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Research and Practice on teaching Mode of Educational Game Design Course based on Design Thinking

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Abstract

With the continuous deepening of educational reform, the design and development of educational games has become the direction of educational information development. The design of educational games, as a product of the combination of education and games, not only emphasizes the scientific nature of game content, but also emphasizes the interest of game methods and forms. It carries people's good wishes for education and unlimited expectations for games. However, how to balance the relationship between education and playing in educational games has become an urgent problem to be solved in academic circles. Therefore, in order to combine the needs of the learners, the work is designed to be both educational and playful. This research analyzes the appropriate points of design thinking and educational game teaching process, based on the "EDIPT" model proposed by Stanford University, incorporates the design thinking approach into the teaching process of specific educational games, and designs the case of "fun thinking" educational game. The case study illustrates the design of educational games from the creation of game situations, clarification of tasks, optimization of solutions, game design and production, and iterative optimization. The research aims to cultivate students' practical innovation ability and problem-solving ability, in order to provide some reference for the combination of design thinking and educational games.

Keywords

Educational games; Design Thinking; "EDIPT" model.

1. Introduction

With the development of education informatization, educational games as a new teaching method have gradually received widespread attention and favor in the education field. Educational games are designed for specific educational goals and combine education and games to stimulate learners' learning motivation [1]. Academic circles regard educational games as the product of the combination of education and games, which has received extensive attention and application. Practical research shows that educational games have a greater impact on students' academic performance and physical and mental development. Educational game design focuses on the selection of curriculum standards and content, ignoring the real needs of game users; The process of game design is not supported by scientific theories and can hardly be applied to other game designs, educational game design needs a set of design methods that can be used flexibly [2]. Compared with foreign countries, the domestic research on educational games started relatively late. After combining national curriculum standards with students' math knowledge, Perace et al designed a "monster Elimination" [3]; Taking "bubble planet" as an example, Chen Xiangdong introduced the design process of augmented reality educational games [4]; CAI Li et al. proposed the design framework and functions of multiplayer

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online educational games based on Flash technology [5]; Yang Wenyang and others designed and developed mathematics education games based on mobile learning environment [6]; Li Haifeng and others took "little bear in forest protection" as an example and put forward an educational game design framework based on humanistic theory [7]. Research shows that the academic community has not yet integrated design thinking into educational game design research.in view of this, in order to meet the educational concept of "people-oriented" of educational games and to meet the needs of users. Based on the "EDIPT" model proposed by Stanford University, this paper takes a specific game design process as an example and uses design thinking concepts and methods to analyse the specific steps of educational game design from user requirements analysis, game content and problem identification, optimization, game design and production, final testing and optimization, etc. In the design process, it combines real situations, fully adopts the needs of students, teachers and users, summarises the specific design of educational games, provides ideas and theoretical support for subsequent educational game design, and aims to design educational games that are truly both educational and interesting.

2. Design Thinking and Educational Games

2.1. Design Thinking

2.1.1. Definition of Design Thinking

The concept of design thinking originates from the book 'Artificial Science', where Simon argues that artificial science is inseparable from human design, and that human thinking is essential to the integration of the artificial with the natural. Simon pointed out that the core task of the school is to guide learners to think about how to design, and thus create more artefacts that blend with nature [8]. Buchanan sees design thinking as an innovative way to solve the problem of inferiority [9]. With the development and application of design thinking, different viewpoints and understandings have emerged on the connotation of design thinking in academic circles. Wu Lifeng believes that design thinking is a way of thinking, but also an ability and a psychological orientation to identify problems, actively explore and seek innovation [10]. Norman believes that design thinking is a creative process of solving problems or designing works, including investigation and exploration, problem definition, proposal of solutions, and evaluation of results [11]. Li Tongtong analyzes the connotation of design thinking from three perspectives: thinking mode theory, problem-solving method theory and innovation process theory. A way of thinking that emphasises a combination of human-centredness, imagery and abstraction, which is both a way of thinking about problems and an ability to think. From the perspective of problem solving method, design thinking is seen as a methodological system of problem solving and design innovation, which provides designers with a series of visual innovation skills and methods.From the perspective of the innovation process, design thinking includes the three processes of inspiration, conception, and implementation. It solves complex problems and continuously optimizes solutions through the three links of conception, prototype, and evaluation [12].

In summary, although the academic circles define the connotation of design thinking from different entry points, their explanations have common points, which allows us to see the complexity and richness of the connotation of design thinking. For example, the 'mindset theory' and the 'competence view' both consider design thinking as a thinking ability; the 'problem-solving approach theory' and the 'method view' both emphasise innovation and consider design thinking as a methodology for solving poorly constructed problems; the 'innovation process theory' and the 'process view' both emphasise design thinking as a process of innovation and creation[13]. We believe that design thinking emphasises 'human-centered', which means that people are able to synthesise their existing knowledge and abilities, and

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through the interdependence and facilitation of the double helix structure of design and thinking, constantly generate new problem-solving strategies, come up with meaningful ideas and thoughts, and then creatively form ideas and solutions to problems.

2.1.2. Design thinking model

Design thinking is a method and thought to support learners' innovative learning and problem solving.,Researchers have developed design thinking patterns suitable for different fields around the three steps of "inspiration, conception and realization". Simon sees design thinking as a general problem solving process, on this basis, Simon established a linear model of "analysis - synthesis - evaluation" [14]. Based on Simon's linear model and a wealth of experience,Tim Brown has distilled ideas from his design work into a flexible thinking framework - 'inspire-conceive-implement' trilogy [15].The British Design Association proposed a "Double Diamond model" that includes four stages of "discovery, definition, development, and delivery" [16]. IDEO company expanded the design thinking model into five stages of "discovery-interpretation-conception-experiment-evaluation" [17]. The design of the five-stage model provides an effective way to implement K-12 education, and at the same time, it provides a set of innovative solutions for cultivating innovative talents in colleges and universities. In addition, the school of design of Stanford University proposed a five stage model of "EDIPT", including "empathy - problem definition - conception - Prototyping - Testing" [18].

Although there are many kinds of design thinking models, they all have the same characteristics in structure and connotation. From a structural point of view, the elements are interconnected and are all iterative processes. From the perspective of connotation, each model provides a framework and pattern for "designers" to solve problems, the main idea is to empathize, acquire user needs, propose visual solutions, and finally solve complex problems in life. In view of the above analysis of the connotation and model of design thinking, this study is based on the 'ETIPT' model (Figure 1), which integrates design thinking methods into the educational game design curriculum, with teachers guiding students to design creative works through visual teaching tools and methods, thereby promoting the development of students' design thinking skills.

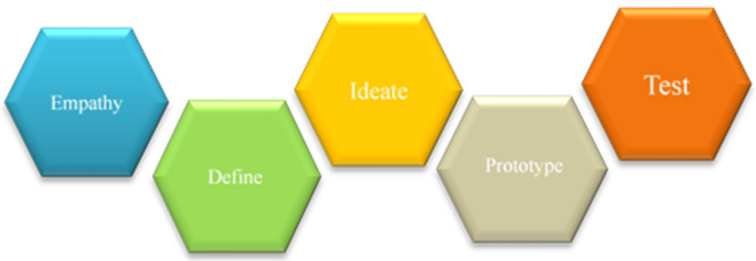

Figure 1. "EDIPT" model

(1) Empathy

It is the most central aspect of design thinking that emphasises human-centredness. Through observation, listening and interviews, we understand the user's daily behaviour and explore their real needs from their perspective, laying the foundation for the definition and conceptualisation process.

(2) Define

Through the information collected in the empathy stage, the user needs are integrated, and the thinking process is carried out to analyze and summarize the key meaningful and feasible problems to be solved.

(3) Ideate

The team put forward innovative ideas through brainstorming, nine grids, six hats, etc., and formulated problem solutions based on user needs and innovative ideas.

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(4) Prototype

In combination with user needs, the solution is presented in a visual form, and the model is constantly created, tested, and iteratively corrected to gradually generate better problem solutions.

(5) Test

Through diverse evaluation methods such as mutual evaluation and self-evaluation, the prototypes are tested and evaluated, and the work is iteratively optimised by combining user participation experience and feedback, thus continuously improving the problem solution.

2.2. Educational Games

2.2.1. Connotation of Educational Games

At the beginning of the research, educational games were mainly operation games. With the development of epistemology, educational games began to focus on the design of motivational and environmental aspects of learning, and the focus gradually shifted to the learner.Subsequently, people realized the effectiveness of integrating knowledge and situation.Therefore, the design of educational games mainly follows the theory of learner situational interaction [19]. Through a literature review, Bao Xueying et al. found that foreign scholars mainly focus on the theory, technology, development and design, and application of educational games [20]. Compared with foreign countries, the domestic research on educational games started late. The "China Educational Game Development Report" believes that games can help solve the problem of insufficient motivation in learning, the intrinsic motivation of the game can improve the initiative, enthusiasm and immersion of learners [21]. Combining the two basic characteristics of educational and playfulness, the researchers regard educational games as healthy and meaningful games. For example, Li Yi proposes that educational games are a kind of electronic games with game characteristics and educational functions, which create virtual situations to arouse learners' curiosity, stimulate learners' fantasy, and motivate learners to explore [22]. According to Zhu Zhiting et al, educational games are games that combine the educational and playful aspects of play into one, in which the accompanying educational effects can be produced.Liu Xiaocui believes that educational games have different emphasis under the influence of different theories, that is, starting from behaviorism, they initially mainly embody "games", and later they began to pursue educational significance, and now they have realized the combination of games and education [23].We regard educational games as an important carrier of teaching. Centering on the "people-oriented" educational concept and policy, educational games can strengthen the effective communication and interaction between educators and the educated, so as to realize the real edutainment.

2.2.2. Design Thinking and the Appropriate Point of the Project-based Teaching Process of Educational Games

Based on the connotation and development of educational games, this paper applies the concepts and methods of design thinking to the project-based teaching process of educational games, and analyzes the appropriate points of design thinking and teaching process of educational games projects from the perspectives of objects, principles, objectives, methods, resources, etc. See Table 1 for details.

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Table 1. The internal relation between design thinking and educational game teaching

	design thinking	Educational game teaching process	Internal connection
object	human-centered	learner-centered	combining user needs
principle	learning by doing	learning by playing, guided by practice and exploration.	cultivate students' hands-on practice and innovation ability
target	seeking innovative solutions to problems.	practical ability to solve problems	Both emphasize the cultivation of students' ability to observe things and solve problems.
method	hands on learning, continuous experimentation, collaborative iteration, brainstorming, and borrowing prototypes.	interpersonal communication, teamwork, independent inquiry learning.	they are project-based learning, emphasizing the iterative design process and cultivating students' innovative consciousness and ability.
teaching resources	design thinking emphasizes observation, exploration and iterative sharing, and effectively supports learner communication and promotes collaborative learning by using digital resources such as real-time communication tools and visual tools.	digital tools are used for information retrieval and online communication, while basic development processes or models (such as WEEV narrative game creation method, EFM educational game design model) or programming languages are used to complete the module functions of the game.	design thinking provides visual tools for the teaching of educational game courses and provides support for learners to design games.

3. Case study "Fun Thinking" Educational Game

3.1. Teaching Analysis

3.1.1. Analysis of Teaching Objects

The subjects of the study are sophomores. Through the teaching and guidance of teachers, students have a preliminary understanding of the connotation and design principles of educational games, but they are relatively weak in grasping the real needs of game users, game level tasks, and program design. On this basis, it is necessary to deepen the investigation of user needs and cultivate students' empathy and problem-solving ability.

3.1.2. Teaching Content Analysis

Content analysis corresponds to the problem definition stage in EDIPT model. Through the analysis of learning situation, the learning content and teaching objectives of educational games are formulated, and the problems to be solved are put forward. Game content combined with students' knowledge reserve and learning ability to build[24]. When determining the learning content, it is necessary to sublimate the original level of learners, improve their level, and design creative and in-depth educational games.

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3.2. Teaching Process Design

3.2.1. Create A Situation to Challenge

The main task of this stage is to observe, participate and understand the user's experience and motivation with empathy under the guidance of the teacher, explore the situation of bad construction and complex problems, and draw the map of empathy, so as to understand the user's pain points and clarify the task. As a guide, teachers introduce game items in a situational way: how to use the learned knowledge to explain the phenomena of mirage in life and the changing sun in the morning? Students discuss this, gather relevant information through the internet, consult relevant materials, etc., and develop a basic background knowledge of how to deal with the challenge. Then, the teacher played the related video of "Education and Game Combination". Let students fully develop their imagination and think in combination with the real experience of game teaching: "How to present the knowledge they have learned in the form of fun games"? The teacher proposed the task of this activity: combining the characteristics of educational games, making full use of the existing subject knowledge, and designing optics-related games based on design thinking method and open source software.Then,Through the design of the scene to experience some laws of optics, so as to master and consolidate the relevant knowledge of optics. To clarify the task even more and reinforce the challenge of understanding, the teacher guides students through the grouping and encourages group members to think about the problem from a wider range of perspectives, culminating in the completion of the empathy map.

3.2.2. Brainstorm and Clarify the Task

The main task of the session is to identify the core issues to be addressed through investigation and exploration. Firstly, the teacher explains the principles of light refraction and the specific methods of gathering ideas (POV, interview data analysis),inspires learners to organise the information created and collected in relation to real-life situations, and guides them to list the "need to know" and "need to do" in the form of a table".Subsequently, the teacher instructs the students to select 2-3 meaningful and feasible key issues, and after consultation and discussion, determine the issues that need to be resolved. Then, each group entered into the investigation and exploration session, which focused on mastering the mirage phenomenon from the refraction of light, experimenting with the laws and principles of light refraction, familiarising themselves with scratch software programming,and integrating subject knowledge with educational games. Finally, teachers and students make a qualitative assessment of the work in relation to its innovative, technical and artistic qualities.

3.2.3. Explore Design and Optimize Scheme

This link mainly includes two stages: scheme conception and scheme optimization. During the conceptualisation stage, the teacher teaches the principles of brainstorming, the four quadrant analysis diagram and the skills of using a mind map.The groups uses brainstorming and mind mapping to present diverse ideas and visual solutions for their respective tasks.Scheme optimization focuses on the convergence of thinking,students select or integrate creative ideas based on the real needs of users, and initially form a design plan with collective wisdom of the group.Then, the program was presented and communicated between groups, and the teacher gave suggestions and guidance.Based on the suggestions, they are continuously revised and refined, resulting in a perfect and detailed solution.For example, in order to master the principle of light reflection in the design of the game, the team realized that they should pay attention to improving the practicality and artistry of the work through the communication and demonstration between the groups. Therefore, the team members added props, beautified the interface and characters, added music and time system, and completely connected the physical knowledge related to the refraction of light.

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3.2.4. Prototyping, Iterative Optimization

This part is a process in which students visualize the conception plan,students combine subject knowledge,programming software, and simple materials to present the plan in kind. Combining the evaluation criteria of the work, carry out display and communication between groups, and clarify the strengths and weaknesses of the scheme, and then improve and perfect the work.

First of all, the teacher provides the group with materials such as Scratch, PS software and props, and encourages students to actively practice and iterate to optimize the product. Students combine their knowledge of optics, use open source software, relevant props, create hands-on group work, write programs and use open source software to initially complete prototype products. Finally, the group tests and evaluates the work according to the evaluation criteria, analyses the problems with the preliminary procedures, lists them, and makes adjustments and optimises the work.For example, in the games of the light series, there are phenomena such as unclear picture pixels, single roles in the game, and relatively simple challenge level tasks. It is difficult to stimulate students' interest in challenging tasks again. Combining the existing shortcomings, the team added task levels and teachers' roles. After iterative optimization, the program and works were optimized.

3.2.5. Evaluate Reflection, Transfer Application

In the final part of the project, the teacher organizes a presentation of the students' results, including the introduction of the content of the task level, programming and functional application, as well as sharing their experiences in the process of requirements analysis, abstract definition, creative ideas, solution optimization and work improvement.The teacher provides a comprehensive evaluation form and an extended application feedback form, and the group produces a video clip or presentation to show the group's problem-solving process, while students watch each other's work and engage in mutual evaluation and reflection.The challenge of the “fun game” theme case comes from the real situation, which not only reflects the key role played by educational games in teaching, but more importantly, the ability to use design thinking methods to cultivate students' empathy and interdisciplinary problem-solving skills. Students can experience a real sense of design, feel the real joy of "learning by doing", and realize the transition from "passive acceptance" to "active exploration and design".

4. Conclusion

Design thinking reflects the divergence and convergence of thinking, focusing on developing students' empathic observation skills, practical innovation and interdisciplinary problem-solving skills.The iterative, contextual nature of design thinking is in line with the philosophy and purpose of educational game design, and both aim to develop learners' practical and creative skills and problem-solving abilities.Research has shown that there is a lack of maturity in academic research that combines design thinking methods and concepts with educational games.In view of this, this study integrates design thinking methods and steps into the design process of educational games, in order to provide some reference for the realization of the combination of design thinking and educational games.

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