Detection of Student Learning Styles Using the Index of Learning Style

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ABSTRACT
Detection of student learning styles is needed to determine the level of motivation and learning performance of a student. In addition, for teachers, it is useful to prepare various kinds of learning materials in various media to accommodate these different student learning styles. To detect student learning styles using a questionnaire from one of Felder and Silverman's learning style models, namely the index of learning style(ILS) from Felder and Solmon. Felder and Silverman Learning Style Model (FSLSM) is a learning style model that is often used for science and engineering learning environments. This study detects student learning styles using ILS. The results of this study can be used as recommendations to teachers to provide various forms of learning materials that can accommodate student learning styles.

Keyword*: detection, learning style, ILS.*

1. INTRODUCTION

Student learning styles differ from one another, if the teacher does not adapt learning to student learning styles, it will have implications for inconsistency and lack of attention by students when participating in learning. As a result, some students will be left behind in following the learning. [1] explained that student learning styles will have an effect on the achievement of student academic achievement and also suggested that student learning styles need to be studied to be used as a reference for teachers when designing learning sessions. Teachers who understand precisely the learning styles of their students and then adjust their learning will contribute to more meaningful learning [2]. Therefore, student learning styles are a problem that teachers need to know with certainty so that teaching and learning design can be well established.

Student academic achievement is often associated with various factors, both internal and external, including personality, gender, family environment, socioeconomic level, interests, attitudes, motivation, learning styles and teaching methods [3]. Of all these factors, there are the main factors that cause the failure of students to obtain high academic achievement, namely the learning styles of the students themselves because students' academic achievement will increase if the methods, resources and programs are adjusted to the characteristics of students' learning styles [4]. Conversely, if the student's learning style is not appropriate, then academic achievement will also decrease. This fact explains the need for teachers to know student learning styles before devising teaching strategies to ensure the quality and effectiveness of the implementation of a teaching and learning session. Apart from that, Ramirez [5] states that student learning styles are related to the teaching methods of the teacher, the teacher's attitude, the teaching materials used and the environment. This confirms that teachers need to know for sure teaching methods that are in accordance with student learning styles in addition to the student's learning style environment. Of course the teacher's ability to adjust student learning styles will lead to good academic achievement by these students [6].

In addition, the failure of students to obtain good academic achievements is due to students not understanding the learning process and style [7]. Dunn's study [6] shows that the success of student academic achievement is related to the learning styles and learning strategies used regardless of the socio-economic level, nationality and geographic location of students. This means that students need to be provided with effective learning methods to increase the success of academic achievement. This explains that if students adjust their learning styles and provide a learning environment according to their learning styles, students' failure to obtain good academic achievements can be reduced.

2. RELATED WORK

Here are some studies that apply the use of a questionnaire to detect learning styles. Švarcová & Jelínková [8] asked 35 students to complete a Learning Style Index questionnaire; and then the students' responses were analyzed using quantitative evaluation techniques to find the learning styles that students liked. Balasubramanian & Margret Anouncia [9] aims to design a framework for determining learning styles automatically based on cognitive skills. First of all, for each student, the proportion of the four skills (Memory, Concentration, Perception, Logical Thinking) that determines the student's cognitive skills is determined. To do that, the writer relies on the responses given by students to fill in Multiple Choice Questions (MCQs). After determining the basic cognitive skills of students, the authors propose a mapping between cognitive skills and learning objects (LO) based on Bloom's taxonomy. Finally, fuzzy inference technique is used to create a reinforcement model for adaptive learning environment based on students' cognitive skills (CS). Alian & Shaout [10] aims to design a fuzzy inference system to predict student learning styles based on the use of VARK (Visual, Auditory, Kinesthetic and Read / Write) questionnaires. Input data is collected from a questionnaire specially designed to obtain input for the fuzzy inference system. Experiments show that the proposed new fuzzy inference system provides the same classification of 48% as compared to the VARK Questionnaire. Mwamikazi et al. [11] proposed a novel learning style assessment approach based on an adaptive electronic questionnaire. This approach uses three main algorithms. The PREDICT algorithm which aims to predict answers to future questions based on the association between questions that have been answered and answers from previous users. The QSELECT algorithm aims to determine which questions should be asked first to minimize the number of questions asked when the PREDICT algorithm is used. Finally, a new predictive algorithm is used to accurately predict student learning styles based on answers and predictive answers. All previous research suggests that research on learning styles should be carried out to improve the effectiveness of the learning process and student academic achievement.

3. FELDER-SILVERMAN LEARNING STYLE MODEL

This study utilise the Felder-Silverman Learning Style Model [12], Richard Felder and Linda Silverman produced this learning model in 1988 with an emphasis on the learning styles of engineering students. Three years later, in 1991, a psychometric assessment instrument called Felder & Solomon's Index of Learning Styles was produced. According to Felder and Silverman [12], initially there were five dimensions, namely Perception (Sensing / Intuitive), Input (Visual / Auditory), Organization (Inductive / Deductive), Process (Active / Reflective) and Understanding (Sequential / Global). Then two changes were made, namely the Organizational (Inductive / Deductive) dimension was removed and the Visual / Auditory subscale was changed to Visual / Verbal.

Index of Learning Style (ILS) Questionnaire is used to determine student learning styles. There are 44 questionnaire items that need to be answered by respondents. ILS tests 4 dimensions of learning style models, namely processing (active / reflective), perception (sensing / intuitive), input (visual / verbal) and understanding (sequential / global). Each of these dimensions contains 11 question items. For each item in this questionnaire, there are two answers provided (“a” or “b”). The values for answers a and b are opposite. When the respondent answers a, the value is +1 and when the respondent answers b, the value is -1 [12].

Table 1. Explanation of the dimensions of the FSLSM model

No.	Dimensions	Learning Styles	Definitions
1	Processing	Active	Tend to understand information by doing practical activities and learning in groups
		Reflective	Tend to learn by thinking about several things at once and learning on their own
2	Perception	Sensing	Tend to learn concrete, practical material, enjoy detailed explanations and solve problems using predetermined methods
		Intuitive	Tend to learn abstract, more innovative and creative material, like global explanations and like challenges
3	Input	Visual	Tend to learn with visual images such as pictures, videos, flowcharts, diagrams, and so on
		Verbal	Tend to learn with verbal, spoken or written words
4	Understanding	Sequential	Tend to learn linearly and explore material sequentially
		Global	Tend to learn randomly, and explore material, not sequentially

4. RESEARCH METHODOLOGY

The subjects of this study were 53 informatics engineering students class of 2020 in Wahid Hasyim University, before lectures were given an electronic questionnaire, that is, students were asked to access a URL that provided the ILS questionnaire, as shown in Figure 1.

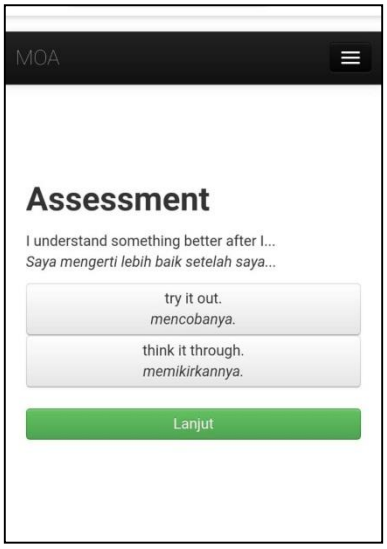

Figure 1. Display of the ILS Questionnaire Application

A total of 44 questions were given, each question was presented on each page along with the answer choices. This questionnaire contains question items and each answer is correct, students choose the answer that is considered dominant for them. There are no negative items because in this study they do not agree or disagree, but choose the answer that dominates the student's life. The total score of the respondents is the sum of the scores of all available items and is used as processed data for the purposes of this research analysis. The questionnaire also includes a translation, to make it easier for students to understand the questions. After all the answers have been selected for all the questions, students will know what percentage of each of their own learning styles is as shown in Figure 2.

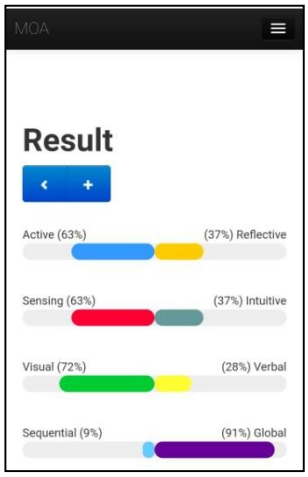

Figure 2. Results of student learning styles

The components of the Felder learning style and the Soloman Index Learning Styles can be seen in table 2

Table 2. Components of Felder's Learning Style and Solomon Index Learning Style

No	Type	Question Items	Total
1	Active-Reflective	1,5, 9, 13, 17, 21, 25, 29, 33, 37, 41	11
2	Sensing-Intuitive	2, 6, 10, 14, 18, 23, 26, 30, 32, 34, 38	11
3	Visual-Verbal	3, 7, 11, 15, 19, 24, 27, 31, 35, 39, 43	11
4	Sequential-Global	4, 8, 12, 16, 20, 25, 28, 32, 36, 40, 44	11
		Total Question Items	44

Table 2 shows that the processing dimension (active / reflective) consists of 11 question items, perception (sensing / intuitive) consists of 11 question items, input (visual / verbal) consists of 11 question items, and understanding (sequential / global) also consists of of the 11 question items. The total number of question items is 44 items.

This question is optional, there is no right or wrong answer, it is filled in according to each situation. Selected items get a score of 1 and items that are not selected get a score of 0 or no score.

The steps taken by the application in analyzing data are: (1) Determine the score of each alternative answer, (2) Save answers number 1 to. 44 according to number sequence, (3) Add up by counting from top to bottom, (4) Calculate the score of each respondent, (5) Calculate the result of the addition by subtracting (for example: answer a = 7, b = 4, then the result is 3a. If the answer is a = 2, b = 9, then the result is 7b), (6) Categorize learning styles according to their scoring, (7) Save the scoring results, (8) Save as a final grade assessment of learning styles in order from top to bottom according to the category and type of learning style, (9) Sum down based on each category, (10) Calculate in percent form using

$$\frac{LearningStyleScore}{NumberOfSubjects} \times 100\%$$

5. RESULTS AND DISCUSSIONS

This study aims to determine the tendency of the dominant learning styles in 53 informatics engineering students. The categorization of student learning style tendency is shown in table 3.

Table 3. Learning Style Tendency

correlation coefficient	category
9-11	Strong (Kuat)
5-7	Moderate (Menengah)
1-3	Balance (Seimbang)

In table 3 the correlation coefficient shows the value that will determine the learning style category. The higher

the value of the meal, the stronger the category or learning style tendency. The scores of 9-11 fall into the category of strong learning styles, meaning that students have a strong tendency in one learning style and weak in the other learning style. The values of 5-7 fall into the intermediate category, meaning that students have a moderate tendency towards one learning style and less strong in the other learning style. Grades 1-3 fall into the balanced category, meaning that students have a balanced learning style in both learning styles but are more inclined towards learning styles that get 1-3 grades. Based on the results of research and data processing, the following results were obtained:

Table 4. Learning styles of Informatics Engineering students class of 2020 Wahid Hasyim University

	Balanced	Moderate	Strong
Active	0 (0%)	18 (34%)	29 (55%)
Reflective	0 (0%)	4 (8%)	2 (4%)
Sensing	0 (0%)	19 (36%)	28 (53%)
Intuitive	0 (0%)	6 (11%)	0 (0%)
Visual	0 (0%)	15 (28%)	28 (53%)
Verbal	0 (0%)	10 (19%)	0 (0%)
Sequential	0 (0%)	18 (34%)	17 (32%)
Global	0 (0%)	16 (30%)	2 (4%)

Based on table 4 it can be seen: (1) Students show a tendency for active rather than reflective learning styles. Based on active learning styles there are no students in the balance category, there are 18 students (34%) who are in the moderate category, and there are 29 students (55%) who are in the strong category, (2) Students show a tendency for sensing rather than intuitive learning styles. Based on the sensing learning style there are no students in the balance category, there are 19 students (36%) who are in the moderate category, and there are 28 students (53%) who are in the strong category, (3) Students show a tendency for visual rather than verbal learning styles. Based on the visual learning style there are no students in the balance category, there are 15 students (28%) who are in the moderate category, and there are 28 students (53%) who are in the strong category, (4) Students show a tendency for sequential rather than global learning styles. Based on active learning styles there are no students in the balance category, there are 18 students (34%) who are in the moderate category, and there are 17 students (32%) who are in the strong category.

Based on these results, the teacher must prepare a lesson that accommodates the student's learning style, with the hope that students' academic achievement will be good and students will be more confident in their academic abilities.

6. CONCLUSION

Learning styles of Informatics Engineering students have a tendency for active learning styles rather than reflective, sensing rather than intuitive, visual rather than verbal, and sequential rather than global. The results showed that 89% of informatics engineering students had a tendency of active learning styles, 89% of students had a tendency towards sensing learning styles, 81% of students had a tendency towards visual learning styles, and 66% of students had a tendency towards sequential learning styles.

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