Prediction Learning Style Based on Prior Knowledge for Personalized Learning

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***Abstract*— The current online learning model still lacks the personalization that is able to accommodate the needs of learners. One of the learning needs is that the learning model should be in accordance with the learning style. Currently the automated detection of learning style have two approaches, namely data driven and literature based. Both approaches focus on retrieving data from the interaction of learners with the system. The interaction of the learners with the system becomes the initial data to determine the learning style. However, the learner interaction approach to this system only has an accuracy value below 80%. One of the causes of lack of accuracy in learning style detection is that it does not take into account the possession of prior knowledge of each learner. Prior knowledge is the knowledge and skills of the learners who are expected to have the basis of determining learning styles. This is because prior knowledge has four levels: Knowledge of Fact, Knowledge of Meaning, Integration of Knowledge and Application of Knowledge that are closely related to learning style. This study proposes a smart learning model using prior knowledge to detect learning styles. There are three stages used in this research: 1. Generating prior knowledge by using the assessment with Weight Cosine Coefficient (WCC) algorithm 2. Measuring the prior knowledge of each learner, where the result of this measurement is named Level of Knowledge (LOK) and the last is prediction of learning style possessed by mapping,**

Keywords—learning style, prior knowledge, prediction

I. INTRODUCTION

The progress of Information Technology in education is marked by the change of learning process from conventional to the learning model using Information Technology [1]. E-learning is a revolutionary learning process that usually relies on teachers, as a centre of science is now using teachers in the capacity of facilitator of the learner. Learners are required to be independent and have a strong motivation in following online learning, otherwise known as e-learning.

The purpose of the learning process is to transfer knowledge and skills possessed by someone or other sources of knowledge formally or informally. According to Bloom's Taxonomy theory there are three learning activities: cognitive, affective and psychomotor [2]. The three domains have their own focus, such as: Cognitive focus on acquiring knowledge, affective focus on changing attitudes of learners, and psychomotor focus on skills. This research model focuses on the cognitive side in following online learning to improve learners' knowledge.

The E-Learning systems built should have the ability of a teacher in knowing the needs of learners. The needs of every learner in the conventional learning system can indeed be detected through the interaction of teachers and learners. However, it is very difficult to give special attention to each learner, due to time constraints and teaching materials. The application of personalization in e-learning is considered appropriate to improve the motivation and ability of learners. One aspect of personalization is learning style [3].

Sabine in his research states that learning styles have been detected at the beginning of online learning to facilitate the learner in the learning process [4]. Several studies have successfully detected learning styles using both conventional and automated approaches. The automated approach has two methods: literature based and data driven. Both approaches have successfully detected learning styles but still have an accuracy rate of less than 80%. This is because the automated detection process, both data driven and literature based, is highly dependent on the learner's knowledge in using the system and requires initial knowledge to make the detection result more accurate.

This study detects learning style with prior knowledge approach of learners. The learning style used is the VARK learning style. This learning style further recommends learners using teaching materials that can help the learner understand

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the material being studied. The results of this study obtained are expected to have more accuracy than previous studies.

II. Related Works

Currently the prior knowledge generation process is still using conventional methods. Some of the conventional methods are the brainstorming approach, Cognitive Map and Know Want Learn Chart (KWL) [5] [6] [7]. The conventional approach has a weakness in terms of time, ineffectiveness and high subjectivity. Disadvantages of the conventional approach have been improved by the online assessment approach. One approach to the assessment is to generate prior knowledge by using Latent Semantic Indexing [8]. After prior knowledge generation the process is continued by detecting learning style.

Some studies that have detected learning styles typically use two conventional and automatic approaches [9]. The conventional learning style detection approach is done using the questionnaire that each model of learning style has. Some research has questionnaires such as: Kolbs with learning style Inventory, Honey and Mumford with Learning Style Questionnaire (LSQ), Felder Silverman learning style Model with Index of learning style, Myers and Brigss with Myers and Brigs indicator and Fleming with Questionnaire VARK [10] [11] [12]. The conventional approach has the disadvantage that learning styles are not fixed and are dependent on teaching materials. This can be seen from some previous research that only uses the results of learning style detection for a single teaching material.

The weakness of the conventional approach has been successfully resolved with an automated approach. The automated approach uses two methods, namely literature based and data driven [13]. The literature based approach retrieves data from the interaction of learners with the system. The system will read data from interactions such as visiting teaching materials, conducting questionnaires, examinations and forum activities

The second approach is to use data driven. This is a method of using data adapted to one of the artificial intelligent methods. Several studies have used data driven, such as Bayesian, Reinforcement learning, Latent Semantic Indexing, Decision Tree and Hidden Markov model [14] [15] [16]. But the application of the data driven method is experiencing constraints because it cannot necessarily be used on real data. This is because each learner has unique characteristics and different knowledge.

Different knowledge is the basis of this research. Every learner has prior knowledge. This knowledge has been able to help the learner to follow the next learning process. Tele's research has divided the prior knowledge into four levels: Knowledge of Fact, Knowledge of Fact, Integration of Knowledge and Application of Knowledge [17].

Some studies, such as Lujan, that have detected VARK learning styles have found that learning styles of learners can be more than one [18]. Thus, Lujan et all's study explains that each learner can be detected to have one, two or even three learning styles. The same is found in Ali Imran's study of school dropouts who have more than one VARK learning style [19]. Both studies detected learning styles using the conventional approach of the questionnaire.

Other studies have detected a VARK learning style with an automated approach using the literature based method by Hamtini et al [20]. Hamtini's research detects learning styles by finding patterns of learner interaction with the system. Some means of interaction include visiting contents, following case studies, looking at examples, and doing exercises and assessments.

The results of these interactions are mapped at the time of visit, the intensity of the visit and the result of the assessment. Similar studies were also conducted by Yahya et al that have detected learning styles in disability learners [21]. Disability learners have limitations in filling out the questionnaire, so the learning style detection process uses a learner interaction pattern of instructional materials.

This pattern will be mapped to the length of time provided and the real time. Other studies detected learning styles with questionnaires and continued with an assessment appropriate to learning styles performed by Moazeni [22]. Moazeni's research suggests that learning style detection is done by topic. This is because each learner has a tendency to have a learning style that changes depending on the topic of learning. This research is based on Moazeni's study.

III. Research Methods

This research model follows up from previous researchconducted by Moazeni. Moazeni's research states that the process of learning style detection is suggested based on the learning topics that will be accepted by the learner. This is because each learning topic has its own characteristics. For that, a smart learning model proposes detection of learning styles based on prior knowledge of the learners. The learning style detection model is as diagram 3.1 below..

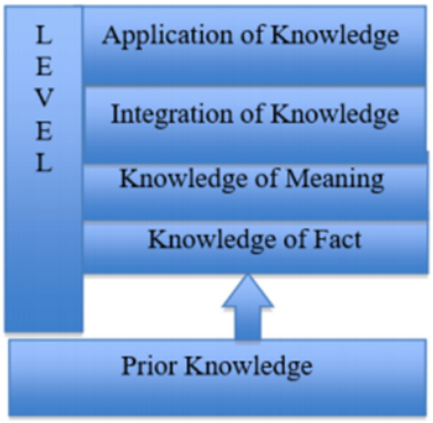

Figure 3.1 Model Smart Learning with prior knowledge

Figure 3.1 explains that in the lower position of priorknowledge is the initial knowledge that has been owned by the learner. The learner's knowledge has been divided into four levels in accordance with research conducted by Tele [17]. The four levels are Knowledge of Fact (KOF), Knowledge of Meaning (KOM), Integration of Knowledge (IOK) and Application of Knowledge (AOK). The characteristics of learners who enter the LOK of Fact (KOF) is the ability to remember according to what they see and hear. Learners at this KOF level can generally mention related matters of learning materials that have been studied, but lack the ability to explain.

- Keyword Question on KOF: whether? why?

where? when? choose, find, specify, who?

- As for the example question:

Can you? Where is it? When is it? Who is it? Mention?

Can you mention?

While Knowledge of Meaning (KOM) has characteristics of learners who have more ability than KOF, learner knowledge has entered the knowledge phase. This is because the learner has been able to define what he or she understands. In addition, the learner also has understood conceptually about the knowledge he studied.

- The keyword questions: explain, define and

understand

The sample questions:

What is the definition of ....?

Explain what you know related ...?

Describe your understanding of ....?

Integration of Knowledge (IOK) is characterized by learners who not only have the ability to understand concepts and knowledge but also have the ability to compare and do the classification.

Keywords: classification, comparing, linking

Sample questions:

Where does the classification come from ...?

Give a comparison of ....?

How do you think the relationship .... and ....?

AOK has the characteristics of learners who are able to solve problems, and produce and implement from the knowledge and skills that they already have.

- Keyword questions: Designing, formulating,

planning

Sample questions:

Design an algorithm to solve the problem ...?

Make a mathematical formula from ....?

Design the completion phase of ...?

After determining the priority LOK, proceed to determine the appropriate algorithm with the model of assessment. This study uses Weight Cosine Coefficient (WCC) to ensure the answer of the learner is in accordance with the prior knowledge possessed. The WCC has a working principle comparing answers from machines with answers from teachers [23]. The WCC formula consists of Reference Assessment (RA), which states the answers referenced by the system and Student Assessment (SA) are the answers of the learner. So later RA • SA, so that later results from the answer machine form part of the student's answer. Each student's answer will be weighted with five categories:

Tabel 1 Category of Weight

Category	Weight
Highly Important	5
Very Important	4
Important	3
Fairly Important	2
Not Important	1

Each learner's answer will be given a value according to its weight. Weighing is done by teachers and based on a priority answer scale. Below is a picture of Assesment Learning Base On Prior Knowledge (ALBOP) architecture model.

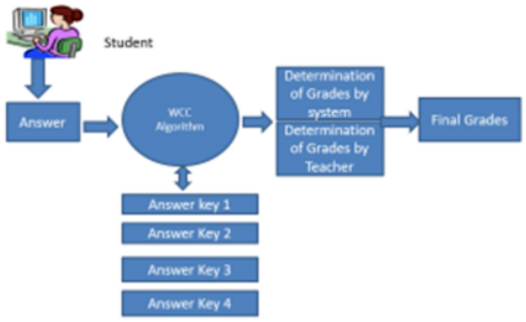

Figure 3.2 Model Architecture Asessment Learning Based on Prior Knowledge (ALBOP)

From Figure 3.2 it can be explained that the learner will get the assessment provided by the e-learning system. This initial or pre-test approach uses the WCC algorithm to get the level of prior knowledge. The WCC Algorithm Model provides teacher-defined answers to the system. Furthermore, the teacher can also provide manual assessment of the system. Therefore, there is a greater accuracy.

The results of the answers processed by the system and the teacher's answer will be mapped to LOK. Furthermore, from

LOK, this learning style of later learners in the map into VARK learning style can be seen in Figure 3.3.

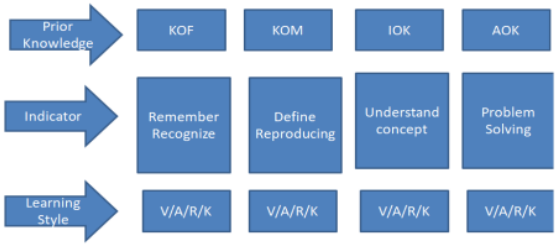

Figure 3.3 Prior Knowledge Mapping and Learning Styles

From this experiment table 2 show implementation mappping prior knowledge and learning style.

Table 2 Implementation Mapping

NO	No	x1	x2	x3	x4	Propose	wawancara
1	6534	3	3	?	?	Knowledge of Meaning	Audio
2	6535	3	3	3	?	Integration of Knowledge	Audio
3	6537	4	3	?	3	Knowledge of Fact	Read
4	6541	5	3	?	?	Knowledge of Fact	Audio
5	6581	3	3	?	?	Knowledge of Meaning	Read
6	6584	4	3	3	?	Knowledge of Fact	kinethestic
7	6585	4	3	3	?	Knowledge of Fact	visual
8	6598	4	3	3	?	Knowledge of Fact	visual
9	6675	3	3	?	?	Knowledge of Meaning	audio
10	6676	?	3	?	?	Knowledge of Meaning	Audio
11	6635	4	3	0	?	Knowledge of Fact	Kinethestic
12	6618	3	3	?	1	Knowledge of Meaning	Visual
13	6552	4	3	3	3	Knowledge of Fact	Visual
14	6560	3	3	?	4	Application of Knowledge	Visual
15	6570	3	3	4	3	Integration of Knowledge	kinethestic
16	6588	3	3	?	4	Application of Knowledge	Read
17	6589	4	3	?	?	Knowledge of Fact	kinethestic
18	6593	?	?	?	1	Integration of Knowledge	Read
19	6594	3	3	3	3	Application of Knowledge	Kinethestic
20	6597	3	4	?	3	Application of Knowledge	Kinethestic
21	6610	3	0	0	?	Knowledge of Fact	Visual
22	6630	3	3	3	3	Application of Knowledge	Kinethestic
23	6632	4	3	?	4	Application of Knowledge	Kinethestic
24	6553	4	3	?	3	Knowledge of Fact	Visual
25	6606	4	3	3	3	Knowledge of Fact	Visual
26	6604	4	3	?	?	Knowledge of Fact	Visual
27	6582	3	3	3	?	Integration of Knowledge	Read
28	6622	?	4	3	?	Integration of Knowledge	Read
29	6559	3	3	1	?	Knowledge of Meaning	AUDIO
30	6624	1	3	3	?	Integration of Knowledge	Read
31	6620	3	?	3	3	Knowledge of Fact	Visual
32	6612	4	3	?	3	Knowledge of Fact	Visual
33	6615	3	3	3	4	Application of Knowledge	Kinethestic
34	6613	4	0	?	?	Knowledge of Fact	Visual
35	6619	4	3	?	3	Knowledge of Fact	Visual

From the table above can be seen the results of interviews with 94.28% of the suitability between prior knowledge with learning styles. This can be the basis that the relationship between learning styles with prior knowledge. The generation process is done by using online assessment.

The main contribution of this study is to solve problemsposed by existing learning styles, which mostly employ literature-based and data driven approaches. Those two schemes possess reliability and validity issues. The reasoning of such phenomenon is that because learning style is dynamic, depending on the topic that one is currently learning. To cope with such reliability and validity problems, this study utilizes learner's prior knowledge to determine the best learning style.

IV. Conclusion

This smart learning model is designed to solve existing learning style detection problems. Constraints of detection style with existing conventional and automatic learning can be overcome. This model detects learning styles according to the topic of learning, because the topic of learning contributes to the learning style to be used.

Recommendations of learning styles that are generated by using prior knowledge approach. Prior knowledge generated determines the Level Of Knowledge that recommends learning styles. In the future expected learning style detection can be predicted automatically with artificial neural network knowledge.

References

[1] L. E. Nugroho, "Kerangka Pengembangan Pendidikan Tinggi di Indonesia," pp. 112–113, 2013.

[2] B. S. Bloom, M. D. Englehard, E. J. Furst, W. H. Hill, and D. R. Krathwohl, "Taxonomy of Educational Objectives: The Classification of Educational Goals: Handbook I Cognitive Domain," Longmans, Green Co LTD, vol. 16, p. 207, 1956.

[3] T. Swinke, "A unique, culture-aware, personalized learning environment," Int. J. Emerg. Technol. Learn., vol. 7, no. SPEC. ISSUE 2, pp. 31–36, 2012.

[4] S. Graf, Kinshuk, and T. C. Liu, "Identifying learning styles in learning management systems by using indications from students' behaviour," Proc. - 8th IEEE Int. Conf. Adv. Learn. Technol. ICALT 2008, pp. 482–486, 2008.

[5] E. Science, "Unit 1•: Using brainstorming to elicit prior knowledge•: sound and musical instruments."

[6] L. B. Gouveia, "A brief survey on cognitive maps as humane representations," 1974.

[7] T. Thi Thanh Dieu, "Trying K-W-L Strategy on Teaching Reading Comprehension to Passive Students in Vietnam," Int. J. Lang. Linguist., vol. 3, no. 6, p. 481, 2015.

[8] P. S. MS Hasibuan, LE Nugroho, "Learning Style Model Detection Based on Prior Knowledge in Elearning System MS," in 2017 Second International Conference on Informatics and Computing (ICIC), 2018, pp. 2–6.

[9] M. S. Hasibuan, "Detecting Learning Style Using Hybrid Model," in IEEE Conference On E-learning, EManagement,and E-Service, 2016.

[10] J. J. Cohen, "LEARNING STYLES OF MYERSBRIGGS TYPE INDICATORS," Indiana StateUniversity Terre Haute, Indiana, 2008.

[11] M. P. P. Liyanage, K. S. L. Gunawardena, and M. Hirakawa, "Using Learning Styles to Enhance Learning Management Systems," 2013 Int. Conf. Adv. ICT Emerg. Reg., no. November 2015, pp. 261–265, 2013.

[12] N. D. Fleming, "I'm different; not dumb. Modes of presentation (VARK) in the tertiary classroom," Res. Dev. High. Educ. Proc. Annu. Conf. High. Educ. Res. Dev. Soc. Australasi, pp. 308–313, 1995.

[13] V. Nam, "a Method for Detection of Learning Styles in Learning Management Systems," vol. 75, 2013.

[14] H. J. Cha, Y. S. Kim, S. H. Park, T. B. Yoon, Y. M. Jung, and J. H. Lee, "Learning styles diagnosis based on user interface behaviours for the customization of learning interfaces in an intelligent tutoring system," Lect. Notes Comput. Sci. (including Subser. Lect. Notes Artif. Intell. Lect. Notes Bioinformatics), vol. 4053 LNCS, pp. 513–524, 2006.

[15] S. M. A. and G. A. Balasubramanian Velusamy, "Reinforcement Learning Approach for adaptive E- Learning using Learning Style.," Inf. Technol. J., p. 2013, 2013.

[16] P. S. MS Hasibuan, LE Nugroho, "Learning Style Model Detection Based on Prior Knowledge in Elearning System," Proceding ICIC 2017, no. Aptikom, pp. 1–8, 2017.

[17] T. Hailikari, Assessing University Students '. Helsinki University Print, Finland, 2009.

[18] H. L. Lujan and S. E. DiCarlo, "First-year medical students prefer multiple learning styles.," Adv. Physiol. Educ., vol. 30, no. 1, pp. 13–16, 2006.

[19] A. Amran, A. Desiani, and M. Hasibuan, "DETECTION LEARNING STYLE VARK FOR OUT OF SCHOOL CHILDREN (OSC)."

[20] T. Hamtini, "A Proposed Dynamic Technique for Detecting Learning Style Using Literature Based Approach," IEEE jordan Conf. an Appl. Electr. Eng. Comput. Technol., 2015.

[21] W. F. F. Yahya and N. M. M. Noor, "Decision Support System for Learning Disabilities Children in Detecting Visual-Auditory-Kinesthetic Learning Style," 7th Int. Conf. Inf. Technol., vol. 2015, pp. 667–671,2015.

[22] S. Moazeni and H. Pourmohammadi, "Smart teaching quantitative topics through the VARK learning styles model," ISEC 2013 - 3rd IEEE Integr. STEM Educ. Conf., 2013.

[23] F. S. Pribadi, T. B. Adji, and A. E. Permanasari, "Automated Short Answer Scoring Using Weighted Cosine Coefficient."

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