 articles show that this differentiated learning method can be combined with various learning models and has

the potential to improve learning achievement and student enthusiasm in the learning process. Apart from that, research also shows that there are opportunities to apply a differentiated learning approach in the framework of strengthening student profiles in terms of Pancasila. These results are used as a basis for developing ESD-oriented teaching modules with a differentiated learning approach.

After analyzing the initial conditions, the next stage is the design stage (26). The design stage is the initial step that focuses on basic planning and design of the teaching modules to be developed [34]. At this stage, this is done by detailing the overall module structure. This includes establishing how the module will be organized, how many chapters or sections there will be, and the order in which the material will be presented. This structure provides a framework for the entire module. The next step is to set learning objectives. Learning objectives must be set clearly and measurably. These are the expected outcomes of students' use of the module. These objectives will serve as a guide for designing material content and activities that are in line with these objectives. The design stage also includes planning a diagnostic assessment that will be used to measure students' initial understanding of energy concepts before using the module. This assessment helps determine students' initial level of understanding and becomes the basis for designing appropriate activities [35]. Next, the learning material is designed. The learning material that will be presented in the module will be designed in more detail. This includes determining the content of material relevant to energy concepts, explaining the material in easy-to-understand language, and organizing the material logically and sequentially. This involves the initial arrangements for how the material will be presented and how students will engage in learning. The next step is creating learning activities by developing various activities that invite students to actively participate in the learning process. These activities include case studies, experiments, group discussions, and project assignments. Apart from that, the teaching module design also develops teaching strategies that are in accordance with ESD principles and a differentiated approach based on the independent curriculum.

After the design stage is complete, the development stage takes place in more depth. At this stage, this is done by filling the module with material content that is in accordance with the learning objectives that have been set. This content is presented in language that is easy for students to understand and logically follows a planned structure. Learning activities that have been designed at the design stage will be translated into concrete form. This includes creating step-by-step instructions for each activity, developing additional materials needed to support the activities, as well as creating additional resources such as worksheets, experiment guides, or case examples.

Implementation of learning strategies by implementing teaching strategies that have been planned at the design stage. During this stage, the module will be enriched with various elements that support the learning process, such as case studies, experiments, group discussions and project assignments. This activity involves the use of technology and tools and materials that are appropriate to a predetermined differentiated learning approach. Next, the module will be compiled and arranged to suit the format set by the Center for Teacher Mobilization. This includes arranging chapters or sections, naming the parts, and organizing the content of the material so that it is easy for students to access and understand. So, the design stage focuses more on planning and initial arrangement of the module, while the development stage involves filling and enriching the module with material content, concrete learning activities, and teaching strategies that support student understanding.

3. Result and Discussion

3.1. Preliminary Analysis

Analysis of initial conditions is an important first step in developing energy concept teaching modules oriented towards ESD with a differentiated learning approach. This analysis was carried out through two approaches: analysis of teaching materials used in five schools in Rembang and literature study on differentiated learning. The results of the analysis of teaching materials show that the teaching materials used in the Senior High School environment in Rembang still do not fully integrate the ESD concept. This indicates that students' understanding of energy and sustainability issues has not been strengthened through existing teaching materials. The lack of integration of ESD concepts in teaching materials highlights the urgent need to develop teaching materials that are more in line with ESD principles. The teaching module developed is expected to fill this gap and help students understand the impact of energy use on their environment. The relationship between ESD pillar indicators and the percentage of their appearance in the five teaching materials for all materials is shown in Figure 1.

Based on data from the analysis of class In the three materials studied, the environmental pillar has the highest percentage of appearances in the ESD pillar. This shows that there is awareness of the importance of environmental aspects in sustainable physics learning. In addition, it is necessary to develop teaching materials that pay more attention to the social and economic pillars in the ESD aspect so that students can understand the social and economic impacts of the topics studied in physics.

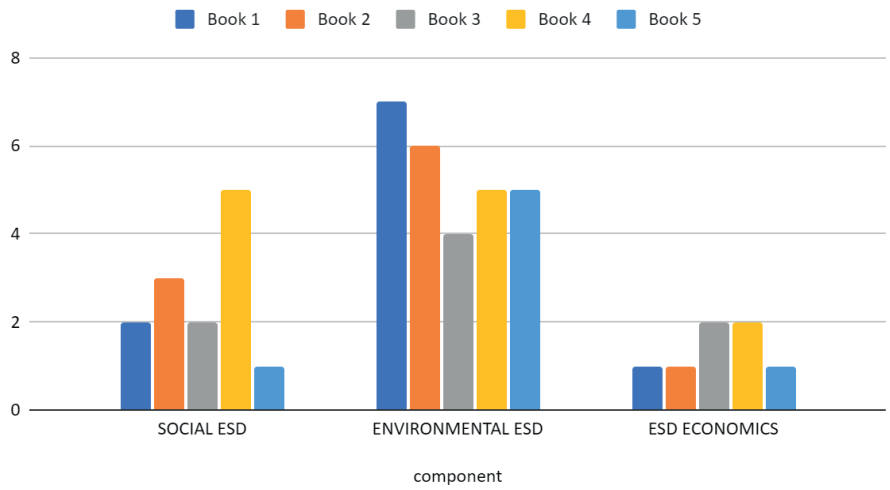

Figure 1: **Graph of the percentage of ESD pillars appearing in the five teaching materials for all materials.**

Analysis of literature on differentiated learning provides a strong theoretical basis for developing modules with this approach. Literature studies reveal that differentiated learning has the potential to improve student learning achievement and their enthusiasm for the learning process. The importance of a differentiated approach becomes relevant in the Rembang context, where students have varying levels of understanding of energy concepts. Teaching modules that are responsive to differences in students' levels of understanding and learning styles are expected to create a more effective learning experience. The results of the evaluation of 82 articles in the literature study also show opportunities to apply a differentiated learning approach in the context of strengthening student profiles related to Pancasila values. This indicates the flexibility and relevance of the differentiated approach in the broader educational context. The positive influence of differentiated learning on student learning achievement has been proven to be significant in a number of studies.

Some literature, as mentioned by [36-40], has revealed that the implementation of differentiated learning positively contributes to increasing student academic achievement. Students who follow this approach tend to achieve better learning outcomes compared to those who follow conventional learning methods. Teachers can consider student characteristics such as interests, profiles, learning styles, and level of learning readiness, so as to provide a more relevant and meaningful learning experience for each student [41-47]. This allows students to study at a level of difficulty appropriate to their abilities, ultimately helping them develop a better understanding and master the material more efficiently.

In addition, the differentiated learning approach encourages students to be actively involved in the learning process. Strategies such as flipped teaching, flexible grouping, and differentiated assignments give students the opportunity to participate in activities that suit their needs and interests [48]. This can increase students' intrinsic motivation and strengthen their engagement in the learning process. In addition, differentiated learning can meet students' individual learning needs. Each student has a different learning style, interests and level of understanding [49-51]. By accommodating these differences, differentiated learning ensures that each student receives a learning experience that meets their needs. This can increase students' self-confidence, motivate them to continue learning, and produce better learning outcomes. Analysis of the implementation of differentiated learning in previous research can be seen in Table 1.

Overall, the initial condition analysis which includes analysis of teaching materials and literature review underlines the urgency and relevance of developing energy concept teaching modules with an ESD approach and differentiated learning in Rembang. This step provides a strong basis for planning and developing teaching modules that suit student needs and ESD principles.

3.2. The Essence of The Teaching Module

This teaching module is carefully designed to combine ESD principles and differentiated learning strategies that suit student needs. The syntax in this teaching module is divided systematically to facilitate understanding for students with different learning styles. This teaching module consists of clear learning objectives, namely identifying and predicting problems in the application of energy transfer and transformation which are important for modern industrial society, their impact on human life through discussions, displays and simulations and presenting reports, as well as designing alternative solutions in the form of simple creative products for reducing the use of fossil energy in the field of renewable alternative energy such as solar energy or micro-hydro energy or wind energy according to surrounding environmental conditions, assembling products, evaluating products and communicating them well and persuasively [52]. Coherently structured material content. Varied learning activities, with a differentiated learning approach. Each section of the module is designed to stimulate students' critical thinking and reflection on energy issues with Sustainable Development Education in mind.

Furthermore, in this module the use of a differentiated approach is implemented through a variety of learning activities. Students are given the opportunity to choose

Table 1: Analysis of Previous Research on Differentiated Learning.

Author	Results	Measured variable	Research Methods
(Wahyuni, 2022; Wulandari, 2022; Maulidia, F. R., & Prafitasari, A. N., 2023; Insani, A. H., & Munandar, K, 2023; Pebriyanti, 2023; Mubarok, 2023; Widiastuti et al., 2020; Saputri, D. A., Nuroso, H., & Sulianto, J., 2023; Saadah, N., Wastri, L., Asmendri, A., & Sari, M., 2023; Ihza Pramudya, M. I., & Hidayati, H. N., 2023; Farid et al., 2022; Kriswanto & Fauzi, 2023; Zulaikha, I. P. N., & Laeli, A. F., 2023; Rigianti, 2023; Safarati & Zuhra, 2023; Marzoan, M, 2023; Hardi & Mudjiran, 2022; Jenyana, 2022; Hamik, M., & Sriwahyuni, E., 2022; Basra, H, 2022; Gusteti, M. U., & Neviyarni, N., 2022; Ningrum, M., & Andriani, R., 2023; Ngaisah, N. C., & Aulia, R., 2023; Handiyani & Muhtar, 2022; Fitra, D. K., 2022; Faiz et al., 2022; de Jager, 2013; Morgan, 2014; Brodersen & Melluzzo, 2017)	Differentiated learning is a learning strategy that can be integrated with learning models according to students' learning styles. Its application improves learning outcomes and student motivation. In science and other subjects, this approach is able to accommodate students' learning needs based on their interests, profiles, learning styles, and readiness. At various levels, differentiated learning has been proven to be effective and relevant in increasing student achievement, improving the quality of learning, and creating a pleasant atmosphere in the classroom.	implementation of differentiated learning, Student Learning Outcomes, motivation and enthusiasm for learning students	literature review
(Nur'azizzah, N., Pramuditya, S. A., & Rosita, C. D., 2023; Rafiska & Susanti, 2023; Hanaunnadiya, F., Azizah, M., Untari, M. F. A., & Purbiyanti, E. D, 2023; Anggarwati & Alfiandra, 2023; Yokoyama et al., 2023; Wuryani et al., 2023; Yanti et al., 2022; Marita, 2023; Nurlaili, N., Suhirman, S., & Lestari, M., 2023; Mirzachaerulsyah, 2023; Muslimin, M., Hirza, B., Nery, R. S., Yuliani, R. E., Heru, H., Supriadi, A., ... & Khairani, N., 2022; Khasanah & Alfiandra, 2023; Pratama, 2022; Alhafiz, 2022; Suprayogi et al., 2017; Mills et al., 2014)	Differentiated learning improves students' mathematical reasoning abilities by accommodating their learning styles. Teachers play an important role in designing learning according to the analysis of student characteristics. This strategy is also effective for teaching saga and PAI with multimedia. Differentiated learning has a positive impact on students' behavior and learning outcomes, Research shows its positive impact on students' learning motivation and literacy	student learning style profile, cognitive abilities, motivation and enthusiasm for learning, student learning achievement, literacy skills	qualitative descriptive research
(Rompis, 2023; Evendi et al., 2023; Jumiarti, D. N., 2023; Fitra, D. K., 2022;Sanjaya, P. A., 2022; Sutrisno, L. T., 2023; Bendriyanti et al., 2021; Made, R. K. N., 2022; Kamal, 2021; Suwartiningsih, 2021; Syarifuddin & Nurmi, 2022; Fitra, D. K., 2022; Nikolaou et al., 2017; Iskandar, 2021; Mulbar et al., 2017; Ferlianti et al., 2022)	Differentiated learning improves student learning outcomes by accommodating their learning styles and needs. The use of e-modules and the Merdeka Curriculum also provides benefits in learning outcomes. Overall, the application of differentiated learning improves XXI century skills and student learning outcomes.	pancasila student profile, learning outcomes, activity, interest, enthusiasm	classroom action research

the type of activity that suits their learning style, such as laboratory experiments, group

Table 1: Continued.

Author	Results	Measured variable	Research Methods
(Kusuma et al., 2023; Januar, 2022; Tanesib et al., 2022; Astiti et al., 2021)	Differentiated learning based on character values and local wisdom works well. Overall, this approach gives positive results in the learning process.	the effectiveness of character value-based differentiation learning	R&D
(Marantika et al., 2023; Widiastuti et al., 2023; Nurdini, 2021; Hamad, 2020; Ghazouani, 2018; Demir, 2021b; Bal, 2018; Variacion et al., 2021; Chandra Handa, 2019)	The teacher understands the concept and application of differentiated learning well. This approach improves student learning outcomes and motivation. Overall, this strategy is effective and produces a good teaching tool.	activeness, motivation, learning achievement, and creativity of students	mixed method
(Qomari et al., 2022; Laia, I. S. A., 2022; Mahdiannur, M. A., Erman, E., Martini, M., Nurita, T., Rosdiana, L., & Qosyim, A. 2022; Pane, R. N. P. S., Lumbantoruan, S., & Simanjuntak, S. D., 2022; Siagian, B. A., Simbolon, E. G., Bangun, K., Sidabutar, S., & Girsang, A., 2022; Demir, 2021a; Gray, 2020; Menekse et al., 2013; Progella, 2019; Brungel et al., 2020; Al-Shehri, 2020; Tahiri et al., 2017; Thapliyal et al., 2022; Meyad et al., 2014; Ismail et al., 2021; Dinç, 2017; Gregorius et al., 2010))	Differentiated learning according to students' learning styles makes learning more memorable and improves learning outcomes. This strategy has a positive impact on students' creativity and motivation. Despite challenges in implementation, inclusive and adaptive approaches still provide real benefits for student learning outcomes. Overall, differentiated learning is effective and beneficial in the learning process.	effectiveness, creativity, student achievement	quantitative approach

discussions, research projects, or essay writing. This allows each student to engage in activities that they find most effective and motivating for themselves [53]. Differentiated learning in this module is also integrated with the use of technology, such as the Merdeka Belajar platform, which allows students to access additional materials, videos or online resources that support their understanding [54].

3.3. Development of Teaching Modules

Teaching modules are important documents in the teaching process that detail the learning steps in detail [55]. A teaching module is a document that contains learning objectives, steps and media, as well as assessments required in one unit/topic based on the flow of learning objectives [56]. In the teaching module, the learning steps are explained in detail so that teachers can guide students effectively. In the teaching module there are 3 components, namely general information, core competencies, and attachments. General information includes the identity of teaching modules, initial competencies, Pancasila student profiles, infrastructure, target students, and learning models. Initial

competencies provide an explanation of predetermined learning outcomes [57]. The Pancasila student profile is a description of the character and attitudes that each student is expected to have as part of education in Indonesia [58]. This teaching module is designed by taking into account various infrastructure that supports an effective learning process. Classrooms, teaching materials, teaching aids and technology are the facilities and infrastructure that support learning activities.

This module is designed to provide inclusive and relevant learning for the majority of students. However, in a more specific approach, this module also considers students with different learning needs according to their learning styles. A differentiated learning approach is used to ensure that each student gets a learning experience that suits their needs, interests and learning style [59]. In this approach, learning materials, activities and assessments are adapted to the individual characteristics of students [60]. This allows students to learn at a level of difficulty that suits their abilities, so that they can develop a better understanding [61]. This energy teaching module facilitates students in making simple solar cells using a project based learning model. Figure 2 shows the steps for making a simple solar cell [62].

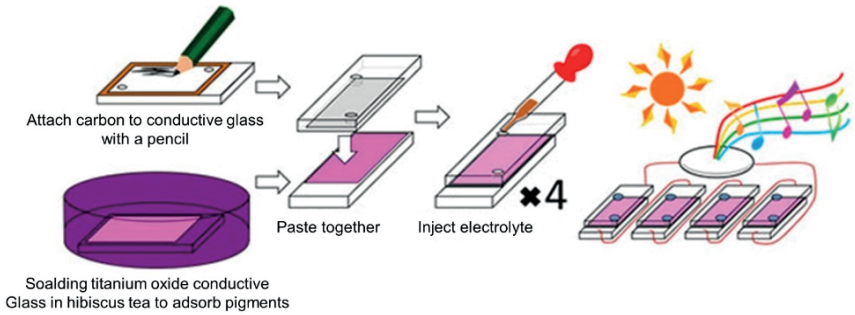

Figure 2a Bonding of electrodes

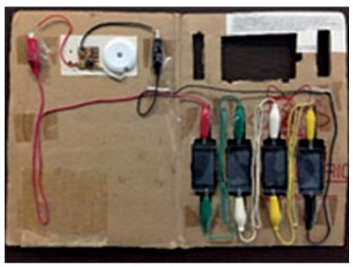

Figure 2b Solar cells connected in series

Figure 2: Making Solar Cells.

Core competencies include learning objectives, meaningful understanding, trigger questions, differentiated learning activities (content, process, and product), assessment (initial learning assessment, assessment during learning, final learning assessment, attitude assessment, performance assessment, and written assessment). Meaningful learning in this teaching module is the main focus to ensure students truly understand

the concept of energy and its impact in everyday life. Sparking questions in this teaching module have a very important role in triggering students' interest and understanding of energy concepts [63]. The differentiated learning activities in this teaching module are designed to accommodate various learning styles, initial levels of understanding, and student interests effectively. This approach focuses on differentiation in three main aspects: content, process and learning products [64]. Content differentiation refers to the use of learning materials that can be adapted to students' level of understanding and interests [65]. This teaching module provides information and resources that students can access according to their needs. For students who have a lower initial understanding of energy concepts, more basic content and more detailed explanations are provided. Process differentiation relates to the various methods used to deliver material and facilitate learning [66]. This module integrates various learning strategies. This teaching module offers a choice of various types of assignments, from written reports to multimedia presentations, from experimental design to energy innovation projects.

In this teaching module, the assessment or assessment process is an integral part of learning [67,68]. An initial assessment is carried out at the beginning of learning to measure students' initial understanding of energy concepts. Assessments during learning are carried out periodically throughout the learning process. The final assessment is carried out after students complete the teaching module. The attachment components include student worksheets, teacher and student reading materials, glossary, and bibliography. The teaching module in one of the meetings with the sub-material of designing alternative energy source products is shown in Table 2.

This teaching module is accompanied by a student worksheet which is shown in Table 3. Where the activity of making alternative energy in the form of a simple solar cell requires tools and materials including conductive (transparent) glass, ink (marking pen), small brush, transparent adhesive, cutter knife or scissors, 2 pieces of thin wire (around 15 cm), multimeter (if available), spotlight or direct sunlight.

The entire process of developing this teaching module reflects a commitment to increasing students' understanding of energy concepts with an approach that is in line with ESD principles, and ensuring that this module can be adapted to various levels of students' understanding. With these steps, this module has proven its validity and quality as an innovative learning tool that supports sustainable development.

Table 2: Sub-Material Teaching Module for Designing Alternative Energy Source Products (Solar Cells).

Activities (time)	Teacher Activities
Initial Preparation (5 minutes)	The teacher prepares all the equipment needed for learning activities, including materials for designing alternative energy source products.
Igniter Question (10 minutes)	The teacher starts the lesson with a trigger question: "Why is it important for us to design alternative energy source products such as simple solar cells? What are the benefits for the environment and our daily lives?"
Introduction and Explanation (15 minutes)	The teacher provides an introduction to today's learning topic, namely designing alternative energy source products, with a focus on simple solar cells. The teacher explains the learning objectives and details what the students will achieve.
Material Presentation (20 minutes)	The teacher explains basic material about alternative energy, especially simple solar cells. Teachers use different approaches according to students' learning types, such as visual examples, stories, or demonstrations for students with visual, auditory, or kinesthetic learning types.
Group discussion (25 minutes)	Students are divided into small groups according to their learning type (auditory, visual, kinesthetic). Each group was given the opportunity to discuss how to design a simple solar cell. The teacher provides guidance to each group based on their learning type.
Practical Activities (30 minutes)	Each group carries out practical activities to design simple solar cell products. Teachers provide guidance and supervision when students carry out practicums.
Evaluation (10 minutes)	Teachers and students jointly evaluate today's learning activities, including students' understanding and their success in designing simple solar cell products.

4. Conclusion

The development of ESD-oriented energy concept teaching modules with a differentiated learning approach has great potential in increasing students' understanding of energy concepts. This research was conducted in a high school environment in Rembang by focusing on students who have diverse socioeconomic backgrounds and different levels of initial understanding of energy concepts. Analysis of initial conditions shows that existing teaching materials are minimal in covering ESD concepts, so the development of ESD-oriented modules becomes very relevant in this context. Literature studies support the implementation of differentiated learning as an effective approach to improving student learning outcomes, enthusiasm for learning, and strengthening the Pancasila student profile. Differentiated learning allows the delivery of material that is appropriate to the level of understanding and learning style of each student.

In the context of this teaching module, there are important components such as general information, core competencies, and attachments. This module is also designed

Table 3: Student Worksheet for Making a Simple Solar Cell.

No	Activity Stages	Activity Steps
1.	Material Preparation	Prepare a clean and dry piece of conductive glass. Use extinguishing ink or a marking pen to make two thin lines, parallel, and about 2 cm apart in the middle of the glass. This will be your solar cell area.
2.	Adding Pigment	With a small brush, smear the area between the two lines you have made with blackout ink pigment. Make sure the pigment is even and not too thick. Let the pigment dry completely.
3.	Making Electrodes	Cut two pieces of see-through tape about 5 cm each. Stick one piece of see-through tape on each end of the conductive glass, covering the piece with pigment. These will be the positive and negative electrodes of your solar cell.
4.	Connecting Cables	Take one of the thin wires and connect the end to the positive electrode (the part coated with pigment). Do the same with the other thin wire on the negative electrode (reverse part). Make sure the cables are installed securely.
5.	Solar Cell Test	Place the solar cell that you have made in direct sunlight or a bright spotlight. Observe what happens to both ends of the wire. If you have a multimeter, connect the multimeter cable to both ends of the wire to measure the voltage (Volts) produced by your solar cell.
6.	Additional Experiments (Optional)	Try replacing the pigment with a different color and note what you observe. Test the solar cell under different light intensities, such as morning and evening sunlight, and record the results.

to support students with visual, auditory and kinesthetic learning styles. The identified learning objectives include understanding energy problems and their use, energy transformation, the law of conservation of energy, energy consumption problems, renewable alternative energy, and making simple solar cells. Apart from that, this module presents trigger questions, differentiated learning activities, and various types of assessments to measure student understanding. Thus, the ESD-oriented energy concept teaching module with a differentiated learning approach is an effective tool in facilitating students' understanding of energy and providing positive encouragement to their enthusiasm for learning. Overall, this research makes an important contribution to the development of more inclusive and relevant learning approaches, especially in the context of sustainable development.

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