From Embodied Cognition to Playful Interaction: The Construction of an Adaptive Learning Environment

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Abstract. Nowadays, with the rapid development of information technology, the traditional teaching theory and teaching model have been unable to meet the needs of current education and teaching. By reviewing the development and content of the embodied cognition theory, this study supplements the traditional cognitive theory and introduces the gamified teaching model. From the perspective of embodied cognition, this study explores the combination of embodied cognition theory and gamified teaching and puts forward the design principles and methods of gamified teaching, so as to reconstruct a highly embodied learning environment model. In order to make a contribution to the problems existing between learning and environment in current teaching.

Keywords: Embodied cognition · gamified teaching · adaptive learning environment

1 Preface

In recent years, under the background of the integration of information technology into classroom teaching, the research on the construction of learning environment has become a new hotspot. With the rapid development of technological means and the use of intelligent teaching equipment, teaching is no longer a simple process of knowledge imparting. From knowledge imparting to environment construction, the contradiction between learners and learning environment gradually appears. In the existing curriculum learning environment, learners' lack of presence and low level of participation continue to affect the cognitive development effect of learners. The traditional cognitive theory and learning environment have been unable to support the promotion and expansion of the teaching process, so it is particularly urgent to introduce new research theories and build an adaptive learning environment. At present, the rapid development of big data, artificial intelligence and other technologies has injected many new elements into the development of embodied cognition theory, and also provided technical support for the construction of adaptive learning environment [1]. Embodied cognition theory focuses on the interaction between the body's sensory organs and various environments, emphasizing the body's embodied experience, situational interaction and collaborative

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interaction, providing new ideas and approaches for the design and creation of learning environments [2]. Therefore, from the perspective of embodied cognition theory, this study explores the application of gamified teaching in teaching. Teachers use gamified teaching methods in the classroom to create a happy classroom for students through the form of games, improve students' learning enthusiasm and participation, and cultivate students' innovative thinking ability. Through the combination of entertainment and teaching, to build a highly embodied learning environment and encourage students to integrate their "bodies" into classroom learning, thus improving the teaching effect of the whole classroom.

2 Problem Formulation and Theoretical Review

2.1 Shortcomings of the Existing Learning Environment

The traditional education model is teacher-centered, teaching materials as the focus, emphasis on norms, light innovation, blackboard teaching mainly, time-consuming, laborious, small information capacity, information display form is monotonous and inflexible. Traditional teaching is not conducive to the improvement of teachers' comprehensive quality, not conducive to the broadness of teachers' and students' vision and the separation of mind and body of the teaching method, and not conducive to the cultivation of students' independent learning ability. The single teaching form also leads to the lack of two-way information exchange between teachers and students, and the low teaching efficiency. According to traditional cognitive theory, cognition is the information processing process of the brain, which has nothing to do with the body. Learning is a relatively lasting change of behavior or behavioral potential produced by repeated experience in a certain situation. Repeated experience "under certain circumstances" is the key to effective learning. However, due to the influence of the "dissociative cognition" view of the dualism of mind and body, the traditional education and teaching practice has long fallen into the misunderstanding of attaching importance to the mental training and ignoring the body feeling, and learning has been turned into "repeated training" on "certain occasions". So we need to introduce new cognitive theory.

2.2 The Theoretical Basis of Embodied Cognition

Cognitive science is the result of interdisciplinary cooperation among psychology, linguistics, neuroscience, computer science, anthropology, philosophy and artificial intelligence. Its goal is to explore the nature and mechanism of human cognition and intelligence. There is no doubt that psychology is the core discipline of cognitive science. The development of cognitive science can be divided into two stages: The first stage is based on the parallel processing of cognitive symbols and connectionism, which is called "the first generation of cognitive science". The second stage examines cognition in real life and considers that the actual cognitive situation is firstly the activity of a living body in a real-time environment. Therefore, the concept of embodied cognition is put forward. The second generation of cognitive science emphasizes situational, embodied and dynamic characteristics.

Embodied cognition is a strong wave of thought sweeping the contemporary cognitive science and psychology fields, and its basis comes from both philosophy and psychology [3]: the philosophical basis of embodied mind, mainly the relevant theories and ideas of Heidegger, Merleau-Ponty and Lakoff and Johnson, etc. Heidegger's "being in the world Heidegger's "being in the world" is the idea that we are active beings who exist in the world and rely on activity for cognition and representation by acting with things around us. This kind of embedded cognition studies that cognition occurs in the brain, and the brain is part of the body, and the body is in the environment, i.e. the environment is the place that houses cognition, brain and body. Merleau-Ponty argues that "the movement of the body is the movement of the body toward an object; it is the response of the body to the action of the object, and this response is independent of any representation." From the perspective of cognitive linguistics, Lakoff and Johnson make three propositions related to embodied cognition: that fundamental thought is mostly unconscious, that the mind is embodied, and that abstract concepts are mostly metaphorical [4].

The psychological basis of embodied cognition is represented by Dewey, Piaget and Vygotsky, etc. Functionalist psychology, represented by Dewey and William James, can be regarded as the forerunner of the research of embodied cognition theory, emphasizing that experience is rooted in the human body and acquired in a certain environment. Piaget's generative epistemology and embodied cognition have a lot in common. They both emphasize that cognition is the interaction between body and environment, and they believe that the interaction between body and environment produces cognition. According to Vygotsky's psycho-social culture theory, psychological development is a process from the lower psychological function to the higher psychological function. Advanced mental function is mediated by psychological tools and restricted by the development of social culture and history. It emphasizes that cognition is generated by the interaction between the subject and the environment. The body's perceptive motor ability is the basis of advanced mental activities, and cognition develops dynamically.

2.3 The Basic Idea of Embodied Cognition

Embodied cognition means that human body plays a key role in the process of cognitive processing. Cognition is mainly formed through the interactive experience and activity forms of various body senses in the environment. Embodied cognition theory points out that cognition, body and environment are mutually nested and inseparable [5]. Cognition is in the brain, the brain is in the body, cognition is attached to the experience produced by the various senses of the body, and the body is integrated into different physical, physiological and cultural environment, all three are indispensable.

The basic meaning of embodied cognition refers to the dependence of cognition on the body. Embodied cognition places cognition in the overall background of the environment and the body, emphasizes the shaping and influence of physiological and biological factors such as body structure, body state, special channels of the sensorimotor system and nervous system on cognition, and emphasizes the participation of the subject, the emphasis on the interaction process and the attention to emotional experience.

Mental activity is not an abstract symbol processing separated from the body, but is closely related to the structure of the body and the action schema of the sensorimotor system. Fundamentally, the mind is shaped by the body's interaction with the environment, and "the body plays a key role in emotional, motivational and cognitive processes".

First, the mind is based on and derived from the body. Cognition, thinking, judgment, reasoning, motivation and emotion are restricted by the physical attributes of the body. The body structure, weight and physical experience of heat and cold directly affect the special and direction of mental activities. Second, the way our bodies interact with the world determines how we perceive. Third, the mind is shaped by the body and its action on the world, and as there is a body, so there is a mind. The interaction between the body and the environment creates the mind and cognition. Mind, body and environment are integrated processes [6].

3 Gamification of Teaching

Embodied cognition challenges the traditional concept of education and sets off a revolution of embodied learning. The value of the body in the process of education has been emphasized and the construction of learning environment has become equally important. Gamified learning takes into account the characteristics of embodied learning and conforms to students' learning preferences and characteristics. Therefore, under the guidance of embodied cognition theory, the introduction of gamification learning into teaching practice is the essential return and form innovation of students' learning.

3.1 Gamified Learning

Games have the characteristics of purpose, spontaneity, fun, regularity, experience and challenge. It is used in the classroom reasonably, to assist teachers in teaching, to stimulate students' enthusiasm for learning, so as to better teach the course knowledge, to complete the teaching task.

Gamification learning is a clever combination of games and learning. Learners learn in the way of games, and teachers use game elements to transfer knowledge and information to learners in the teaching process [7]. Learners are naturally interested in games and media, so teachers take advantage of this psychology of students and use games as a bridge between teaching and learning. They introduce games into the classroom and teach students in a pleasant atmosphere. The theory is guided by the educational thought of "people-oriented". Through games, students can strengthen their learning enthusiasm and classroom participation, improve their knowledge mastery and skill proficiency, and cultivate their information literacy and life skills. This theory mainly holds that appropriate game activities introduced into students' learning will not have a negative impact on students, but will also promote students' learning, help them master knowledge and ability, improve their learning efficiency and exercise their thinking ability. Gamification learning is in line with the characteristics of gamification teaching. The design of game levels and tasks, as well as the fun and competitiveness of the game itself, can promote students' learning motivation and cultivate their imagination and creativity imsubtly.

Knowledge is gradually constructed and formed in the process of interaction between the cognitive subject, the cognitive object and the environment, which has distinct characteristics of involvement, situation and generation. Learning is a process in which learners fully integrate their natural environment and internal physiological resources to promote knowledge construction. In order for learning to occur, it is necessary to attach importance to the role of the body in knowledge learning, provide the required environment for knowledge learning and promote the holistic learning of knowledge. Ideal teaching is embodied, with the characteristics of sensory participation, mind-body unity and physical practice, and is a series of behavioral combinations carried out by teachers in order to promote learners to learn effectively. To carry out the teaching effectively, it is necessary to liberate the students' body, build a multi-modal teaching environment, strengthen the teaching intervention, choose interesting teaching content, emphasize the body experience and adopt the teaching way of learning [8].

3.2 The Fit Between Embodied Cognition Theory and Gamification Teaching

As the name implies, gamified teaching is to carry out teaching activities in a gamified way. Physical and mental participation is the common requirement of embodied cognition theory and gamification teaching. According to learners' psychological development level and character characteristics, teachers combine the fun, interactivity and situational nature of games with the educational function of games. Gamification teaching is teacher-led and learner-dominated. The body of learners is the carrier of their participation in gamification teaching, and the development of learners' mind is the source of motivation to participate in games. Through games, learners can better control themselves and generate a sense of self-efficacy, so as to participate in the next stage of teaching more actively. Learners control the body and participate in the game under the joint action of all parts of the body. This participation process is not a simple mechanical entry of the body, but a combination of knowledge, emotion, intention and action. Students are not only the master of the body, but also the main body of the game. Secondly, gamification teaching is a process in which the body discovers "truth" in the process of playing games, which coincides with the view that cognition comes from the body in embodied cognition theory, both of which agree with the role of the body. Traditional cramming education cannot match the needs of students, so "discovery learning" in the game teaching activities is the best way to learn.

Embodied cognition believes that environment is an essential condition for individual cognition, and the body is in the environment all the time. Therefore, the content, process and way of cognition are closely related to the body. Game teaching emphasizes the contextuality of education and the construction of environment, including the construction of psychological environment and physiological environment. First, fundamentally, mental activity is shaped by the interaction between the body and the environment. The process of gamification teaching is also carried out through the interaction with people or objects in the environment. The environment provides the teaching place for gamification teaching, and the environment is also the space for the occurrence of embodied cognition. There is a close relationship between the two. Secondly, students find and solve problems in specific situations. In teaching games, teachers should create environments or create situations to meet the teaching needs, which may be either fairy tale

situations or specific life situations. Let students physically participate in games, exercise their athletic ability, enhance the development of physical coordination and motor ability, and then promote the development of memory, imagery, thinking, emotion and other advanced cognitive abilities.

4 Adaptive Learning Environment

4.1 Environment Construction

Based on the theory of embodied cognition and gamified teaching, this paper intends to build an adaptive learning environment model to help students better integrate into the learning atmosphere, so as to better complete their studies. Learning environment is the sum of all factors that promote learners' learning [9]. Traditional disembodied cognitive learning environment cannot continuously and effectively promote learners' meaningful and constructive learning. Therefore, adaptive learning environment requires the "body" to be brought into the classroom, emphasizing the integration of mind and body as well as the integration of subject and object. The embodied learning environment is built to promote the embodied learning of learners [10]. Its environment is dynamic and contains the mutually-beneficial coexistence of "body and mind". The overall environment mainly includes the physical environment, physiological environment and social and cultural environment (See Fig. 1 for interaction mode). In this environment, knowledge acquisition of learners not only exists in information processing at the cognitive level, but is also closely related to the body. With the help of various sensory organs of the body, the behaviors of the body can be made explicit, or the interaction with various elements in the environment can be realized through specific role experience [11].

From the perspective of embodied cognition, the construction of learning environment can be divided into two parts: material and immaterial, including learning space, learning content and learning role [12]. At the material level, the learning space includes two kinds of teaching space, physical and online. The learning content mainly includes learning materials and course teaching tasks. At the non-material level, the learning space mainly points to the social relationship, and the learning content includes the implicit learning content such as skills, knowledge and experience. The learning role refers to

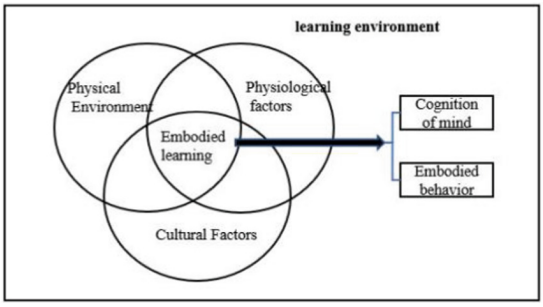

Fig. 1. Model diagram of embodied learning environment

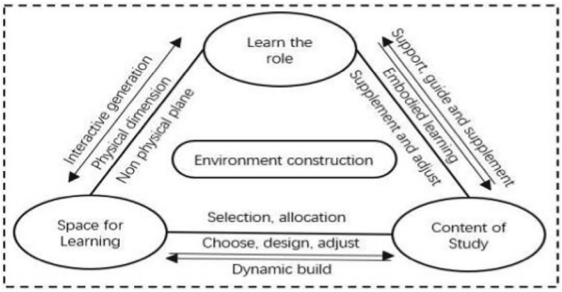

Fig. 2. Learning environment system

the relative relationship of "teacher-learner" formed in the process of learner interaction. The idea that the body gets the learning experience before the brain suggests that in the process of building the embodied learning environment, the characteristics of the embodied learning environment are gradually formed: interactive generation, dynamic construction and embodied learning. Through the interaction between the body and the learning space and the learning role in the learning environment, the body can achieve the input, transformation and output of cognition, and the process of the selection, sequencing, distribution and generation of the learning content is the driving force to promote embodied learning to the deep level. The interaction diagram of learning environment system is shown in Fig. 2.

4.2 Principles of Gamification Instructional Design

In the course of gamification instructional design, the instructional design principles should be followed. Only with rigorous game teaching design can teaching practice proceed in an orderly manner. The design principles include the following points: First, the content rationality principle, the game link is not blindly introduced, in order to adapt to the nature of children to change the previous rigid teaching for the purpose. Moderate participation in games is engaging and enriching. Teachers can also improve the quality of teaching in a harmonious classroom atmosphere. Secondly, the fun of game activities, which can effectively stimulate students' internal learning motivation, improve their enthusiasm for learning, and stimulate their inquiry and enthusiasm for knowledge learning. The third is the principle of implementability. Before designing game activities, environmental factors should be considered to ensure that the activities can be carried out smoothly. The selection of games should be close to students' life, so that they are easier to understand and willing to participate in, and should be practical and operable to a certain extent. The difficulty of games should meet students' acceptance level, and the rules of games should be easy to understand, so that students of different levels can find their own appropriate roles in gamified teaching activities. The fourth is the principle of diversity of evaluation. Teaching evaluation should be considered from various aspects, to understand students' knowledge grasp and synthesize their performance. In the teaching process, students' classroom performance should be observed and recorded anytime and anywhere, and teaching objectives should be taken as one of the basis for teaching evaluation.

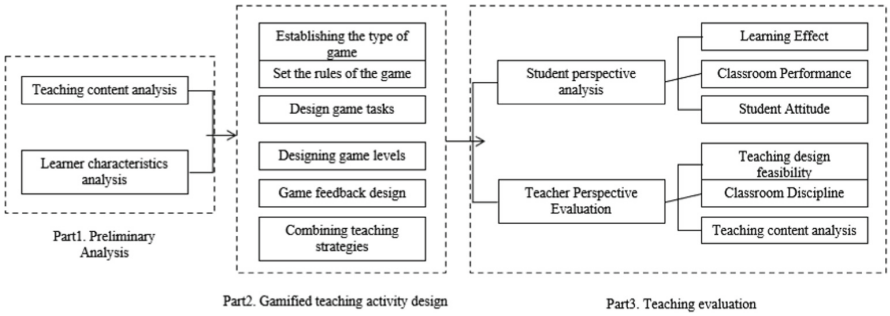

Fig. 3. Gamification instructional design model diagram

4.3 Gamified Instructional Design Model

The gamified instructional design process is divided into three stages: preliminary analysis, gamified instructional activity design and evaluation stage. Preliminary analysis mainly analyzes the teaching content and the characteristics of learners. The design of gamified teaching activities is considered from five aspects, namely, the selection of game methods, the formulation of game rules, the design of game tasks, the design of game levels, the design of game feedback and the combined use of gamified teaching strategies. The teaching evaluation part considers from two perspectives of students and teachers, and uses classroom observation scale, after-class interview, questionnaire and other methods to test whether this model can be applied in practice, whether the teachers' teaching objectives are achieved and whether the students' learning tasks are completed through the implementation of this model. Thus, based on the theory of embodied cognition and the principles and modes of gamification teaching, an adaptive learning environment is constructed, and learning modes suitable for different learners can be designed according to specific requirements. See Fig. 3 for game-based teaching design mode.

5 Conclusion

As an emerging psychological cognitive approach, embodied cognition has received more and more attention and research because of its embodied, generative, and contextual characteristics, and the application of embodied cognition in gamified teaching provides a new reference for teachers' teaching mode. With the development of information technology, game-based teaching based on artificial intelligence will be more common in the future, and the importance of embodied cognition will be more prominent. Based on the theory of embodied cognition, building an adaptive learning environment is conducive to enhancing students' learning ability and promoting their overall development.

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