International Journal of Engineering & Technology, 7 (4.40) (2018) 118-122

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper



Model E-learning MDP for Learning Style Detection Using Prior Knowledge

Muhammad Said Hasibuan[1,2], Lukito Edi Nugroho[1], Paulus Insap Santosa[1]

[1]Electrical Engineering and Information Technology
University Gadjah Mada
[2]Magister Technology Information, Institute Business and Informatics
Darmajaya, Indonesia
**Corresponding author E-mail: said.s3te15@mail.ugm.ac.id*

Abstract

The Learning Style Detection model in e-learning systems is experiencing rapid development. This development is characterized by the existence of two learning style detection approaches namely automatic and conventional. The development of detection of automatic and conventional learning styles that exist today does not pay attention to the relationship of learning styles with prior knowledge. This is important to note because the style of learning is not static and tends to be dynamic depending on the topic of learning. This study builds the VARK MDP learning style detection model. It explores the relationship between learning styles with prior knowledge as evidenced by experiments on 32 learners. There are three steps taken: Measurement Prior Knowledge, Determine Prior Knowledge, Preference Learning Style. To evaluate this model we built detection scenarios with prior knowledge and compared with the results of interviews based on VARK learning style questionnaire. This study succeeded in building a model of measurement of prior knowledge that is more accurate than the previous model. Detection results also show that every learner does not only have one learning style and changes according to the topic.

Keywords: *Dectecting Learning Style, Prior Knowledge, VARK.*

1. Introduction

The detection model of learning styles in e-learning systems has experienced very rapid development. This development is characterized by the existence of two detection methods that have been developed, namely conventional methods [1] [2] and automatic methods [3] [4] [5] [6]. Detection of learning styles is needed in the e-learning system; this is due to the limitations of meeting learners with teachers. This limitation if not noticed will reduce the learner's motivation in participating in learning, because previously Sabine stated in his research that the detection of learning styles could increase learner motivation [7].

The current process of detecting learning styles has not used prior knowledge as a basis for determining the learning styles. Prior knowledge is existing knowledge possessed by a learner that can help them by offering convenience in subsequent learning [8]. The relationship between learning styles and prior knowledge is shown in previous studies, which stated that learning styles depend on topics and tend to change frequently [9] [10].

This study will build a detection model of VARK learning styles with a prior knowledge approach. VARK learning style is a method that is developed with a teaching material approach consisting of Visual, Audio, Read and Kinesthetic [2]. This VARK learning style is one of the relevant methods used in e-learning systems, and this is characterized by the many learning objects or teaching materials available on the Internet.

This study builds a detection model of VARK learning styles with a prior knowledge approach, this is done to prove the existence of a relationship between learning styles with prior knowledge and to achieve more accurate detection results.

2. Related Works

The current learning style detection model can be divided into two, namely conventional and automatic [3]. The conventional approach is done using a questionnaire that is owned by each learning style. Some learning style questionnaires include Kolb's with Kolb Learning Style Inventory (KLSI) [11], Honey and Mumford questionnaire [12] and Flemming with a questionnaire of VARK learning style [2]. The conventional detection model has the disadvantage that this model is less accurate because when the learner fills in the questionnaire they feel bored because of the number of questions and don't even understand the purpose of the questions.

The second model is the automatic detection model. This model is built with two approaches, namely literature based, data driven and hybrid [13] [14] [15] [16] [17] [18] [19] [5]. Research that uses literature based is by using learner visit logs on teaching materials. This visit log is like a visit to teaching materials, discussion or assessment. Length of visit and periodic visits become the basis for determining learning styles [20].

While the current automatic learning style detection models can be grouped into two, namely based on external and internal factors.

Copyright © 2018 Authors. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

External factors can be characterized by the behaviour of the learners' visit to teaching materials, the process of the learners following the discussion forum, the process of the length of the interaction for learners, while the internal learning process follows assessment.

The accuracy measurement method involves comparing the results of automatic detection with conventional. As for testing the accuracy, the model normally uses mathematical equations:

$$RT\ ls = \sum \frac{Time\ Spend}{Time\ Predictable}$$

Research by Yahya succeeded in detecting Visual, Audio and Kinaesthetic (VAK) learning styles with an automatic approach by calculating the number of visits and the time used by learners to access teaching materials [6].

The VARK learning style detection model is then carried out by Amran by detecting learning styles by using questionnaires given to children outside school [4]. This study successfully detected the VARK learning style using questionnaires. This study found that every learner does not only have one learning style. Each learner has one, two even three learning styles as identified through questionnaires.

The same study related to the detection of VARK learning styles was carried out by adopting questionnaire r that has been adapted to the topic carried out by Moazeni [10]. Moazeni detects learning styles with quizzers, then learners obtain learning models that are appropriate to their learning styles. This detection process is carried out by learner per topics so that it is more dynamic, the learning model is given in the form of Power Points.

Moayeri's research detected VARK learning styles by using a questionnaire and proficiency test. The results of the detection of VARK learning styles indicate a relationship between test results and learning styles [18]. The research was given to the three fields of Humanities, Engineering and Basic Science.

Another study was conducted by Drago to detect VARK Learning styles using online quizzers [19]. Drago detected VARK learning styles by comparing their use in classes and online learning. Drago obtained six findings related to the use of VARK learning styles in the classroom and online. One of the results of this study states that the use of Kinaesthetic learning styles is not recommended online.

This method of measuring prior knowledge uses brainstorming methods, cognitive maps and KWL charts. This method has the disadvantage of the very long time to obtain the value of prior knowledge and is also subjective because of face-to-face meetings. This study uses the W-BLEU method to measure prior knowledge.

The W-BLEU method was developed initially to translate the language [21] [22]. The W-BLEU method was originally developed from the BLEU method and experienced progress towards accuracy. Based on the W-BLEU method, the concept uses knowledge keywords to indicate prior knowledge.

3. Research Method

The VARK Learning Style detection model in this study can be seen in Figure 1 below. This model is named the Detect Model of MDP learning style which describes the steps of the process of obtaining learning styles, namely: Measurement Prior Knowledge, Determine Prior Knowledge, Preference Learning Style. This MDP process can be seen in the red block diagram below.

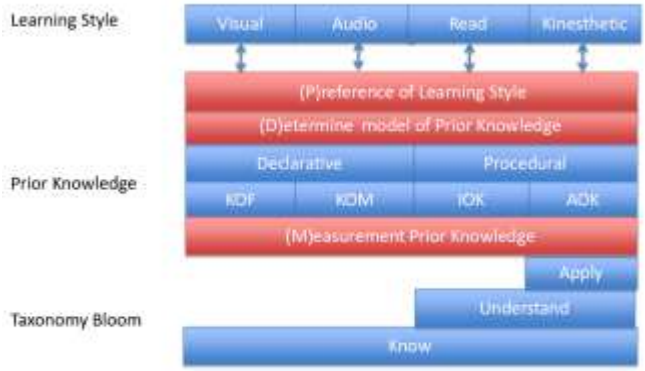

Figure 1: MDP Detection Learning Style Model

In Figure 1 above we can see that there are three basic theories that build this model. First is Bloom's taxonomy theory. Bloom's theory was developed in 1965 and is used for the learning process that focuses on the cognitive side [23]. Bloom's taxonomy has six cognitive levels, namely Know, Understand, Apply. This study only uses three levels of the six in Bloom's taxonomy, namely Know, Understand and Apply. The taxonomy that Bloom used is the taxonomy that has been revised by Alexander.

The second theory used is the Prior Knowledge Theory used by Hailikari. This theory is used to determine the ownership of the prior knowledge learner after prior knowledge is measured through assessment. There are four levels of prior knowledge according to Hailikari, namely Knowledge of Fact, Knowledge of Meaning, Integration of Knowledge and Application of Knowledge [24]. The third theory used is the VARK Learning Style Theory. This VARK Learning Style Theory is a learning style model developed by Flemming consisting of Visual, Audio, Read and Kinaesthetic.

Based on the above three theories, a detection model of VARK learning style is built with a prior knowledge approach. This model of detection approach to learning styles with prior knowledge is more dynamic than previous detection models. This is because the learning style detection process is done at the beginning of each learning topic. This is done in order to measure the prior knowledge possessed by the learner, which will later become a learning style preference.

So, in its implementation, later learners who have more knowledge and understanding on a particular topic will find it easier, be motivated and quickly complete the learning process. This is certainly different if the learner does not have prior knowledge. The process of measuring prior knowledge uses the essay method. Questions given by the essay method will reflect the level of prior knowledge that the learner has. In the next process the system will read the answers of each learner using the W-BLEU method. The W-BLEU method works by finding the match of the keyword with the learner's answer; this keyword will have a value of 1 while the non-keyword value is 0.

From the results of prior knowledge measurement it then continues by grouping prior knowledge. There are two groups, namely declarative and procedural. Declarative is a group with knowing what learning process. This declarative group has initial and basic knowledge. The declarative group is divided into two, namely Knowledge of Fact and Knowledge of Meaning. Both are characterized by facts- and understanding-based learning. Facts are things they see and mean something they understand.

Whereas the second group, namely procedural, has entered the "knowing how" domain. This understanding enters the realm of

implementation of the knowledge that has been possessed. This procedural group is divided into two, namely Integration of Knowledge and Application of Knowledge.

From the two prior knowledge groups, the prior knowledge of the learner will be determined. The mapping results between learning styles with prior knowledge can be seen in Table 1, which is the basis of reference for teachers to build essay questions. This mapping can be used in accordance with the learning topics that will be given. Of course, the declarative point is noted to the theoretical and procedural portion to the implementation portion of the theory that has been obtained from previous knowledge.

Table 1: Mapping Prior Knowledge with Learning Style

Prior Knowledge	Learning Style	Description
Knowledge of Fact	Visual	Learners do learning based on experience of interaction with the environment and usually only have a basic knowledge of the definition but not yet deep understanding.
Knowledge of Meaning	Audio	This learner conducts more learners from the knowledge of fact because they have understanding and knowledge through listening to information that is related to the visual. Characterized by learners who are able to provide definitions and understand the concept.
Integration of Knowledge	Read/Write	Learners do the learning with the method of reading and writing. Learners at this stage have skills comparing several concepts.
Application of Knowledge	Kinaesthetic	These learners already have the knowledge and skills so as to solve problems and implement solutions. This learner already has a qualified expertise.

In the table above it can be seen that the Prior Knowledge with Knowledge of Fact level is recommended using Visual learning styles. This is because visual learning style is the basic sensor that learners have in learning. There are two basic sensors, namely seeing by using the eye and listening using the ear. The eye works by looking at the visualization received by the learner, the learner can gain new knowledge but has not arrived at the realm of understanding the knowledge.

For level 2 Prior Knowledge, Knowledge of Meaning can be recommended with Audio learning styles. This is consistent with the second sensor that the learner has after the eye, namely the ear. By hearing information the learner can complete what is seen with what is heard. So that the learner at the Knowledge of Meaning level is marked by a learner who has the ability to define and understand something deeper than the previous level of Knowledge of Fact.

Whereas the third level is the Integration of Knowledge (IOK). This IOK level can be recommended with the Read/Write learning style. Learners at this level already have sufficient knowledge and understanding to be able to do integration. Based on the knowledge and understanding they have, the learner has the ability to compare one concept with another.

The last level of prior knowledge is the Application of Knowledge (AOK). This level of AOK can be recommended with the Kinaesthetic learning style. Kinaesthetic level is marked by the learner not only having the ability of knowledge and understanding and also integration but also having the ability to solve problems faced. So that learners at this level have the ability to solve problems through comprehensively comprehended knowledge and understanding.

After mapping the prior knowledge determination is given, then the rule base is used to give preference to the learning style. The rulings are as follows:

If x1 > x2,x3,x4 : Visual
If x1 = x2 : Audio
If x1 = x3 : Read
If x1 = x2, x3 : Read
If x1 = x2, x3, x4 : Kinaesthetic
If x1 = x4 : Kinaesthetic

If x2 > x1, x2,x3 : Audio
If x2 < x1 : Audio
If x2 = x3 : Read
If x2 = x4 : Kinaesthetic

If x 3 > x1,x2,x3 : Read
If x3 = x4 : Kinaesthetic
If x3 <x1 : Visual
If x3 < x4 : Kinaesthetic

If x4 > x1,x2,x3 : Kinaesthetic
If x4 <x3 : Read
If x4 <x1 : Visual
If x4 < x2 : Audio

From the above rule, it is translated in Table 3 below and confirmation of answers is made through interviews with learners. To test the accuracy of the MDP learning style detection model, we tested it with Figure 2 below

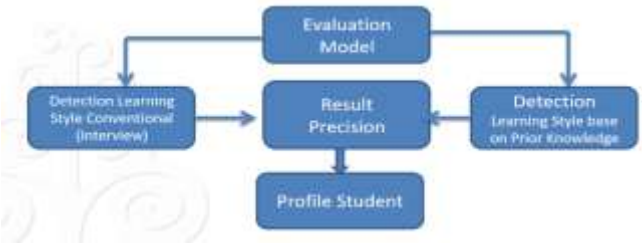

Figure 2:. Models testing of learning styles detection MDP

To test this MDP model, testing was carried out according to Figure 2. The testing process was by comparing the detection model with prior knowledge with the results of interviews based on questionnaires.

4. Result and Discussion

To confirm if this MDP Learning Style detection model is feasible or not, testing of the MDP model is needed. The testing process is carried out by involving grade 7 students of SMK 2 Banjarmasin with a total of 34 learners. The first step taken is that the learner will enter the e-learning system with the address http://e-learning.darmajaya.ac.id/.



Figure 3: Display Implementation of MDP Models in Moodle

After the learner has registered on the e-learning system, they will be given a login and password. Furthermore, learners will participate in an assessment with the form of essay questions to measure the prior knowledge they have.

Testing the VARK MDP learning style detection model uses computer network subjects with the topic of learning computer network infrastructure. There are eight questions given which will be mapped to four prior knowledge levels, namely KOF, KOM, IOK and AOK.

Table 2: Measurement Results of Prior Knowledge

NIS	x1	x2	x3	x4
6534	3	3	2	2
6535	3	3	3	2
6537	4	3	2	3
6541	5	3	2	2
6581	3	3	2	2
6584	4	3	3	2
6585	4	3	3	2
6598	4	3	3	2
6625	3	3	2	2
6626	2	3	2	2
6618	3	3	2	1
6552	4	3	3	3
6560	3	3	2	4
6570	3	3	4	3
6588	3	3	2	4
6589	4	3	2	2
6593	2	2	2	1
6594	3	3	3	3
6597	3	4	2	3
6630	3	3	3	3
6632	4	3	2	4
6553	4	3	2	3
6606	4	3	3	3
6604	4	3	2	2
6582	3	3	3	2
6622	2	4	3	2
6559	3	3	1	2
6624	1	3	3	2
6620	3	2	3	3
6612	4	3	2	3
6615	3	3	3	4
6619	4	3	2	3

From Table 2 above it can be seen that there are x1, x2, x3 and x4. x1 is the value for KOF, while x2 is the value for KOM, x3 is the value for IOK and x4 is the value for AOK.

From the results of Table 2, the next step is to use rule base to determine the preference of the learning style of the learner. Table 3 below is the result of using the rule base by using the results of the reduction in Table 2.

Table 3: Results of the rule base research

NIS	Result	
	Propose Model	Wawancara
6534	Audio	Audio
6535	Read	Audio
6537	Visual	Read
6541	Visual	Audio
6581	Audio	Read
6584	Visual	Kinaesthetic
6585	Visual	Visual
6598	Visual	Visual
6625	Audio	Audio
6626	Audio	Audio
6618	Audio	Visual
6552	Visual	Visual
6560	Kinaesthetic	Visual
6570	Read	Kinaesthetic
6588	Kinaesthetic	Read
6589	Visual	Kinaesthetic
6593	Read	Read
6594	Kinaesthetic	Kinaesthetic
6597	Audio	Kinaesthetic
6630	Kinaesthetic	Kinaesthetic
6632	Kinaesthetic	Kinaesthetic
6553	Visual	Visual
6606	Visual	Visual
6604	Visual	Visual
6582	Read	Read
6622	Audio	Read
6559	Audio	Audio
6624	Read	Read
6620	Visual	Visual
6612	Visual	Visual
6615	Kinaesthetic	Kinaesthetic
6619	Visual	Visual

From the table above it can be seen that in the results of testing of VARK learning style detection from 34 learners there are 12 that are not appropriate. To calculate the accuracy value of this study, the equation is used

$$\text{Accurate} = \sum \left(LS \frac{MDP}{Wawancara} * participant\right.$$

From the equation, the results are obtained (34-12) / 34 = 64%.

5. Conclusion

The detection model of VARK MDP learning style uses a prior knowledge approach to detect learning styles. The results of this study are better than the previous model which conducted learning style detection with a literature base approach and data driven to detect VARK learning styles.

The advantage of the MDP detection model is that it is more dynamic because the detection process is carried out per learning topic. This aims to ensure that the learner has prior knowledge of their topic, because the influence of initial knowledge has an impact on learning styles.

In the future, it is expected that this detection model can provide teaching material recommendations that are in accordance with the learning style that has been detected in this MDP model.

Acknowledgement

This work was supported by Ministry of Research and Higher Education of the Republic of Indonesia under Doctoral Research Grant

References

[1] [A. Y. Kolb and D. a Kolb, "The Kolb Learning Style Inventory — Version 3 . 1 2005 Technical Specifi cations," LSI Tech. Man., pp. 1–72, 2005.

[2] 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.

[3] S. Graf, S. Viola, and Kinshuk, "Automatic student modelling for detecting learning style preferences in learning management systems," IADIS Int. Conf. Cogn. Explor. Learn. Digit. Age, no. 1988, pp. 172–179, 2007.

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

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

[6] 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.

[7] S. Graf, "Advanced Adaptivity in Learning Management Systems by Considering Learning Styles *," IEEE Int. Conf. web Intell. agent Technol., 2009.

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

[9] A. Latham, K. Crockett, and D. Mclean, "Profiling Student Learning Styles with Multilayer Perceptron Neural Networks," 2013 IEEE Int. Conf. Syst. Man, Cybern., pp. 2510–2515, 2013.

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

[11] Kolb, Experiential Learning: Experience as the Source of Learning and Development [Paperback], no. December. 1983.

[12] J. Rosewell, Learning styles, no. 4659. 2005.

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

[14] M. P. P. Liyanage, K. S. L. Gunawardena, and M. Hirakawa, "Using Learning Styles to Enhance Learning Management Systems," Chapter I, vol. 07, no. 02, pp. 1–10, 2014.

[15] 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.

[16] D. S. S. Sahid, L. E. Nugroho, and P. I. Santosa, "Integrated stochastic and literate based driven approaches in learning style identification for personalized E-learning purpose," Int. J. Adv. Sci. Eng. Inf. Technol., vol. 7, no. 5, pp. 1708–1715, 2017.

[17] V. Marcy, "Adult learning styles: How the VARK Learning Styles Inventory can be used to improve student learning," Perspect. Physician Assist. Educ., vol. 12, no. 2, pp. 117–120, 2001.

[18] H. Moayyeri, "The Impact of Undergraduate Students' Learning Preferences (VARK Model) on Their Language Achievement," J. Lang. Teach. Res., vol. 6, no. 1, pp. 132–139, 2015.

[19] W. A. Drago and R. J. Wagner, "Vark preferred learning styles and online education," Manag. Res. News, vol. 27, no. 7, pp. 1–13, 2004.

[20] 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.

[21] F. S. Pribadi, E. Permanasari, and T. Ninomiya, "Short Answer Scoring Using W-Bleu For Reguler Assessment In Vocational High School," Ijil, 2018.

[22] K. Papineni, S. Roukos, T. Ward, and W. Zhu, "BLEU: a method for automatic evaluation of machine translation," … 40Th Annu. Meet. …, no. July, pp. 311–318, 2002.

[23] J. M. Lampinen and J. D. Arnal, "A Revision of Bloom's Taxonomy: An Overview," Am. J. Psychol., vol. 122, no. 1, pp. 39–52, 2009.

[24] T. Hailikari, Assessing University Students, vol., no. 2009.