

Design and Application of Virtual Simulation Experiment of The Montessori Method of Education

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Abstract: With the increase of social demand, more and more colleges and universities set up The Montessori education courses. The course is practical, in addition to the traditional offline training, online virtual simulation experiment has also become a beneficial supplement to the course practice. The virtual simulation experiment of The Montessori education is designed for three sub-experiments: material cognition, material operation and environment creation. Through interactive operation, it helps learners understand the principles of Montessori classroom environment creation, the principles and methods of material operation for teachers and children. And through the blended learning of online and offline, the combination of theory、virtuality and reality, it stimulates learning interest and improves learning quality.

Keywords: The Montessori method of education; Virtual simulation experiment; Integration of theory, virtuality and reality; Blended learning

1. Introduction

The Montessori Method of Education was founded by Dr. Maria Montessori, a famous Italian educator, with a complete set of educational theories and methods, which had a profound impact on the development of children's education in the world. It was introduced into China at the beginning of the 20th century, and has been rapidly disseminated and developed since the 1990s. As its educational philosophy, operating materials and educational institutions are gradually known, more and more college preschool education majors begin to set up special Montessori education courses to meet the needs of the society for teachers. This course is very practical, Montessori operating materials that reflect the Montessori educational philosophy are expensive, rich colleges and universities will build offline Montessori Operation classroom, but in the absence of offline operation classroom or when it is difficult to arrange offline operations, the development of virtual simulation experiments that can be completed online can also meet some of the needs of course practice.

2. Design of virtual simulation experiment of The Montessori method

2.1 Purpose of the experiment

At present, the "Montessori Method of Education" in colleges and universities is mainly for children aged 3-6. Based on Kindergarten L, we create an online Montessori classroom for 3-6 years old, creating a convenient opportunity for learners to learn about Montessori educational practices online. The experiment was designed to:

(1) Through an immersive visit to the virtual simulation Montessori classroom, I can understand the beautiful, generous and warm layout style of the Montessori classroom, understand the regional division method of the Montessori classroom and the principles of operating materials setting, master the names and functions of common operating materials, and test the learning effect by trying to create a Montessori classroom.

(2) By observing the operation process of virtual teachers and virtual children's demonstration operating materials and the interaction method of teachers and children, the author can master the purpose, operation method, error point and other information of ten classic operating materials, and understand the educational concept contained in the design of operating materials and teaching process.

(3) Through the online immersive virtual simulation (3) experiment, I realized that the development of information technology has

brought great changes to the learning style, and developed a strong interest in learning, and improved the learning quality by adopting the blended learning that integrates online and offline, theory, virtual and real.

2.2 Principle of the Experiment

The Montessori method virtual simulation experiment contains four operating principles that need to help learners master.

(1) The Layout Principle of Montessori Operation classroom^[1]: The regional division of each classroom is arranged by the leading teacher according to the situation of the classroom, and must follow the order from Practical Life area, sensory area, mathematics area, language area to science and culture area to maintain the continuity between the areas; The location must be determined according to the facilities and space required by each district.

(2) Design principles of Montessori operating materials^[2]: Principle of independence, principle of error correction, principle of attraction, principle of Order and logic, Principle of life.

(3) The setting principle of Montessori operating materials^[3]: Each class places a set of operating materials; Pay attention to the scientific design, placement and operation of operating materials; operating materials display is targeted to children of different ages; operating materials display order: from left to right, from top to bottom, from simple to complex, from concrete to abstract, from classic operating materials to extended operating materials^[4].

(4) The guidelines for presentation : individual guidance is the main requirement, concise, clear and objective language^[5]; Know in advance what activities the child has already done; The movement demonstration is complete and smooth, the moderate pause shows the emphasis, the movement is slow and elegant, reflecting the sense of order; Observe the children and adjust the teaching activities according to the children's performance.

2.3 Content of the Experiment

In the form of virtual simulation, following the design ideas of “visiting Montessori classroom and understanding common classic Montessori operating materials” -- “learning and operating classic operating materials” -- “trying to create a Montessori classroom”, the Montessori virtual simulation experiment was designed into three interrelated sub-experiments:

Experiment 1. Cognition of operating materials. A warm, bright, clean and beautiful virtual Montessori classroom is presented, which is set clockwise into Practical Life area, sensory area, mathematics area and language area (the offline physical kindergarten Montessori classroom referred to in this experiment is set into four areas, and the content of the science and culture area is infiltrated into the other four areas), and the areas are separated by operating materials cabinets. Each area has a different number of tables, chairs and work blankets as needed. Dozens of classic Montessori operating materials are placed on the operating materials shelf. After selecting the operating materials, you can learn the basic information of operating materials such as composition, educational purpose and applicable age.

Experiment 2. operating materials operation. Ten classic operating materials from Practical Life education, sensory education, mathematics education and language education are selected, each of which sets “learning mode” and “operation mode”. The “learning mode” mainly learns the operation process of operating materials and the interaction method of teachers and children. The “operation mode” requires learners to try to demonstrate operating materials according to the correct process, and complete the knowledge question and answer after the “operation mode”. Only after answering the correct questions can you submit it and get the result of the operating materials.

Experiment 3. Environment Creation. Learn the basic requirements of Montessori classroom environment, and then decorate a Montessori classroom with furniture and operating materials provided in the material library according to the requirements of Montessori classroom environment layout.

2.4 Process and interactive operation method of the Experiment

The virtual simulation experiment of Montessori education method is designed in two versions: immersive VR (based on C/S architecture) and WEB (based on B/S architecture) operated by computer and mouse.

(1) Experimental methods for the VR version

VR experiments need to be configured with special experimental sites and special equipment to carry out. Learners enter the laboratory equipped with VR equipment, put on a helmet (helmet-type display), put on a headset, hold a controller (interactive device) and walk into the warm, tidy and orderly virtual Montessori classroom, see the observation chair by the door, see the Montessori line on the ground, and see the four areas arranged in order: Practical Life, sensory, mathematical and language. Mentally review the layout requirements of Montessori classroom environment and verify whether the layout of this virtual classroom meets the requirements. You can use the handle to “teleport” to one of the areas, walk around to observe how the teaching aid cabinet and tables and chairs are

arranged in the area, and then carefully observe what operating materials are on the teaching aid cabinet and how to place the operating materials, and operate the handle to grab the highlighted operating materials, feel its weight, and learn its name, function and other basic information, and exit the virtual classroom after observing the four areas in turn.

(2) Experimental process and method for the WEB version

The WEB version uses the keyboard and mouse operation experiment, the cost is lower, in addition to the computer, monitor, network and experimental software, there are no other hardware conditions, more convenient for learners to operate, but also easier to promote.

①Login Experiment Platform

After logging in the virtual simulation experiment platform, learners can choose one of the three experiments, enter the experiment interface, and start the operation.

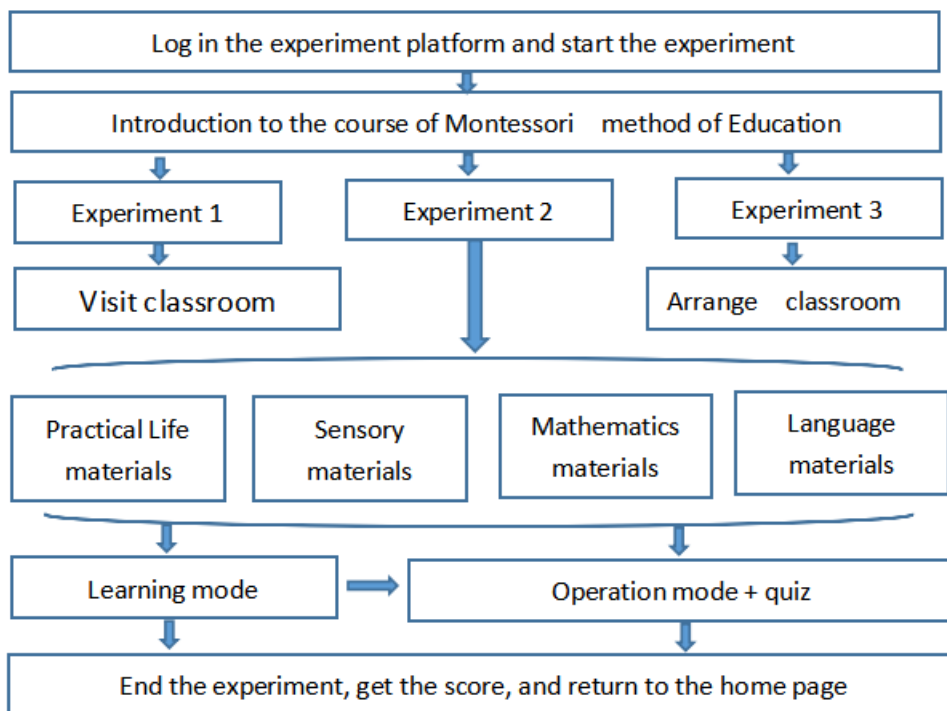


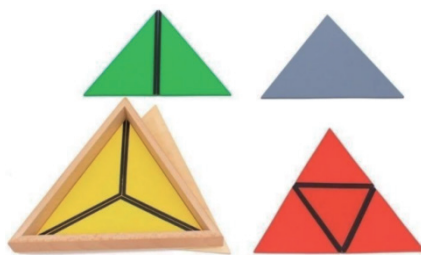
FIG. 1 Flow chart of virtual simulation experiment

②Experimental procedures and methods

Taking the classic work “triangle box” in sensory area as an example to introduce the experimental method. Choose experiment 2 “Teaching aid operation” and then choose sensory teaching aid “triangle box”. After entering the interface of the “triangle box”, first learn the information of the composition of the operating materials, the direct and indirect purposes of the operating materials, the age of application, control of error and suggestions for follow-up activities, and then choose to enter the “learning mode” or “operation mode”, the general recommendation is to learn before practicing. After the “Learning Mode” interface is opened, you can see the teacher at the desk to demonstrate the operation of operating materials for a child. It is suggested that learners record (or memorize) the position, movement, expression, posture, language and tone used in demonstration, work flow, and how teachers and children interact while watching. The “Learning mode” has an “acceleration” button, which can be selected and used according to needs. After learning, enter Operation Mode. In the “Operation mode”, learners try to simulate and demonstrate the work of “triangle box” for children step by step according to the correct operation process, and the progress can be set by themselves. The experiment provides tips for next operation and the teacher’s voice tips, and learners can choose to use them according to their own needs. After the end of the operation, complete a relevant knowledge question, the system automatically evaluates the right or wrong, and can end the experiment of “triangle box” and obtain the results of the project.

Through the operation process of the operating materials “triangle box” (the operation process is not expanded here, the main point of the operation is to break up the triangles, pair them and trace the black lines, and compare them with the gray regular triangles), the learners understand that the direct aim of the operating materials is to help children understand that a regular triangle can be decomposed into other types of different triangles, so as to prepare for learning geometry. The indirect aim is to develop the

child's ability to distinguish lines and shapes, explore ways of constructing shapes, exercise control of the wrist muscles, and develop a sense of order, concentration, coordination, and independence.



The operation process of Montessori operating materials is to lead children to learn from simple to complex and from concrete to abstract. In the experiment, the composition, educational purpose and operation process of each teaching aid are different, so as to stimulate the potential of children from all aspects, promote the comprehensive development of children, and ultimately help children grow into their unique selves.

2.5 Evaluation of the experiment

The virtual simulation experiment of Montessori education method can be used in several courses of preschool education majors, and teachers will decide the course assessment. It can also be used as a project of course practice in the course of “The Montessori Method of Education “ and combined with other course practice methods.

The scoring rules for the WEB version experiment are as follows:

Experiment 1 operating materials cognition. The content of the experiment is to visit the Montessori classroom and recognize a large number of Montessori operating materials without scoring, but setting a five-minute learning time limit. As long as you enter the Montessori classroom, you can't exit after five minutes. Through the rules, you can ensure the learning time and improve the learning effect. Teachers can use flexible methods to assess their knowledge of operating materials and the Montessori classroom environment in other forms of the class.

Experiment 2 operating materials operation. Experiment 2 is a scoring project, 10 points are scored for the learning, operation and knowledge questions of each classic operating materials, and the total score of the 10 operating materials is 100 points. Among them, complete the learning mode gets 4 points, complete the operation mode and correct answer gets 6 points. The operation mode has its own “control of error “ function, and learners can complete the experiment and get results only when they complete the operation correctly and answer the questions correctly. The experiment can be repeated several times until the learner achieves satisfactory results.

Experiment 3 environment creation. In experiment 3, learners were asked to arrange a Montessori classroom independently according to the observation of the Montessori classroom in Experiment 1 and the requirements of the creation of the Montessori classroom environment in Experiment 3. It was an open question with no score. The Montessori classroom created by the learners in the experiment is saved in the form of a screenshot taken by a camera, and the teacher can carry out online or offline sharing, evaluation and other activities to promote students to learn and think more deeply.

3. Application of virtual simulation experiment of The Montessori method

3.1 Blended course practice with the integration of theory , virtuality and reality^[6]

The course of Montessori educational method mainly covers the formation and dissemination of Montessori educational thought, the basic theory of children's view and education view, teaching content and teaching method, five fields of education and the production of operating materials, the theory and practice of class management, and the localization of Montessori education. In the overall teaching design of the course, the virtual simulation experiment is taken as a part of the practical teaching of the course. Together with other course contents, it provides diversified and unified learning support for learners through the combination of theory and practice, online and offline, on-campus and off-campus, virtual and reality. It is assumed that the Montessori Teaching Method^[7] is the main textbook, taking it as an example and integrating the relevant content of other auxiliary teaching materials, the theoretical teaching and practical teaching of the course can be designed as a whole, and the list is as follows.

In the overall teaching design of the course, a large number of learning resources on the Internet can be introduced to this course, such as the MOOC of Chinese University, the smart vocational education network, the online courses of the National Open University Learning network and the resources of some Montessori education and training websites, etc. There are both theoretical lectures and operating materials operation demonstration by teachers . These resources can be used as learning materials after teachers' selection.

Table 1 Blended Practical Teaching Design of The Montessori method

Teaching content	Theoretical teaching	Online virtual simulation experiment	Offline practice and training
Overview of Montessori teaching methods	The connotation of Montessori pedagogy	Experiment 1 Visit the classroom	Visit Montessori class
The theoretical basis of Montessori teaching method	View of children, view of teachers, view of teaching	Experiment 3 Design the classroom	Design the class environment
The implementation of Montessori teaching method	Teaching content, teaching method	Experiment 1 Cognition of operating materials	Learn about Montessori operating materials
Practical Life, sensory, mathematics, language, culture and science education	Values, content, principles, methods	Experiment 2 Operation of operating materials	materials operation
The principle and guarantee of Montessori teaching method	Freedom and discipline, rewards and punishment ,environment	Experiment 2 Operation of operating materials	Analyze teacher behavior
Montessori operating materials production	Montessori operating materials, principles of production		Design and make operating materials
Localization of Montessori education	Current situation and countermeasures		Visit localized Montessori Kindergarten

The operation demonstration of online learning operating materials and the online viewing of Montessori kindergarten activities are also a form of curriculum practice, and learners can choose independently according to their own knowledge, experience and ability range, and carry out continuous and repeated learning. This learning style is consistent with the criterion of children’s “work” in Montessori education^[8], such as order, independence, freedom, repetition, concentration, etc. When learners adopt Montessori education concepts and methods to learn how to carry out Montessori education, they will gain more profound experience and understanding.

3.2 Implementation effect of Montessori virtual simulation experiment

As online virtual simulation experiment is a new form of course practice, especially the immersive VR version, learners can experience the shock of coming into a real Montessori classroom , holding the operating materials in their hands and even feeling its weight, and walking to the demonstrator’s side, which greatly stimulates learners’ interest in participation, and then arouses their interest in further learning courses. In the experiment of the WEB version operated in the computer room, the system scored the operation of operating materials in experiment 2 directly, and all learners could complete the learning, operation and knowledge questioning of ten kinds of operating materials in stages according to the course process, and obtain full marks (the experiment set up the “control of error” function, full marks is the only score). After the completion of the cognition of operating materials in experiment 1, learners are asked to sort out the information of various classical operating materials, such as the main Sensory operating materials, the composition, suitable age, direct purpose, indirect purpose and other information, in this way, learners gain more. The screenshots created by experiment 3 are displayed, shared, discussed and compared in offline teaching activities, and good learning results are also achieved.

4. Rethinking the construction of the virtual simulation experiment

4.1 Rationally view the function of the experiment in course practice

Virtual simulation is a comprehensive technology to construct and display the virtual world, which is characterized by Immersion, Interaction and Imagination. Virtual simulation experiments can solve the problems caused by traditional high-risk, high-cost and high-pollution experiments, solve the pain points of practical course learning for distance learners, and provide learners with various forms of digital resources that can be learned anytime and anywhere. It also promotes the reform and innovation of practice teaching mode. However, if we follow the principle of “combination of virtuality and reality, mutual complement, can be real and not virtual” proposed by the Ministry of Education in 2013, and from the classification of “demonstration type” and “interactive type”^[9], this experiment is a “demonstration” experiment, and its effect on the improvement of learners’ practical ability is relatively limited.

Based on this, combined with the characteristics of this course, in the setting of practical teaching objectives, adhere to the offline practical training as the main, the online virtual imitation experiment as the supplement; In terms of practical content, virtual experiments are only a small part of course practice, and most of them need to be completed in the form of actual hands-on operation of operating materials, personal interaction with children, and actual visit to traditional Montessori kindergartens and localized Montessori kindergartens. Only in terms of the number of Montessori operating materials, among 88 pieces of classic operating materials,

the experiment only provides the virtual operation demonstration of 10 pieces of operating materials, which is far from enough, in addition, there are a large number of self-made operating materials that need to be made offline. In the assessment of curriculum practice, the proportion of experiment assessment is correspondingly very low. Combining with the characteristics of the course, it may be more appropriate to develop or share other low-cost and high-quality online resources such as teaching videos and use them in combination with existing virtual experiments.

In addition, due to the high production cost and the restriction of use conditions, virtual simulation experiment will cause some other problems, such as the sustainable development of virtual simulation experiment resources, sharing with other colleges and universities, and technical problems in the use process, which need to have corresponding solutions.

4.2 The teaching quality of The Montessori method still needs to be improved

The Montessori method has a complete set of curriculum philosophy, objectives, contents, operating materials and evaluation methods, which belongs to a relatively complete and pre-developed curriculum system^[10], The main job of teachers is to arrange children's individualized learning according to their characteristics and needs. If the curriculum is of good quality, novice teachers will be able to pay more attention to the needs of each child, and teachers themselves will be more likely to gain professional confidence and happiness.

However, the current situation of Montessori education course in colleges and universities is not optimistic, and even some students dislike the Montessori Educational philosophy and method^[11], The author believes that the key to solve the problem is that teachers should have accurate positioning of the curriculum. Montessori attaches great importance to teacher training, and its "3-6 year old Preschool Teacher Course" requires 14 courses^[12], requires hundreds of hours of theoretical study and course practice, and learners need to pass rigorous assessments to obtain certifications. However, the Montessori education courses offered by ordinary colleges and universities are set at 2-3 credits and 36-54 credit hours, which is far from the entry standard. It may be more appropriate to set the course goal as improving students' understanding of the course and arrange original reading, classic operating materials operation demonstration and in-depth analysis of the Educational philosophy, designing and making operating materials, and visiting Localized Kindergartens as the course content.

Since there are not many teachers holding Montessori Teacher Certificate and Montessori Trainer Certificate in colleges and universities, to improve the quality of teaching, on the one hand, colleges and universities should encourage teachers to get the certificate, on the other hand, colleges and universities could cooperate with Montessori teacher training institutions to set up "dual Certificate Courses"^[13]. To improve the level of teachers, improve the teaching quality of courses, and ultimately provide high-quality preschool education for children.

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