

# AIOLSD: Adaptive and Intelligent Online Learning System Design

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**Abstract:** *With the evolution of internet in the field of education, online learning has gained a broader scope in past few years. Even during the situation of covid-19 pandemic, online learning is proven as a boon in field of education. With the endless number of courses available online, learners face problem in selecting the most appropriate course for them. It is usually because of the fact that all learners have a unique learning style. Learners have also indicated that they suffer from improper evaluation and monitoring in case of online learning systems. The adaptive learning systems are the computer-based systems that are designed to adjust and modify themselves in accordance with the learning style of the learners whereas an immediate and personalized support is provided to the learners by designing intelligent systems. Learning style refers to way in which a learner learns or processes new information. Researchers have developed various models like Felder Silverman, VAK, and David Kolb learning style models etc. to detect the learners' learning style. The detection of the learners' learning style provides help and support to the learner in order to select the most appropriate course or course content for them and continue the learning process in a more productive manner. In our study, we worked on identification of learning style of learner using VAK learning style model and recommending the courses/course content as per their learning style.*

**Keywords:** *Learning Style, Learning style model, Online Learning, Online learning system, Adaptive Learning System, Intelligent Tutoring System, Personalized learning, VAK model.*

## 1. Introduction

In today's world, education and internet, both have become indispensable in one's life. With the increased use of internet in the field of education, online learning has acquired immense popularity in past few years. All the educational institutions over the world opted online learning during the Covid-19 pandemic. There are various educational websites offering online wide range of courses in various fields and since there are large collection/ choices for courses online, learners are overwhelmed in selecting the most appropriate course for them. Learners usually begin learning with the first course they find. This might not be a problem in the beginning but if the course does not suit the learner's preferences, he/she might face difficulty in learning. Hence, there is a requirement to determine the most appropriate course for the learner, and to do so, it is essential to determine the learners' learning style. Every learner has a unique learning style and researchers have described various learning style models that can be used for finding out the learners' learning style. The identified learning style can then be used to suggest the best appropriate course/course content to the learner. Since education has been a core topic of research in past few years, researchers have discussed various learning style models.

In 1984, David Kolb's Learning Style Model [1] indicates 4 learning styles named as Divergers (learned from Experience and observations), Assimulators (learned from

conceptualization and observation), Converging (learned from conceptualization and experimentation), Accommodating (learned from experience and experimentation).

Honey and Munford Learning style model [9] was developed in 1982 and identified 4 learning styles as Activist, Pragmatist, Reflector and Theorist. Kolb's learning styles were used as a basis for discovering these 4 learning styles.

Richard Felder and Linda Silverman [10] created Felder-Silverman learning style model (FSLSM) with 4 learning style dimensions namely active and reflective, visual or verbal, sensing and intuitive and sequential and global. These learning style combinations make up the learning preferences of individual. They also developed an Index of learning style questionnaire (ILS) containing 44 questions that were further split into 11 questions of each dimension of Felder Silverman model.

Psychologists developed, VAK Learning Style Model [5] in 1920, that classified the common ways in which the people learn. According to VAK (Visual, Auditory, Kinesthetic) model, learner possess a dominant or preferred learning style. Authors in [8] developed VARK model, a variation of VAK model, in their study. VARK stands for Visual (pictures and graphs), Auditory (voice-based instructions), Read/Write (Using words and writing) and Kinesthetic (experience or practical approach).

## 2. Related Work

Karun Thankachan [4] described a model of intelligent and adaptive tutoring system that offers pedagogical support to the learners. The proposed system design modifies the traditional system of training for online courses by utilizing the data available in MOOC database with system-user interaction details. The interaction logs enable the system in adapting as per the user's requirements. System also provides manual intervention by the administrator of respective courses to help the users. Various methods, for instance educational data mining, visual data analytics and learning analytics are applied for identifying the most beneficial method and provides pedagogical support for each learner. Author's proposed scheme is intended to provide the students with a personalized learning experience and an instructor to administer the course. The minimalist view of ITS or Intelligent tutoring system is presented in the paper [4], that includes an adaption engine to adapt the courses as per user's requirements.

Authors in [3] have presented Poly-X: An online Intelligent tutoring System for E-Learning, which integrates various components such as adaptive navigation, learning control, intelligent quiz module for the purpose of learning assessment outcome and also include video conference module to support online presentations. It is an online intelligent tutoring system that provides flexible and reliable support for teacher-student related activities. It includes various function modules such as Interactive content module to present interactive content to the learner, Intelligent quiz module to provide quiz exercises and hints for answers, Online discussion board that includes video conference model and online white board for power point presentation and statistical & analysis module to record user's input for future investigation (determining if content provided is beneficial to learner and analyse quiz performance).

To resolve the limitation of traditional learning management system, a new adaptive learning framework was proposed by Mubaraka Sani Ibrahim and Mohamed Hamada [7], which classified learners based on their preferences such as their way of understanding or processing new information. The proposed framework generates the learners' learning style using the FSLSM along with ILS questionnaire and use the generated learning style for making recommendations of the course structure to the learners. The designed system allowed instructors to monitor the learning style of learner and the suggested course content to the learners. In the framework, automatic modelling for students is used, which

could be used in automated detection of learning style in future. The adaptive learning components include predictive model (for static and automatic detection of learning style), Adaptive engine (to recommend content to the learners), Dashboard (to share queries) and Intervention engine (allows instructors to monitor course flow).

Authors in [6] aimed to identify the VAK learning style to improve the teaching methods for students as per the identified learning styles. Authors intended to find the relationship between teaching methodologies & the learning styles of learners. 31 students were randomly selected from a university in Sri Lanka and Honey and Mumfield questionnaire was directed to them. The data generated resulted that most of the students examined were visual learners. The authors also determined that the gender of the student played no role in the learning style identification.

In [2], authors discussed about using personalized e-learning features for personalization of e-learning system. The features include learning content and learning activities of the learner. FLSM is used to classify learning style into four dimensions (processing, perception, input and understanding). The ILS questionnaire was applied in the system to identify the learners' learning style. The algorithm for content personalization were used to allow users to use the learning material as per their learning style. The Felder-Silverman model along with ADIE modelling was used to stage the e-learning content.

The existing online learning systems were either intelligent or adaptive learning system. The existing learning management systems could be enhanced if adaptive and intelligent online learning systems are blended together. Moreover, the proposed approach includes identification of new learning style combinations that will be used as a basis for recommending the courses and learning contents to the learners.

### 3. Proposed Method

This section presents the proposed method for the design of an Adaptive as well as Intelligent Online learning system and is shown in Fig 1. An adaptive learning system is the computer-based system that adapts itself as per the learner's information such as knowledge level, learning style etc. Furthermore, an intelligent system is one that prepares and presents an immediate and personalized support to the learner in form of monitoring or feedback. Initially, learner's information is collected and based on this information, the learners' learning style is identified. Later, the identified learning style of learner is used to recommend the course and course content to the learner. Fig. 1 gives a block diagram enlisting the steps to be followed in the proposed approach.

In this research work, we used a questionnaire set consisting of 15 questions to determine the learning style of various learners. The learners were required to answer the questions in scale of 1-5 and based on the score obtained, each learner was classified into one of the dimensions of VAK learning style model i.e., either visual, auditory or Kinesthetic. But as we progressed further, it was realized that sometimes learners go for more than one learning style, thus grouping a learner into just one dimension of VAK model might not be efficient. Therefore, the learners were clustered on the basis of similar features (similar score of the questionnaire) using k-means clustering algorithm. As a result of applying clustering, new learning style combinations are determined. Three sets of learning style combinations were obtained and in each set one dimension of VAK (Visual, Auditory, Kinesthetic) model is dominant. Table 1 represents various learning style combinations obtained.

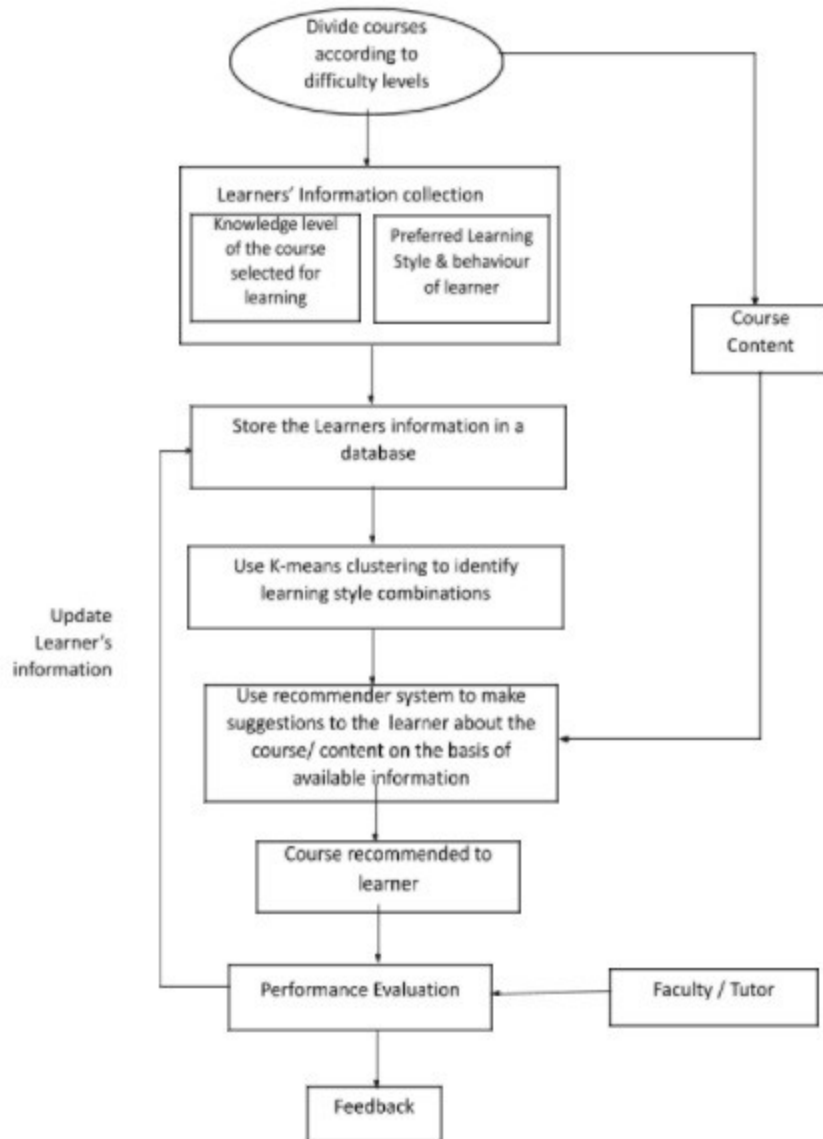


Fig. 1: The Proposed Model of the System

Table 1: Learning style combination

Set	Dominant Learning style	Learning style combination
Set 1	V	V, VA, KV, VKA
Set 2	A	A, AK, AV, AKV
Set 3	K	K, KA, KV, KAV

These learning style combinations are used to suggest the course/course content to the learner as per their identified learning style.

Table 2: Course content recommendation

Set	Dominant Learning Style	Learning style combinations	Recommended Course Content		
			1 <sup>st</sup> Preference	2 <sup>nd</sup> Preference	3 <sup>rd</sup> Preference
Set 1	Visual	V	Graphs & Charts	-	-
		VA	Graphs & Charts	Voice based instructions	-
		VK	Graphs & Charts	Practical or experiments	-
		VKA	Graphs & Charts	Practical or experiments	Voice based instructions
Set 2	Auditory	A	Voice based instructions	-	-
		AK	Voice based instructions	Practical or experiments	-
		AV	Voice based instructions	Graphs & Charts	-
		AVK	Voice based instructions	Graphs & Charts	Practical or experiments
Set 3	Kinesthetic	K	Practical or experiments	-	-
		KA	Practical or experiments	Voice based instructions	-
		KV	Practical or experiments	Graphs & Charts	-
		KAV	Practical or experiments	Voice based instructions	Graphs & Charts

Table 2 represents the course content recommended to the learners with respect to the learning style combinations identified. The course content is recommended to the learner is displayed in level of preference (i.e., 1<sup>st</sup> preference, 2<sup>nd</sup> preference & 3<sup>rd</sup> preference), which depends upon the type of learning style combination derived for the respective learner.

#### 4. Limitations

In order to classify the learner into any dimension of learning style model (VAK model here), the learners are required to answer various questions and sometimes the learner may not be able to provide the correct response to the questions. In this scenario, it would be challenging to predict the appropriate learners' learning style. Further, it is also analysed that the learner's learning style may vary over time, hence using the same learning style would not be efficient.

## 5. Conclusion

In this research work, VAK learning style model has been used for determining various new learning style combinations. In this way, more learning styles were developed. In the same way, FSLSM could be applied together with Index of learning style questionnaire to develop more learning style combinations. Moreover, since learner's learning style change with time, a dynamic model needs to be developed that could predict if the learners' learning style changes over time.

## REFERENCES

- [1]. A. Kolb and D. Kolb, "The Kolb Learning Style Inventory - Version 3.1", Technical Specification. Boston: Hay Group, 2005
- [2]. J. H. Sihombing, K. A. Laksitowening and E. Darwiyanto, "Personalized E-Learning Content Based On Felder-Silverman Learning Style Model," In the proceedings of 8th International Conference on Information and Communication Technology (ICoICT), 2020.
- [3]. J. N. K. Liu, S. Shiu, Y. Wang, Z. Li, L. Jia and Y. Rao, "Poly-X: An online intelligent tutoring system for e-learning," In the proceedings of 3rd International Conference on Data Mining and Intelligent Information Technology Applications, Macao, 2011.
- [4]. K. Thankachan, "Intelligent Tutoring System", In the proceedings of International Conference on Inventive Computing and Informatics (ICICI), IEEE, 2017.
- [5]. M. K. A. Ariyaratne and F. M. Marikar, "Identification of the Best Teaching Practice by VAK Model in the Computer Degree Programme," 2019 International Conference on Advancements in Computing (ICAC), 2019, pp. 216-219, doi: 10.1109/ICAC49085.2019.9103343.
- [6]. M. K. A. Ariyaratne and F. M. Marikar, "Identification of the Best Teaching Practice by VAK Model in the Computer Degree Programme", In the proceeding of International Conference on Advancements in Computing (ICAC), 2019.
- [7]. Mubarak Sani Ibrahim, Mohamed Hamada, "Adaptive Learning Framework", In the Proceedings of 15<sup>th</sup> International Conference on Information Technology Based Higher Education and Training (ITHET), IEEE, 2016.
- [8]. N. D. Fleming, Teaching and learning styles: VARK strategies. IGI Global, 2001.
- [9]. P. Honey and A. Mumford, The Learning Styles Helpers Guide. Peter Honey Publications Ltd., 1992.
- [10]. R. M. Felder and B. A. Soloman, "Index of learning styles questionnaire," Online available at <http://www.engr.ncsu.edu/learningstyles/ilsweb.html>, 1997.