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Development Of Ethnophysics-Based Teaching Materials To Improve The Self-Regulatory Skills Of Prospective Physics Teachers

Habibi[1], Lovy Herayanti[2*], Baiq Azmi Sukroyanti[3]

[1] Physiscs Education, Universitas Pendidikan Mandalika, Mataram, Indonesia.

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Corresponding Author:
Lovy Herayanti
lovyherayanti@undikma.ac.id

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Abstract: This development research aims to produce a product in the form of an ethnophysics-based learning tool to improve prospective physics teachers' valid and effective self-regulation. The products developed are Lecture Event Units known as SAP, Student Worksheets or LKM, Teaching Materials, and test instruments. The research design used is a 4D model consisting of Defining, Designing, Developing, and Disseminating. Data collection techniques use validation sheets and evaluation tools. Device validity data was analyzed using a Likert scale. Three expert validators assess product validity. Assessment by validators with valid to very valid criteria. The effectiveness of the teaching materials developed by researchers can be determined by increasing students' self-regulation based on the results of the N-Gain test after being given a pretest and posttest. The planning indicators show that the percentage of students who were suitable/suitable before implementing the ethno-physics learning model was 42%. This indicates that more than 50% of students have self-management related to learning planning that still needs to be improved. Applying the ethno-physics learning model as a stimulus to help students manage good learning planning contributed 36%, increasing to 78%. The monitoring indicator also has the same increase in the number of students as the planning indicator, namely 36%. This can be described as more and more students being able to manage their learning by monitoring their learning process. The evaluation indicator shows the largest percentage increase in the number of students, namely 38%, while it is only 28% for strengthening. This indicates that the ethno-physics learning model has the greatest contribution to stimulating students' evaluation abilities.

Keywords: Ethnophysics; Learning Material; Self Regulatory.

Introduction

The development of science, technology, and information in the 21st century is happening quickly. It is full of competition, so many people feel more familiar with foreign cultures than their own local culture and wisdom (Dewi et al., 2020; Aza Nuralita, 2020). To keep up with the demands of the 21st century, which emphasizes students' competence in investigating something that comes from various sources, describing a problem, thinking logically, and also being able to work together and collaborate in solving problems and achieving meaningful learning can be done by using the method of integrating cultural knowledge. in the learning process, reconstructing original knowledge from society into scientific knowledge is an important factor and needs to be considered (Sawitri et al., 2019; Yuliana, 2012). The integration of cultural knowledge into the learning process is called ethnoscience.

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Ethnoscience is cultural knowledge possessed by a region or nation. Parris (2010:) in an article entitled "Cultural Dimensions of Learning: Addressing the Challenges of Multicultural Instruction," explains that culture-based learning is very necessary for students because implementing culture-based learning will teach an attitude of love for culture and nation because ethnoscience-based learning will introduce students to the potential of a region so that students will become more familiar with the culture of their region. Ethnoscience as cultural knowledge also teaches children to be considerate towards friends with different cultural backgrounds. The noble culture inherited from our ancestors will gradually disappear under pressure from foreign cultures transformed by electronic media. It is hoped that with the role of education in cultivating ethnoscience-filled insights, students will have broader knowledge about their surrounding environment and avoid alienation from their environment.

Ethnoscience is an activity that can change the original science of society with science that has a scientific nature (Novitasari et al., 2017). Ethnoscience-integrated learning is an innovation in education that combines culture with science. Integrating ethnoscience in long-term learning will influence students' awareness of utilizing science and technology to provide solutions and protect the environment. Ethnoscience can be applied to various types of learning models. A model is a general pattern of behavior in learning to achieve the desired specific learning goals (Wijanarko, 2017). A learning model is a frame for implementing an approach, method, and learning techniques. The learning model is one of the learning components that serves as a guide in carrying out actions or activities.

Ethnophysics is linked to learning physics through local wisdom. Local culture can be brought into physics learning contextually so that students directly learn from the phenomena and conditions in the environment (Astuti et al., 2021). The characteristic of ethnophysics is that it links the culture of a region in the physics learning process, both as teaching material and as a learning process. This, of course, impacts student learning outcomes so that students can easily understand physics concepts contained in regional culture. (Lestari, 2023). Ethnophysics relates to knowledge originating from culture, which can act as a basis for building a reality that emphasizes the relationship between culture and physical knowledge. Learning physics is also close to ethnophysics, which is related to learning physics with the culture that exists in the region and is a legacy passed down from generation to generation (Putri & Noe, 2022). Ethnophysics is often paired with traditional games. Several traditional games in Indonesia contain physics concepts, one of which is *geulengkue teu peu poe*, which links to the concept of parabolic motion (Nurmasyitah et al., 2022). Traditional dance can also be used as an object of study connected to physics concepts. In one of the Soya-Soya regional dances, every movement made by the Soya-Soya dancer can be studied physically using various physical concepts, namely sound waves, moment of inertia, pendulum oscillations, collisions, and Pascal's law. This concept can develop in society without realizing it. Studying physics with ethnophysics can help students recognize Ternate's unique local wisdom and improve their knowledge of physics from a culture into real physics. By learning the typical local wisdom of Ternate, namely the Soya-Soya dance, students can increase their knowledge of physics concepts, changing the learning process from teacher-centered to student-centered learning (Astuti et al., 2022).

Apart from that, it is still related to regional culture being integrated into learning. Ethnoscience is a learning approach that integrates cultural themes and local knowledge into scientific studies. It aims to bridge the gap between traditional and scientific knowledge by recognizing and utilizing existing knowledge and practices within a particular culture or community. Ethnoscience learning includes presenting science-related cultural topics, reconstructing knowledge that develops in society, building concept mastery, and utilizing a scientific approach to explore knowledge and skills. By implementing ethnoscience learning, students can develop their scientific literacy and become more sensitive to everyday problems, finding solutions by applying scientific knowledge (Nabilah et al., 2022). Learning models that consider the cultural environment will produce a scientifically literate generation. In its implementation, students can organize strategies and tactics to determine problem-solving steps. Thus, learning organized educators must also understand their local knowledge (Dinissjah et al., 2019). Ahmad et al. (2020) also argue that ethnoscience-based learning aims to introduce students to facts that have developed in a society linked to learning material. Besides, ethnoscience in physics learning provides an alternative learning resource for understanding physics concepts (Asbanu, 2023). Using local culture in learning allows students to make direct observations, and students are trained to discover the concepts studied holistically, meaningfully, authentically, and actively (Damayanti et al., 2017).

Based on the results of PISA research, scientific literacy in Indonesia is still relatively low. In 2015, Indonesia was ranked 62nd and 70th among countries with an average score of 493; in 2018, Indonesia was ranked 74th out of 79 countries with a score of 396. These average scores are classified as low because they are below 500 (OECD, 2020).

Referring to the solution to overcome the problems above, Ogunkola (2013) and Bordner (1986) in Suwarto (2013) are to make students active in learning, namely by using learning media. Using teaching materials in learning activities is very important for teachers and students because by using teaching materials, teachers can easily increase the effectiveness of learning, and students will also have no difficulty learning (Sungkono, 2003). Teaching materials consist of two types: printed teaching materials, audio program teaching materials, and interactive teaching materials (Pras Towo, 2014).

Teaching materials are a learning media that play an important role in the learning process. Teaching materials can be defined as all materials (information, tools, and texts) arranged systematically, which display a complete figure of competencies that students will master and use in the learning process to plan and review learning implementation (Prastowo, 2015). So far, the science reconstruction process is still fully guided by lecturers. To overcome this problem, it is necessary to develop an ethnoscience-based teaching material that specifically discusses indigenous science/local wisdom and is equipped with several examples of local wisdom related to scientific science. The examples of science reconstructions presented in this teaching material can be used as a reference by students in carrying out science reconstructions for different topics. This teaching material can broaden students' insight and increase their confidence that scientific science does not only apply in the field of education but can also be applied and linked to real science found in everyday life. A phenomenon can be explained by scientific knowledge and genuine science. This belief will increase student motivation in carrying out scientific reconstruction.

An ethnoscience approach to the learning process needs to be carried out to minimize the erosion of local Indonesian cultural values due to the rapid flow of globalization, which causes friction between cultural values and local wisdom (Puspasari et al., 2019). Ethnoscience learning is important to study specifically because this can be a bridge towards good science learning as a study of learning in schools (Parmin, 2017). Apart from learning science, ethnoscience can also be applied in learning physics, chemistry, and biology, which are part of science learning.

Self-regulation refers to the ability to use self-management behavior in the learning process. In this case, self-regulation allows students to apply their self-beliefs to determine learning independently (Zimmerman, 1995). Self-regulation refers to the process of managing his or her thoughts, feelings, and actions to achieve personal goals. It involves self-generated thoughts, feelings, and actions that are planned and adjusted cyclically to achieve those goals. Self-regulation is important for effective learning and academic achievement (Locke & Latham, 2002; Khul, 1987). Self-regulation skills are very important for a child's development. It is important to increase learning motivation so that new self-regulation skills are learned well during learning (Hautangkas et al., 2022). These skills refer to the abilities and strategies individuals use to manage their learning and behavior (Cleary et al., 2022). Scientific literacy skills can be developed using local community culture or ethnoscience as a learning resource (Innatesari, 2015). Ethnoscience is knowledge from a society that has been passed down from generation to generation, which can be linked to the concept of scientific knowledge (Mahendrani, 2015). Ethnoscience learning is very important because it aims to explore the community's original knowledge, which is then connected to the knowledge that has been studied at school (Parmin, 2017). Using ethnoscience is meaningful contextual learning to increase students' scientific literacy (Atmojo, 2012). By integrating ethnoscience, students are encouraged to apply scientific knowledge, creativity, and problem-solving based on unique knowledge, including language, customs, culture, morals, and techniques created by specific people or those with scientific knowledge. This approach encourages active student involvement, critical thinking, and creative thinking skills, resulting in a more meaningful and effective learning experience (Patricia et al., 2022). It is important to learn using a local cultural approach and the surrounding environment or an ethnoscience approach as a learning resource to make the learning process more meaningful for students. It can influence improving students' academic results (Pertiwi & Firdausi, 2019). By incorporating ethnoscience into science education, students can experience more contextual and meaningful learning, overcome difficulties, and foster curiosity and active involvement in these subjects (Selamat & Priyanka, 2023).

Method

The type of research used in this research is research and development. Sugiona (2014) explains that "research and development is a research method that aims to develop learning media and test the product's effectiveness." As the name suggests, Research and Development is understood as research activities that begin with research activities and continue with development activities. "Research activities are carried out to obtain information about user needs (needs assessment) while development activities are carried out to produce learning tools" (Prasetyo, 2012). The development model used in this research is the 4D

(Define, Design, Develop, and Disseminate) developed by Thiagarajan (1974).

The Define stage carries out initial analysis, student analysis, task analysis, and specification of learning objectives. The draft RPP, LKM, and test instruments are prepared in the Design stage. The development stage is carried out to obtain an assessment from the validator of the product draft that has been developed. Validation is carried out by six validators consisting of three expert validators, lecturers, and three practitioner validators, in this case, teachers.

The dissemination stage is carried out by providing a product that has been revised according to comments and suggestions from the validator. The research instrument used in this research is a learning device validation sheet to obtain assessments, comments, and suggestions from the validator regarding the device being developed. The types of data obtained in this research are quantitative, qualitative, and data on improving self-regulation. Expert validators obtain Quantitative data from the assessment results on the validation sheet. Qualitative data is obtained from expert validators' comments, input, criticism, and suggestions outlined in the expert validity sheet. Apart from that, data on increasing self-regulation was also obtained through pretests and posttests.

Table 1. Expert validity assessment scores for learning tools

Score Interval	Category	Description
1.0 ≤ P ≤ 1.75	Very Invalid	It cannot be used yet and still requires consultation
1.75 ≤ P ≤ 2.75	Invalid	It can be used with major revisions
2.75 ≤ P ≤ 3.25	Valid	It can be used with minor revisions
3.25 ≤ P ≤ 4.0	Very valid	It can be used without revisions

The validity of learning tools is the quality of learning tools (RPS, SAP, LKM, textbooks) assessed by validators using the learning tool validation sheet. The learning device is declared valid for use if the minimum level of validity reaches the valid category. The learning device validity sheet is used to obtain data on the validity of the learning device regarding the content, consistency of components in the device, and the correctness of the device being developed. The validation sheet is filled in by experts who act as validators to review and assess the learning tools being developed. The validation sheet comprises RPS, SAP, textbook, LKM, and test validation sheets. This validation sheet is in the form of a table with columns containing the aspects to be observed. The validation sheet is filled in by experts who are competent in their field. Validation provides a score based on the aspects assessed with a number range of 1-4. Table 1 shows the expert validity assessment scores for learning tools.

The interpretation of the percentage results that have been obtained is shown in Table 2.

Table 2. Interpretation of validity percentage results

Percentage (%)	Criteria
0-20	Very Weak
21-40	Weak
41-60	Quite valid
61-80	Valid
81-100	Very Valid

The N-Gain test can calculate increased self-regulation and the effectiveness of learning tools. The amount of N-Gain is calculated using the Formula 1.

$$g = \frac{S\,pos - Spre}{Smax - Spre} \quad (1)$$

Information:
$Spos$ = Posttest score
$SPre$ = Pretest score
$Smax$ = Maximum score

The results of the N-Gain calculation are then interpreted using the classification proposed by Meltzer (in Eka et al., 2017), as shown in Table 3.

Table 3. N-Gain Classification

G Score	Interprets
g >0,7	Tinggi
0.3 <g ≤0.7	Sedang
g ≤0.3	Rendah

Result and Discussion

The ethno-physics learning model is expected to positively impact good self-regulation skills following learning objectives. Data was obtained from self-regulatory skills questionnaire scores on a 1-4 Likert scale. The scores obtained were analyzed using frequency analysis (proportion) to determine the percentage increase in students who conformed to the self-regulatory skills indicators. The differences in the percentage of self-regulatory skills match before and after implementing the ethno-physical model are shown in the following Table 4.

Table 4. Percentage of Self-regulatory Skills Indicator

Likert	Planning (%)		Monitoring (%)		Evaluate (%)		Strengthening (%)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
4	7	23	12	44	3	29	9	47
3	35	55	38	42	41	53	53	43
2	42	19	36	8	44	12	23	7
1	16	3	14	4	12	6	15	3
Suitable	42	78	50	86	44	82	62	90
Not Suitable	58	22	50	12	56	18	38	10

Description: 4=very suitable/suitable, 3=suitable/suitable, 2=not suitable/suitable, and 1=very unsuitable/suitable

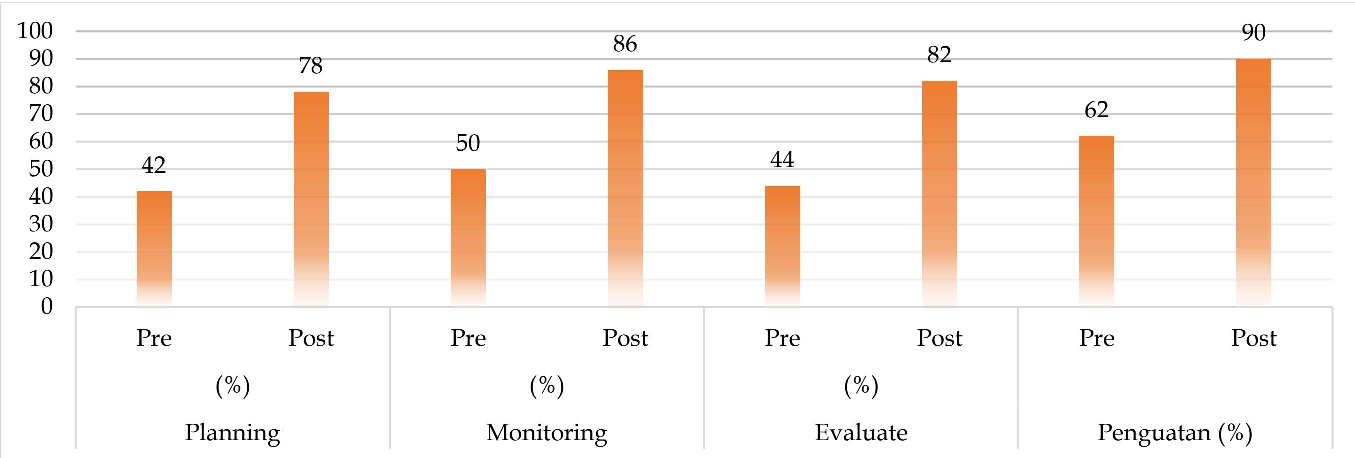

Figure 1. Pretest-posttest Self Regulatory Skill Indicator

The frequency analysis results of students' self-regulatory abilities shown in the table above show that each indicator has a different percentage increase. The planning indicators show that the percentage of students who were suitable/suitable before implementing the ethno-physics learning model was 42%. This indicates that more than 50% of students have self-management related to learning planning that still needs to be improved. Applying the ethno-physics learning model as a stimulus to help students manage good learning planning contributed 36%, increasing to 78%. The monitoring indicator also has the same increase in the number of students as the planning indicator, namely 36%. This can be described as more and more students being able to manage their learning by monitoring their learning process. The evaluation indicator shows the largest percentage increase in the number of students, namely 38%, while it is only 28% for strengthening. This indicates that the ethno-physics learning model has the greatest contribution to stimulating students' evaluation abilities.

This is under several research results on self-regulation (SR), which reveal that SR positively correlates with non-academic outcomes such as active student involvement in class. SR is also believed to provide motivation and contribute to improving learning performance. Third, SR learning was a significant predictor of academic and non-academic outcomes. These results highlight the importance of self-regulation skills in improving students' learning experiences and outcomes in digital learning environments (Anthonysamy et al., 2020). In online learning, self-regulation is very necessary. Students with good self-regulation skills will be more confident in accessing learning, so motivation to learn and academic achievement will have a positive impact (Landrum, 2020). Students with high levels of self-regulated learning are more independent in managing their learning and are more likely to succeed in their online classes. Several factors, including service quality, student attitudes, and learning quality, significantly influence students' independent learning skills. Educators must create an effective interactive learning environment that considers these factors to encourage independent or self-regulatory learning (Albelbisi & Yusop, 2019).

Several studies on the development of ethnoscience-based science teaching materials/learning tools have been carried out and have had a positive impact on the learning process, including research conducted by Suastra (2010), which produced science teaching materials based on local wisdom which contributed to increasing students' understanding of concepts and performance, Waluyo et al. (2016) who produced integrated science learning tools that were able to increase students' enthusiasm and science learning outcomes and research conducted by Perwitasari et al. (2016) showed that learning using integrated ethnoscience science materials was successful in increasing students' scientific literacy.

Ethnoscience learning is a strategy for creating a learning environment and designing learning experiences that integrate culture as part of the learning process. Ethnoscience learning is implemented by incorporating the culture that develops in society into the learning. Active involvement in learning will give rise to values instilled through life experience and a sense of empathy for the environment so that educators not only convey theory. However, it can also transfer the values taken from learning activities through character education. Integrating ethnoscience into learning will be more effective if included in the main material. Students' cultural backgrounds influence the learning process in their efforts to master learning concepts (Atika et al., 2020). Apart from that, based on the results of research conducted by Dwi Anggraini Harita et al. (2022), it is stated that integrating ethnoscience into learning can improve learning outcomes compared to conventional learning.

Conclusion

This development research aims to produce a product in the form of an ethnophysics-based learning tool to improve prospective physics teachers' valid and effective self-regulation. The products developed are SAP, LKM, teaching materials, and test instruments. The learning tools developed in this research have met the valid criteria. Expert validators have validated the tools developed to guarantee their quality before being used in the learning process. The validation results for the developed device are included in the very valid criteria. Based on data analysis, the average pretest score for the instrument for implementing the ethno-physics learning model as a stimulus to help students manage their learning planning provides an increase in contribution of 78%. The monitoring indicator also has the same increase in the number of students as the planning indicator, namely 36%. This can be described as the increasing number of students who can manage their learning by monitoring their learning process. For the evaluation indicator, the largest increase in the percentage of students is 38%, while for reinforcement, it is only 28%. This indicates that the ethno-physics learning model has the greatest contribution to stimulating students' evaluation abilities.

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Author Contributions

Conceptualizing the research idea, developing products, analyzing data, and writing articles: L. H., H.H; Draft preparation: L.H., B.A.S; writing—review and editing: L. H., H.H., B.A.S. Every author has reviewed and approved the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest

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