

# A Learning Style Model Designed for Online Learning Environments

Qiusha Min, Yating Chen, Neng Liu, and Mingzhang Zuo

**Abstract**—With the deep integration of information technology and education, online learning has become more and more widespread. Online learners are more extensive and have individual differences in knowledge level, learning style and learning ability. According to most education researchers, learning style is one of the most important factors affecting personality differences. Based on the learning style theory of traditional classroom, this paper constructs an online learning style model according to the characteristics of online learning. This research about online learning style model can help students evaluate and predict their learning outcomes. In addition, it can help teachers implement teaching interventions and provide data support for adaptive platforms.

**Index Terms**—Learning styles, online learning environments, student modeling.

## I. INTRODUCTION

With the deep integration of information technology and education, online learning has become more and more widespread [1]. In traditional classroom teaching, learners have relatively fixed and specific characteristics. However, online learners are more extensive and have individual differences in knowledge level, learning style and learning ability. According to most education researchers, learning style is one of the most important factors affecting personality differences and has a great influence on the learning process [2].

Everyone in the learning process has its own learning style. Learning style of different learners will show different tendencies in learning. In traditional classroom learning, it is difficult for teachers to adopt different teaching methods for students of different learning styles in the classroom. However, the online learning platform can utilize some technical means to implement educational interventions for learners and provide personalized learning services [3]. If educational interventions want to improve the learning efficiency of learners and have positive effects on learners, it is necessary to understand the individual differences of learners. The differences between learners are related to their learning style, therefore it is necessary to study the learning

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styles of online learners. In addition, online learning also has some characteristics that are different from traditional classroom learning, resulting in differences in learning styles between online learners and traditional learners. This factor should be considered in the research process.

Based on the learning style theory of traditional classrooms, this paper modifies the learning style model according to the different characteristics of online learning compared to traditional classroom learning. Matching the learning style with the learning behaviors on the learning platform, this paper constructs an online learning style model.

## II. LITERATURE REVIEW

There are many studies on learning styles. Currently, there are over 70 kinds of learning styles available. Some commonly used classic learning style models are introduced here, as shown in the Table I.

TABLE I: CLASSIC LEARNING STYLE MODELS

Learning Style Model	Classification
Dunn and Dunn Learning Style	Sound/Light/Temperature/Design (Environment), Visual/Aural/Time/Kinesthetic (Physiology), Impulsive/Reflective/Analytic/Global (Psychology), Motivation/Persistence/Responsibility (Emotion), Self/Pair/Peers/Team/Varied(Society)
Felder–Silverman Learning Style	Visual/Verbal, Active/Reflective, Sensitive/Intuitive, Sequential/Global
Kolb Experiential Learning Theory	Diverger/Assimilator/Converger /Accommodator
Gregorc Learning Style	Concrete-Sequential(CS), Abstract-Sequential(AS), Abstract-Random (AR), Concrete-Random (CR)
Grasha-Riechmann Learning Style	Participatory/Avoidant, Cooperative/Competitive, Independent/Dependent
Myers-Briggs Learning Style	Judging/Perceptive, Sensing/Intuition, Feeling/Thinking Extraversion/Introversion
Honey and Mumford Learning Style	Actors/reflectors, theorists/pragmatists
Bandler and Grinder Learning Style	Visual/auditory/touch-sensitive

The Dunn and Dunn learning style model divides learning styles into five categories, which are environmental factors, physiological factors, psychological elements, emotional elements and social elements, all these have an influence to learner's learning style [4]. For example, environmental

elements include sound, light, temperature and sitting position. These respectively indicate the learners' request for the background music, lighting, temperature and the environment and furnishings.

The Felder-Silverman learning style model divides the learning style into four dimensions: perception, input, processing, and comprehension [5]. Each of these dimensions is subdivided into two styles: sensitive/intuitive (perception), visual/verbal (input), active/reflective (processing), sequential/global (understanding).

The Kolb Experiential Learning Theory divides learning cycle into four processes, starting with Concrete Experience (CE), moving toward Reflective Observation (RO), then to Abstract Conceptualization (AC) and finally to Active Experimentation (AE) [6]. According to the performance of each learner in the two dimensions of perception and information processing, individual learning styles is divided into four basic learning styles: Diverger (CE and RO), Assimilator (RO and AC), Converger (AC and AE), and Accommodator (AE and CE).

The Gregorc Learning Style Model divides learning styles according to how students learn. The perception is divided into abstract and specific and the learning process is divided into sequential and random [7]. According to these two dimensions, learners are divided into four learning styles of Concrete-Sequential(CS), Abstract-Sequential(AS), Abstract-Random (AR), and Concrete-Random (CR).

The Grasha-Riechmann Learning Style Model studies the way of students learn, divides them into six different types of learning styles: participatory and avoidant, cooperative and competitive, and independent and dependent [8].

Myers-Briggs learning style is based on Jung's theory of personality, from these four perspectives of energy control, judging things, life attitude, understanding of the world, the learning style is divided into eight types: Extraversion or Introversion, Sensing or Intuition, Judging or Perceptive, Feeling or Thinking [9]. It mainly concerned with psychological factors related to study, especially learner's emotion, motivation, perception and learning process and internal psychological characteristics related to learning styles.

According to the performance and preference of students in the learning process, the Honey and Mumford Learning Style Model divided students into actors, reflectors, theorists and pragmatists [10]. Actors prefer to "act first and then think"; reflectors tend to "think twice before"; theorists think "logic is good"; pragmatists think "useful is good."

The Bandler and Grinder Learning Style Model divide learning styles into three basic types (visual, auditory, and touch-sensitive) based on the learner's physiological preference for information reception and processing [11]. This theory mainly focuses on learners' preferred characteristics of sensory channel.

All of these classic learning style models are constructed based on the learning styles of learners in traditional classrooms and don't consider that online learners have some different learning styles compared to traditional classroom learners. However, in order to keep up with the pace of education and achieve personalized education, it is necessary to study the learning style of online learners. In this work,

some classical learning style models based on traditional classrooms is firstly analyzed. According to the different characteristics of online learners, this paper propose an online learning style model corresponding to learning behaviors and clarified the judgment of each learning style. Finally, the application of this model are introduced.

### III. CONSTRUCTION OF THE ONLINE LEARNING STYLE MODEL

Different from the traditional classroom learning, the online learning is no longer confined to the study time from 8 am to 5 pm. It is not limited to fixed classrooms, laboratories and other places of study, and is no longer limited to students only. The online learning is a learning model that anyone can do in anywhere at any time [12]. In the process of online learning, a great deal of behavioral data left by learners on the learning platform contributes to judge the learner's learning style. This characteristic of online learning will be fully utilized to make judgement. According to the difference between the online learning environment and the traditional classroom learning environment, an online learning style model corresponding to learning behavior as shown in Fig. 1. is constructed.

Among many classic learning style models, the dimensions of the online learning style model choose the Dunn and Dunn learning style model's five dimensions: society, physiology, psychology, environment, and emotion. The Dunn and Dunn learning style theory gave a more comprehensive analysis of the learner's learning style from a number of dimensions, having a great influence in the area of learning style. Learning from the classic style of learning, the online study style model makes some appropriate adjustments based on the characteristics of online learning. The following will give a specific analysis of each dimension combining online learners' learning behavior on the learning platform.

#### A. *The Social Dimension*

Social dimension is a dimension that cannot be neglected in learning style. Learners are bound to interact with the learning contents, other learners and learning environment in the process of learning. Each learner has its own interactive way in the process of interaction. Therefore, the social dimension is an indispensable aspect in the study of learning style.

The social dimension mainly describes the learner's interaction preference with other learners and teachers in the process of learning, that is, the learner's preference for social interaction. Compared with the traditional classroom learning, online learning has its own characteristics on the interactive manner. In traditional teaching, teachers and students can communicate face-to-face. However, because of space constraints, online learners need to interact with others through interactive tools such as email, chat rooms, forums and answering areas to communicate with others learners and teachers.

In traditional learning, learners are classified according to learners' interaction in class. However, online learning can record learners' behavior data through online learning

platform and classify students into different kinds of learning styles according to how learners use these tools in the process of communication.

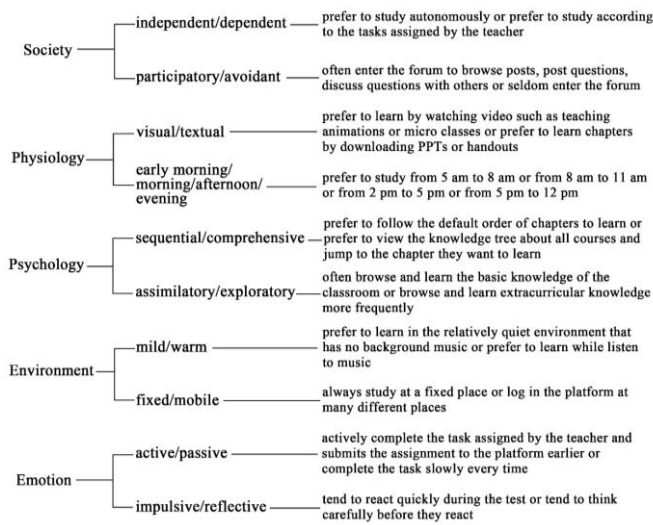


Fig. 1. An online learning style model.

The social dimension is based on the Grasha and Riechmann's theory of learning interaction. Grasha and Riechmann's learning style model mainly describes the learner's personality characteristics of social interaction, that is, the learner's interaction preferences with class activities, teachers and other learners in the process of learning. In this learning style model, Grasha and Riechman classifies learners into the participatory or the avoidant according to their interactive performance in class activities; dividing them into the independent or the dependent according to their dependence on teachers in personal learning; dividing them into the cooperative or the competitive based on learners' relationship with other learners in team learning. However, online learning is different from traditional classroom learning. There is no requirement for learning time and place of study for learners, and it is difficult to organize class activities. Therefore, the social dimension of online learning style model mainly considers learners' performance in personal learning and team learning.

In personal learning, learners' learning style is divided into independent and dependent. It can be judged by the comparison of the time that teachers assign tasks and the time that learners start studying on the online learning platform. If learners prefer to study autonomously, that is, they begin to learn before the teacher assigns tasks, they are judged as the independent. If learners prefer to study according to the tasks assigned by the teacher, that is, they don't start learning until the teacher sets tasks for them, they are judged as the dependent.

In team learning, learners' learning style is divided into participatory and avoidant. It can be judged by the frequency that learners enter the forum area, the frequency of posting questions and mutual evaluation with other learners on the online learning platform. If learners often enter the forum to browse posts, post questions, discuss questions with others, they are judged as the participatory. If learners seldom enter the forum, they are judged as the avoidant.

### B. The Physical Dimension

The learning style of this paper is based on the online learning platform, there are richer learning contents and more diverse education resources on the online learning platform. There are not only some text learning resources, for example, PPTs that teacher lectures and handouts (including important concepts and tests of this chapter), but also a lot of video resources such as teaching animation and micro class that teachers recorded. In the process of learning, learners' learning style is divided into visual and textual. It can be judged by the frequency that the learner clicks learning videos and the number that PPT is downloaded based on the data of the learning platform. If learners prefer to learn by watching video such as teaching animations or micro classes, that is, the number that video is clicked during the learning process is greater than the number that the PPT and the handout are clicked, the learner is judged to be a video style. Otherwise judged as text style, that is, the learner prefers to learn chapters by downloading PPTs or handouts (learning knowledge through answering questions).

In addition, compared to traditional learning methods, the time of online learning is more flexible. In traditional classroom learning, the learning time of learners is generally distributed in the time range of 8: 00-17: 00; while in online learning, learners are free to control the learning time by using the network and electronic devices and arbitrarily choose the time to learn, no longer tied to a certain period of time. Because of individual differences, each person's best learning time is different. Some people prefer to study in the morning, because they are energetic and have a higher learning efficiency after they get up; some people prefer to learn in the afternoon because they want to sleep in the morning; others prefer to learn knowledge and think questions at night, because they have a clearer mind and learn more efficient at that time. Therefore, based on the characteristics of online learning, learners are divided into early morning style, morning style, afternoon style, night style according to the preference of learners for different learning times. The learner prefers to learn at a certain time period, so the time of landing the learning platform has certain regularity and fixedness. If learners always study from 5 am to 8 am, then they are judged as the early morning style; if the learning time is between 8 am and 11 am, then they are judged as the morning style; if the learning time between 2 pm and 5 pm, then they are judged as the afternoon style; if the learning time between 6 pm and 12 pm, then they are judged as the night style.

### C. The Psychological Dimension

The psychological dimension is based on Gregorc's learning style model. The model divides perception into abstract and concrete style and divides the learning process into sequential and random style. According to how they learn, learners are divided into four learning styles: Concrete-Sequential(CS), Abstract-Sequential(AS), Abstract-Random (AR), Concrete-Random (CR). Online learning is difficult to judge the perception of students, so here mainly analyses the learning process of each learner. Learners will be divided into the sequential and the comprehensive according to the learning preferences of learners. If learners prefer to follow the default order of

chapters to learn, that is, learning by clicking the next button and the previous button to jump to the next chapter or previous chapter, then judged as the sequential; if they prefer to view the knowledge tree about all courses and jump to the chapter they want to learn through the knowledge tree, then they are judged as the comprehensive.

At the same time, another classification style has been added to this dimension based on the characteristics of online learning. E-learning learners are no longer confined to students. Anyone from different industries and different fields can study online. Different learners are interested in different knowledge, they are divided into the assimilatory style or the exploratory style according to their interests in different knowledge and preferences for different contents. The online learning platform firstly divides learning contents into two major categories: basic knowledge in class and extracurricular knowledge. Then it can make judgement according to the contents the learners browsed. If learners browse and learn extracurricular knowledge more frequently and like to learn and explore it, they are judged as the exploratory; if learners often browse and learn the basic knowledge of the classroom, they are judged as the assimilatory.

#### *D. The Environmental Dimension*

The environmental dimension is based on the Dunn and Dunn's learning style model. The Dunn and Dunn divided the environmental dimension into four elements of sound, light, temperature and sitting posture and classified learners according to their requirements for these four elements. However, this model is aimed at traditional classroom learning. It is very difficult to obtain learner's preference for light, temperature and sitting position through data on the online learning platform. Therefore, the online learning style model mainly considers learners' preference for sound. Some people prefer to learn in the relatively quiet environment that has no background music; some people prefer to learn while listen to music. It can be judged by the status of background music on the platform. If the background music is on when learners is studying, they are judged as the mild. If the background music is off, they are judged as the warm.

Based on the differences between online learning and traditional learning, learners' preference for learning places is added in this dimension. In the traditional teaching mode, students' places of study are arranged in advance by school and learners have no autonomy in the choice of the place of study which cannot reflect their different learning styles. In the traditional teaching mode, students are learning in a classroom. The fixed places bring a lot of inconveniences to learners. However, online learning is based on the cyberspace. Learners are free to choose their places of study, whether in an in-house cafe, at home, or at an airport. Their places of study actually reflect their different learning styles. Online learning platform can locate the learner's learning environment through GPS and classify learners according to their learning places. If learners always study at a fixed place, then they are judged as the fixed. If they log in the platform at many different places, then they are judges as the mobile.

#### *E. The Emotional Dimension*

Professor Dingliang Tan describes the emotion as the learning attitude, the rational level, the motivation and the attribution of the learners in the study of learning style. Because of the behavior data that can be obtained by learning platforms are limited, the online learning style model of this article mainly divides the emotional dimension into two aspects: learning attitude and rationality.

Learners are divided into the active and the passive according to their learning attitude on the platform. If the learners actively complete the task assigned by the teacher and submits the assignment to the platform earlier, that is, the submit time is far away from the homework deadline, they are judged as the active; if the learners complete the task slowly every time, that is, the submit time is close to the deadline, they are judges as the passive.

In the aspect of rationality, the learner's learning style is divided into impulsive and reflective. During the test, if the learners tend to react quickly, they are judged as the impulsive. In other words, the time the learners spend on the test that can be obtained by the time they start the test and the time they submit the answer is shorter than the average time. If learners tend to think carefully before they react, that is, the time that the learners do tests is longer than the average time, they are judged as the reflective.

#### IV. THE APPLICATION OF THE ONLINE LEARNING STYLE MODEL

The research about online learning styles can provide data for adaptive platforms, therefore it can achieve personalized push for learners of different learning styles [13]. For example, for learners who often log in the platform at a fixed place, the adaptive platform can push the knowledge to learners what they interest when they arrive at the fixed place. For learners who are the visual style, the platform automatically selects learning resources in the form of videos when it pushes relevant knowledge. For learners who are the comprehensive (that is, they prefer to jump to the relevant chapters through the knowledge tree), the platform automatically generates learning paths for them.

In addition to helping adaptive platforms achieve personalized recommendations, this online learning style model can also be used to predict and assess the learning result of learners who have different learning styles and to help teachers to implement teaching interventions. For example, for dependent learners (that is, they like to study according to the task assigned by the teacher), teachers can arrange related tasks for them in advance to assist their learning. For passive learners (that is, they are not active every time they submit the tasks), teachers can remind them to finish the assignment before the deadline. For exploratory learners (that is, they browse the extracurricular knowledge frequently), teachers can provide them extracurricular knowledge that are related to teaching contents to help them broaden their horizons. Therefore, online learning style research can help learners evaluate and predict their learning outcomes. In addition, it can help teachers implement teaching interventions and provide data support for adaptive platforms.

## V. CONCLUSION

According to the classic learning style model for traditional classroom, this paper constructs a novel learning style model for online learning environments. This learning style model is proposed based on the characteristics of online learning and can be used for adaptive learning platforms to improve its personalized services.

Future work is to collect the learner's corresponding learning behavior data on the platform according to the proposed online learning style model. Through learning behavior data, it is possible to mine the learning habits of learners, analyze their learning preferences and determine their learning styles. Therefore, the adaptive learning platforms can push appropriate and personalized learning contents for learners of different learning styles. In this way, students' learning can be improved effectively and efficiently.

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