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Learning Strategies Design to Accommodate Learning Styles, Initial Knowledge and Reduce The Differences of Scientific Reasoning and Argumentation Performance

AL Naj'iyah[1], Viyanti[1*]and Agus Suyatna[1]

[1]Program studi magister pendidikan fisika, FKIP Universitas Lampung, Indonesia

*viyanti.1980@fkip.unila.ac.id

Abstract. The purpose of this research is to create learning strategies design that can be used to accommodate the differences of learning styles and initial knowledge so that it does not affect the differences of scientific reasoning accomplisment and students' argumentation performance on hydropower and wind energy material. This research uses the ADDIE model (Analyze, Design, Develop, Implementate, and Evaluate) , this article is just limited to the analysis and design stages. Needs analysis data was obtained through a questionnaire with students and high school teachers in Lampung as the respondents. The data analysis technique used a qualitative descriptive analysis. The results showed that teachers and students needed a learning strategy design that was able to improve scientific reasoning and argumentation performance and also reduce differences of learning styles and students' initial knowledge. The learning strategy design which is developed to modify the PjBL syntax by integrating STEM which contains activities to solve problems, expand scientific literacy, design and create projects, and communicate it.

1.   Introduction

Education in the revolution era 4.0 leads to the development of 21st century competencies which include 4C skills (critical thinking, creativity, collaboration, communication). However, in the learning process not all students master the four competencies, it is caused by individual student differences. The learning strategies used by the teacher should facilitate a variety of learning styles and students' initial knowledge levels. In fact, the strategies used by the teacher in the learning process have not been able to accommodate a variety of learning styles and initial abilities. The learning strategy used by the teacher is beneficial for a group of students in order to exist differences of scientific reasoning and argumentation performance among students.

The purpose of this study is to create learning strategies design that are able to accommodate a variety of learning styles and students' initial knowledge as well as train scientific reasoning and argumentation performance. Previously, a blended learning-based learning design had been prepared, but the strategy was not able to accommodate a variety of learning styles and students' initial knowledge [1]. The innovation of the learning strategy developed is the integration of STEM in the strategy to be developed and its ability to accommodate a variety of learning styles and students' initial knowledge.

Based on the explanation above, it can be concluded that it is very important to develop STEM-based learning strategies to accommodate a variety of learning styles and students' initial knowledge, as well

as train scientific reasoning and argumentation performance. Thus, the learning process carried out not only benefits certain students, but all students can own scientific reasoning and good argumentation performance.

STEM-based learning strategies are learning plans that contain steps in learning by combining science, technology, engineering and mathematics as well as the use of various facilities and infrastructures to achieve learning objectives [2], [3].

Learning style is the best way for students to process and understand information [4]. Learning style consists of visual, auditory and kinetics [5]. Each student has a different learning style, they have one or two dominant learning styles [6]. This style can adapt and there is a potential to change according to the situation [7]. Learning style differences of students result in scientific reasoning variation [8], namely the ability to think systematically and logically to solve problems with scientific methods which include the process of evaluating facts, making hypotheses, determining and controlling variables, designing and conducting experiments, collecting and analyzing data and concluding [9].

The role of the teacher in optimizing the variation of student learning styles can be carried out by using various learning methods that cover all student learning styles [10] and applying flexible learning strategies [11]. The suitability of learning strategies with learning styles has a positive impact on learning outcomes [12].

Initial knowledge is the knowledge that students own before the learning process started to acquire new knowledge [13]. Initial knowledge is available before the learning process. Initial knowledge is divided into declarative knowledge and procedural knowledge. Declarative knowledge consists of knowledge of facts and knowledge of meaning. Procedural knowledge consists of integration of knowledge and application of knowledge [14]. Students 'initial knowledge affects the quality of scientific reasoning [15] and students' argumentation performance [16]. The teacher needs to know the level of students' initial knowledge, so that the teacher can determine the right strategy to use in the learning process [17].

2.   Method

This research is a research development with the ADDIE development model which consists of five stages, including Analyze, Design, Development, Implementation, and Evaluation. In this article, we will present a limited analysis of the analyze (analysis) and learning strategy design stages.

The analysis stage is carried out by using a need analysis questionnaire that is distributed via google form. The need analysis questionnaire consists of 31 statements for teachers and 30 statements for students that aim to reveal the learning strategies used by teachers in school. Need analysis data were obtained from 250 students and 30 teachers. Furthermore, the data obtained were analyzed with descriptive qualtative.

At the design stage, the researcher createde a learning strategies design to be developed based on the indicators to be achieved. The learning strategy design compiled is supported by theoretical studies and empirical studies. The learning strategy design that has been compiled is then assessed for its ability to facilitate student learning styles and initial knowledge as well as its ability to improve scientific reasoning and the performance of student arguments. The assessment was carried out by 15 high school physics teachers in Lampung through a google form equipped with a learning strategy design file download link. The assessment on the questionnaire uses a Likert scale consisting of 5 choices with the criteria (5) strongly agree, (4) agree, (3) less disagree, (2) disagree, (1) strongly disagree. The scale is used as a form of expression by the respondent (teacher / student) to the statement given by the researcher. Respondents have the right to choose one of these scales for each statement, starting from strongly agree, agree, disagree, disagree and strongly disagree with the statements submitted. The results of the assessment obtained were then analyzed by calculating the average score of each activity in the learning strategy design. Then converted with the criteria as in the following table:

Table 1. Criteria for assessment scores and decisions

Average Score	Criteria
4.20-5.00	It is very suitable for facilitating the learning style and initial knowledge and enhancing scientific reasoning and argumentation performance
3,40-4,19	Suitable for facilitating the learning style and initial knowledge as well as improving scientific reasoning and argumentation performance
2.60-3.39	Not suitable for facilitating learning styles and initial knowledge and improving scientific reasoning and argumentation performance
1.80-2.59	Not suitable for facilitating learning style and initial knowledge and enhancing scientific reasoning and argumentation performance
1.00-1.79	It is not very suitable for facilitating learning style and initial knowledge and improving scientific reasoning and argumentation performance

3.   Results and Discussion

The results of the teacher needs analysis are shown in Table 2 and the results of the student needs analysis are shown in Table 3.

Table 2. Results of the teacher needs analysis

No.	Percentage of statement analysis
1	100% of teachers prepare lesson plans before teaching
2	93.8% of teachers use interesting and not boring teaching methods
3	96.9% of teachers teaching physics using learning strategies that are relevant to the material
4	21.8% of teachers do not use learning strategies that make students active
5	93.8% of teachers teach physics by utilizing supporting technology
6	84.4% of teachers guide students to develop scientific literacy
7	62.6% of teachers are used to training students to create engineering technique
8	78.1% of teachers are used to modeling problems and predictions through mathematics
9	90.6% of teachers are accustomed to guiding students to mathematically formulate experimental results
10	84.4% of teachers integrate science, technology, engineering and mathematics in the learning process which makes it easier for students to understand physics concepts
11	90.6% of teachers teach physics with explanations equipped by pictures and videos
12	87.5% of teachers are accustomed to teaching physics by giving oral explanations
13	84.4% of teachers teach physics equipped by experimental activities
14	75% of teachers teach physics using methods that facilitate all student learning styles
15	31.2% of teachers use learning strategies that do not facilitate all student learning styles

No.	Percentage of statement analysis
16	93.8% of teachers are used to asking questions before starting physics lessons
17	84.4% of teachers said that not all students were able to answer the initial questions asked
18	25% of teachers do not use learning strategies that facilitate students' initial level of knowledge
19	90.7% of teachers train students to analyze physics concepts and the relationship between variables in a physical phenomenon
20	93.8% of teachers train students to conclude a physics concept by utilizing a variety of information
21	25.1% Teachers have not been able to use learning strategies that can reduce scientific reasoning differences among students
22	90.6% of teachers give students opportunities to state based on the observations
23	93.8% of teachers train students to present data from observations in the form of numbers and words
24	96.9% of teachers provide opportunities for students to argue against statements made by their friends
25	25% of teachers have not been able to develop learning strategies that can reduce argumentation performance differences among students

Table 3. Results of student needs analysis

No.	Percentage of statement analysis
1	89.0% of students stated that physics learning strategy is very fun
2	67.3% Students could easily understand physics lessons
3	84.2% Students declared that the physics concept that I received can be used in daily life
4	14.1% of students said that the teaching method of the teacher is less fun
5	89.7% Students stated that physics teacher uses learning strategies that are relevant to the material
6	85.5% Students stated the teacher teaches physics by utilizing the supporting technology
7	87.4% Students declared that teacher introduces technology in accordance with the learning that was carried out at that time
8	86.2% Students stated that the teacher guides students to develop scientific literacy
9	76.7% Students stated that teacher trains students to make engineering techniques
10	87.8% Students stated that the teacher guides students to formulate the results of the experiment mathematically
11	84.3% Students stated that the teacher integrates science, technology, engineering and mathematics in the learning process which made it easier for me to understand the concept of physics
12	83.5% Students declared that they have a visual learning style, which is easier to understand the material when the explanation is equipped by pictures and videos

No.	Percentage of statement analysis
13	67.7% Students declared that they have an audiotory learning style, which is easier to understand the material being taught when listening to teacher explanations or learning by listening to music
14	89.7% Students declared that they have a kinesthetic learning style, which is easier to understand the material through experimental activities
15	20.0% Students stated that physics teachers use methods incompatible with their learning styles
16	34.3% Students declared that they cannot understand the material presented by the teacher, with the learning styles they have
17	63.8% Students stated that the teacher gives questions before starting physics lessons
18	88.5% Students declared that they are able to answer teacher questions with the knowledge they own
19	26.4% Students stated they cannot understand the material taught by the teacher with the scientific reasoning they have
20	30.7% Students stated that they cannot understand the material taught by the teacher based on their scientific skills

The results of the teacher needs analysis in table 2 and the results of the student needs analysis in table 3 show that students have different learning styles and initial knowledge. The learning strategies used by the teacher in the learning process have not been able to facilitate various learning styles and students' initial knowledge, resulting in differences of scientific reasoning and argumentation performance among students. Not all students have good scientific reasoning and argumentation performance. Therefore, researchers will develop learning strategy designs that facilitate the various learning styles and levels of students' initial knowledge.

Learning strategies that can facilitate various learning styles and students' initial knowledge levels are learning strategies developed with the STEM approach [18]. One of the materials that can be used to integrate STEM together is renewable energy [19]. So that in this study the researcher will develop a physics learning strategy design with a STEM approach which contains wind energy and hydropower energy. The strategies to be developed are compiled to facilitate various learning styles and students' initial knowledge levels, so that all students with various learning styles and levels of initial knowledge can have good scientific reasoning and argumentation performance.

The learning strategy design developed contains several activities including:

- Apperception. This activity is carried out to accommodate students who have low initial knowledge
- Question and answer. This activity contains science topics (S) and facilitates students who have auditory learning styles and educate scientific reasoning in the form of conservation reasoning and argumentation performance in the form of claim.
- Expository. This activity utilizes technology (T) and media in the form of images and videos that facilitate students who have visual and auditory learning styles.
- Experiment. This activity integrates the skills of using Technology (T), facilitates students who have a synthetic learning style and educates scientific reasoning in the form of controlling variables and argumentation performance in the form of data.
- Discussion. This activity integrates engineering and facilitates auditory learning styles and educates scientific reasoning in the form of proportional reasoning, probabilistic reasoning, deductive hypotheses and argumentation performance in the form of warrant and backing.
- Presentation. This activity facilitates auditoy and visual learning styles as well as educates argumentation performance in the form of rebuttal.

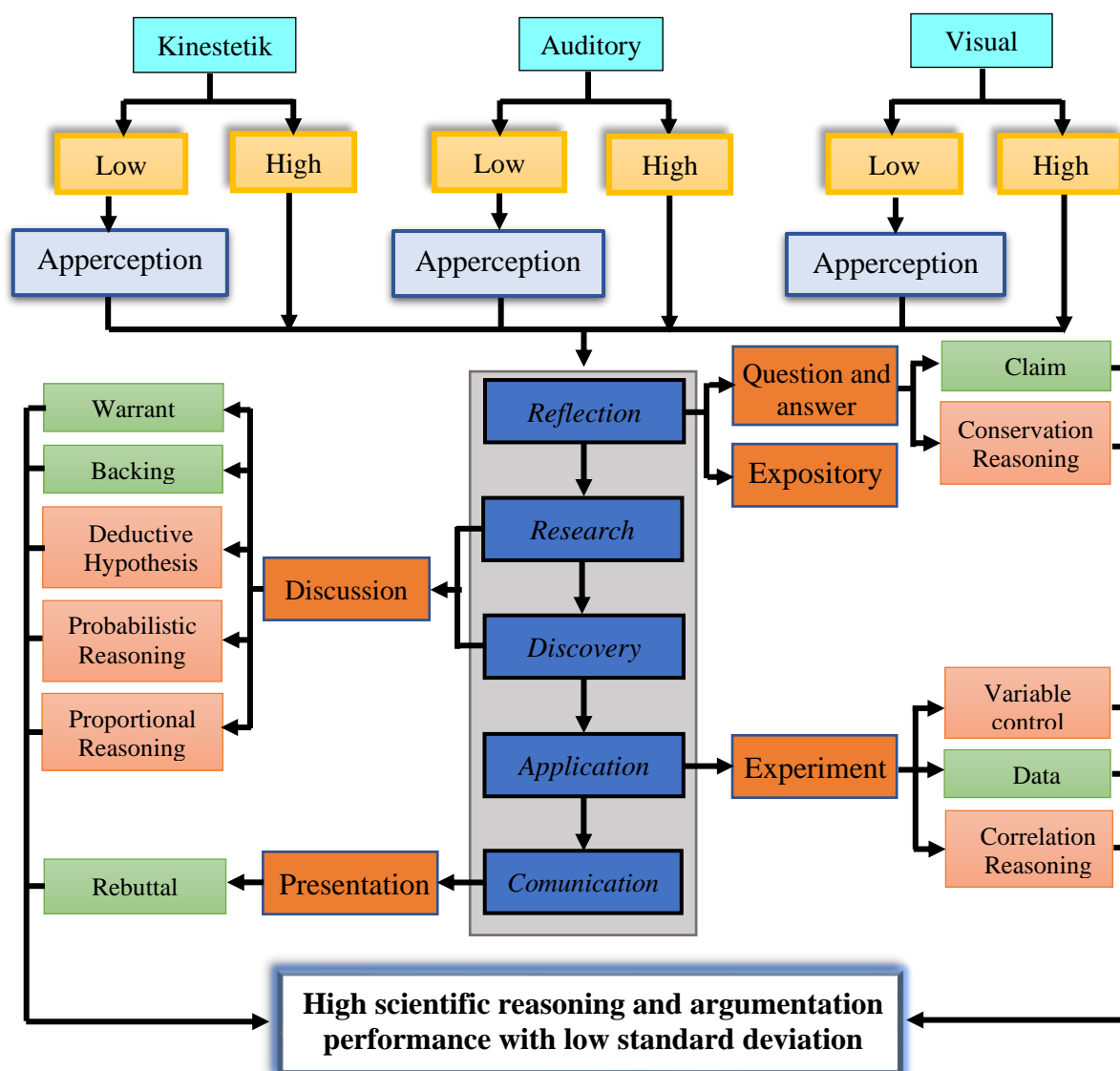The learning strategy development design chart can be seen in Figure 1 below:

Figure 1. Learning Strategy Design

The learning strategy design is designed by containing several learning activities with integrated STEM PjBL syntax. The learning activities carried out aim to accommodate students' learning styles and initial knowledge as well as train scientific reasoning and student argumention performance. Thus, the use of learning strategies that will be developed, it is hoped that there will be no differences of

scientific reasoning and argumentation performance among students, all students have good scientific reasoning and argumentation performance even though they have different learning styles and initial knowledge.

The assessment of the learning strategy design is carried out on the suitability of the substance of the learning strategy, each learning activity, STEM integration in learning activities and the effectiveness of learning strategies in facilitating various learning styles and levels of students' initial knowledge and reducing the differences of scientific reasoning and argumentation performance. The results of the assessment are shown in table 4 below:

Table 4. Results of the learning strategy design assessment

No.	Learning Strategy Design	Average Score
1	**Suitability of Learning Strategies**	
	The substance of the strategy developed is in accordance with the principles of the Dick and Carry learning strategy	4.33
	The substance of the strategy developed is in accordance with the components of the learning strategy	4,3
	Activities in the strategy developed in accordance with the Project Based Learning (PjBL) syntax	4.33
2	**Apperception Activity**	
	The apperception activity carried out has the potential to accommodate students who have low initial knowledge	4.33
3	**Expository Activities**	
	Expository activities facilitate students who have auditory and visual learning styles	4,6
4	**Question and Answer Activity**	
	Question and answer activities are able to educate students' scientific reasoning, namely the ability to understand the characteristics of the phenome (conservation reasoning)	4,6
	Question and answer activities are able to train students in making initial statements (claims)	4,4
5	**Discussion Activities**	
	Discussion activities are able to educate students' scientific reasoning in the form of reasoning proportional, probabilistic reasoning and deductive hypothesis	4.53
	Discussion activities are able to train students in strengthening statements that have been disclosed (claims) based on the information obtained	4.47
6	**Experimental Activities**	
	Experimental activities are able to accommodate students who have kinesthetic learning styles	4.47
	Through experimental activities, it is able to train students in collecting data	4,6
	Experimental activities are able to train students in determining experimental variables	4.73
	Analysis activities are able to train students in determining the relationship between experimental variables	4.47

No.	Learning Strategy Design	Average Score
7	**Presentation Activities**	
	Presentation activities are able to accommodate students with auditory and visual learning styles	4,4
	Presentation activities are able to educate students' skills in submitting rebuttals to something different from what they understand	4.53
8	**STEM integration**	
	Various plans for learning activities that have been prepared contain STEM components (science, technology, engineering, mathematic)	4.33
9	**The Effectiveness of Learning Strategies**	
	Various activities that have been designed have the potential to reduce the differences of learning styles and students' initial knowledge	4.13
	A variety of learning activities designed to improve students' scientific reasoning and argumentation performance	4.53

Based on the average assessment in table 4, it is found that one component has a score of 3.13 and the other components have an average score above 4.20. Based on the table the criteria for the assessment score in table 1, it can be concluded that the design of the learning strategy is very suitable for facilitating the learning style and initial knowledge as well as improving scientific reasoning and the performance of student arguments. This is because the learning strategy design developed uses the STEM approach which is integrated into the project based learning (PjBL) learning model. This is supported by the results of previous research that the various learning styles of students can be facilitated by a variety of STEM-integrated activities [20]. Another supporting system is a statement which states that the purpose of STEM-based project based learning activities is one of which is to develop students' scientific reasoning [21]. Students' initial knowledge affects their argumentation performance, students who have high initial knowledge will have superior argumentation performance [22], [23]. Thus, the learning strategy developed by containing activities that facilitate students 'initial knowledge is able to improve students' argumentation performance.

4.   Conclusion

Education in the revolution era 4.0 requires students to have 21st century skills. However, in fact not all students can have these skills. This is because the differences of learning styles and students' level of initial knowledge. In learning activities, learning strategies are needed that facilitate various learning styles and students' initial knowledge levels so that the learning process is not only beneficial for certain students. The design of the learning strategy uses the STEM approach which includes learning activities that facilitate various learning styles and students' initial knowledge levels as well as train students' scientific reasoning and their argumentation performance that consist of apperception, question and answer, expository, discussion, experimentation and presentation activities.

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