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A Study on Maker Education and Its Integration into College English Teaching Based on Learning by Design

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Abstract: *Maker Education is the brand-new education concept and model highlighting the integration of modern information technology into educational process. The paper elaborates the components and features of Maker curriculum on the basis of Learning by Design which focuses on the explorative process through understanding those challenging tasks, designing several strategies to fulfill the tasks, and finding some new means or new tasks on solving these problems to start a new explorative circulation. Maker Education can be integrated into any course teaching with similar teaching designs: to find the most suitable project; to take advantage of multidisciplinary resources to fulfill the project; to develop hands-on ability and basic knowledge to improve critical thinking, creative thinking, and social skills. In college English teaching, it's necessary to design some practical tasks for the students to fulfill by means of new knowledge learnt from the text and the modern technology. The integration of Maker Education into different courses is the mega trend of Chinese future education.*

Keywords*: The Maker Education, Learning by Design, double circulation, college English teaching*

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I. Introduction

Maker Education originated from the practical exploration in recent European maker activities which inherited the following educational ideals of Dewey, Piaget, and Seymour Papert. Obama administration launched Maker Education Initiative in 2014 aimed at accelerating the pace of establishing A Nation of Makers in order to enhance the creative ability of the youth. The Ministry of Education in China issued 13th Five-Year Plan in Education Information in July, 2016, which proposed that it is necessary to explore the application of information technology in the new education pattern such as maker education, and to promote the students' information literacy, creative awareness and abilities. [1] Driven by such initiative and proposal, we educators should focus on exploring the new maker education-oriented teaching pattern, contributing to the students' development in practical and creative ability.

Maker Education is the Competence-Based Education, concentrating on problem exploration, operational design. It is relevant to Design Based Learning which stresses the actual situationality, designablity, iteration and achievement. Literally speaking, Maker emphasizes the activity and spirits of operation, sharing and problem solving. When it is connected with education, Maker Education seeks to promote Maker Spirit as the core mission, to make Maker Space as its main space, the modern information technology as its major tool, integrating STEAM and interdisciplinary knowledge to realize the modern teaching activity to develop the students' imagination, creativity, and problem solving skills using their own hands. Compared with traditional class learning, maker education realizes the unity of moral knowledge, practice and creation.

Literally speaking, Maker stresses the behavior of tinkering, sharing and problem solving and the corresponding spirits. When Maker is mapped to the educational domain, Maker education is centered on promoting Maker spirit, with maker space as the main site, the modern technology as the main tool. It is a teaching process integrating Steam and other multidisciplinary knowledge through the complete process of coming up with creative ideas, designing and implementing with the goal of developing students' ability in imagination, creation and hands-on problem solving. Obviously, compared with the traditional class, Maker Education realizes the common unity of moral knowledge and practice and even the evolution from moral knowledge to the unity of moral knowledge and practice, and creation as well. [2] As a result, Maker Education is neither the second class, nor the comprehensively practical activity class, but is a brand-new educational concept and pattern integrating school education system and curriculum elements.

II. Analysis of Maker Education: Components and Features of Maker Curriculum and Maker Education Based on Learning by Design

2.1 The components and features of Maker curriculum

The curriculum goal: the western scholars believe that the goal of Maker Education is to explore the students' creativity, enhancing their ability in utilizing technology and means to create products and tools in order to tackle practical problems. As to the Chinese scholars, they argue that the goal of Maker Education focuses on developing students' creative awareness, creative thinking, and creativity. According to the previous Maker Education cases home and abroad, we can conclude that its goal lies in the core attainment to solve problems on the basis of digital design and fabrication. This core attainment runs through the level of double elementary course (basic knowledge and skill relevant to different disciplines and also digital design and fabrication), the level of problem solving (the basic means obtained through solving problems), the level of disciplinary thinking (the steady thinking methods and values to think about and solve the problems in the process of project implementation, and the level of higher-order ability (vocational, learning, and creative ability formed in the process of Maker practice).

The curriculum contents: according to the theoretical analysis, Maker curriculum doesn't belong to a concrete subject, but integrates basic knowledge and skills of different subjects. Therefore, the contents of Maker curriculum don't have strict subject stipulation, but have the feature of generativity led by Maker research project. In other words, Maker projects limit the basic knowledge and skills relevant to different subjects, the solution to problems and thinking models. The core of constructing Maker curriculum is how to set the research projects. Based on the previous Maker practices, the research projects mainly derive from the practical problem through observing daily life, and some projects derive from subject teaching. But what kind of project is suitable for Maker curriculum? Table 1 [3] presents us the selection criteria and instructions of Maker curriculum.

Selection Criteria	Instructions
Correlation of the project	The project should be interesting, being related with students' daily lives, which can arouse their enthusiasm.
Integrity of the subject	The project should cover multidisciplinary knowledge and skills, its difficulty being adapted to students' knowledge reserve and learning ability.
Sufficiency of the resources	The resources for completing project should match the conditions provided by the college.
Rationality of the time	The time for completing project should be confined to the proper time horizon.
Visibility of the outcome	The outcome should be displayed in visible works, being shared, tested and discussed by the teacher and students.

Table 1: The selection criteria of Maker research projects

2.2 The Maker Education based on Learning by Design

Design and Learning by Design: Learning by Design, being different from Learning by Inquiry, can serve as a concrete realization which integrates Maker Education into regular subject teaching. Learning by design, in essence, inherits and integrates the benefits of Learning by Inquiry and Learning by Project, highlighting the features of inquiry and experiment in the process of Maker learning. Design, as the medium of Learning by Inquiry, is the focus of Learning by Design, and the design itself is a kind of creative activity to solve the valuable problems. Researchers conclude the general procedures of Learning by Design presented in the following Table 2 [4].

Procedures of Learning by Design	Requirements
Challenging tasks	Teachers put forward challenging tasks to develop divergent thinking in students.
Integrative thinking	Learners integrate different knowledge of subjects, designing the products reflecting the theme by means of recalling previous knowledge
Iterative design	Learners modify and redesign the product through newly-learnt knowledge

Table 2: The general procedures and requirements of Learning by Design

It is obvious that both Maker Education and Learning by Design have the same orientation in the process of exploration; it is a process to design the product and iteration. As to the Maker Education, the good Maker projects must meet the current practical requirements. Applying design concept in the process of problem solving, students can obtain abundant knowledge and social skills used in different research areas and daily lives, which hence encourages them to learn the subjects with greater interest and enthusiasm.

Maker Education on the basis of Learning by Design: the creativity of Maker Education lies in the fact that the students can get various knowledge and skills inclusive of critical thinking ability, independent

searching ability, creative applying ability, ideas testing ability, learning from mistakes and coming up with the new solution, cooperating with others and making democratic decision. From the perspective of modern didactic, the process of Learning by Design is to find the problem, to put forward the problem, to analyze the problem, and to solve the problem. It is vital to develop the problem awareness, to stimulate their active, different and creative thinking, to encourage their explorative spirits and aspiration after truth. In a series of Maker practice and analytical case study, learners master skills, strategies, abilities and behavioral habits, and experience-oriented learning is contained in Maker Education.

III. Integration of Maker Education into College English Teaching Based on Learning by Design

3.1 The learning procedure of Maker Education based on Learning by Design

Most of inquiry teaching model adopt scripted-inquiry teaching model, and the current Maker Education keeps adopting such teaching model. In fact, the scripted-inquiry teaching tends to lead to the complexity of knowledge and lack of learning experience. Confronted with this unfavorable condition, the double circulation-inquiry teaching model comes into being. Kolodner constructed double circulations in accordance with the complexity and inquiry of design which include research and design circulation including understanding challenge, requiring new knowledge, planning and design, displaying outcome, evaluating and analyzing. [5]This model renders the learning design and redesign circulation, stressing the iteration and inquiry of Learning by Design. The following Fig. 1 clearly illustrates the concrete process of this double circulation.

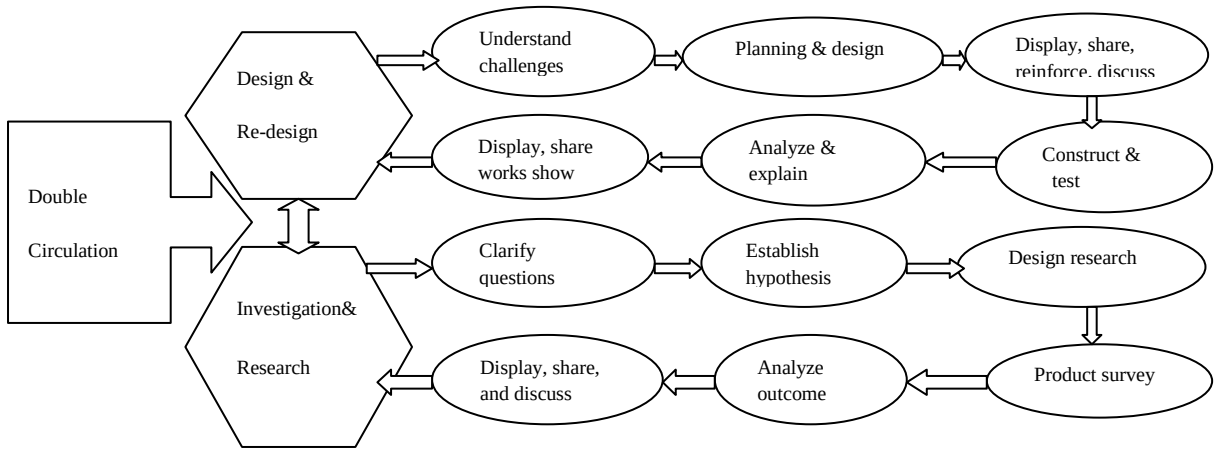

Fig. 1: The operational process of double circulation based on Learning by Design

In this double circulation, learning process begins from the first link (understand challenges) of the first circulation (design & re-design) which involves all the activities relevant to the design of completing the challenging tasks. The process of accomplishing the tasks isn't separated from explorative activities. When the students have to learn about new things on taking part in designing challenges, they are encouraged to make investigation, and hence the second circulation appears accordingly.

3.2 The design of English Maker learning space and the display of Maker case for college English teaching

The design of English Maker learning space: Online English Maker learning space provides the teachers and students with network-based, digital and intelligent cloud learning space. Maker teachers not only design, upload Maker resources through online Maker space, but also assign homework and take staged tests. This space can also grade the assignment automatically with real-time recording, providing statistical analysis that reveals the performance of students in learning English. The purpose of this analysis is to realize differentiated teaching. Students can watch Maker micro-video through online SPOC Maker space to learn new Maker knowledge.

SPOC English Maker space: Maker teachers and students can make Maker micro-video according to the requirements of MOOC with additional resources of micro-courseware, micro-project, micro-case, and micro-experiment. Students finish micro-assignment, and also take part in such learning feedback as online test, discussion, and survey.

Virtual English Maker class: this is a virtual teaching space which is constructed from a real class. It can facilitate teachers and students to hold various teaching activities through network. These virtual Maker classes include simulated real class (synchronous live teaching, synchronous interactive discussion), extended

real class (asynchronous on-demand teaching, asynchronous interactive discussion), and creative real class (independent learning based on digital resources, team learning based on online cooperation, and social learning based on online team interaction). [6]

The display of an English Maker case: to set up Virtual Police Departments; to ascertain necessary facilities; and to design and develop the webpage.

The student organizing committee members from different faculties are responsible for the following tasks: Publicizing the concept of VPSO through billboards, campus broadcasting, LAN forum, internet forum and activities in the local community to attract as many participants and funds as possible; start recruiting new members according to their criteria when former trainees graduate to ensure adequate working staff in their virtual departments; With drafted vision, discipline, basic policing tasks and services, they set up their own virtual police departments, establishing the structure and staff within the departments, assigning the organizing work accordingly to realize their plan. The indispensable software includes VPSO platform, English for Elite Police Network, 21 Century College English teaching discs series developed by Dreamweaver8, Office2007, Ulead Video Studio, VisualJW, UltraISO and Visual Studio. Hardware includes two server computers, five teaching computers, and four multimedia classrooms with facilities like Newclass multimedia teaching systems, 320 student computers, projectors and loud-speakers. All the computers are linked through the Campus Network, Police Network and the Internet. The homepage for each virtual police department contains basic News & Events, Support & Advise, Recruitment and two major parts: Policing Services and Policing Tasks. Police services of Social Order Administration, for example, include Community Affairs, Find & Lost, and Inquiries. Policing tasks include establishing and investigating a criminal case, interrogating a witness and arresting a suspect.

IV. Conclusion

The Chinese Maker Education proposes that the goal of Maker Education should focus on developing students' creative awareness, creative thinking, and creativity. This new education concept meets the requirements of the information era emphasizing explorative and creative abilities. According to the previous Maker Education practices, we can conclude that the principle and process of Maker Education is similar to those of Learning by Design, so it is necessary for us to conduct the research into Maker Education on the basis of Learning by Design. As a result, the strategy of double circulation is applied in Maker Education, which highlights the functions of design and redesign, investigation and research. The process of Maker Education is a circulated creative process with pertinent projects and creative design and re-designs. It can be integrated into any course so long as we advocate and adhere to the principle that exploration, design, creation, and reflection are the main educational objectives and orientations in the 21st century.

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