Research on Immersive Programming Based on Two flat and Four Ends Learning Space from the Perspective of Metaverse

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Abstract. In response to the shortcomings of our school's programming computer public general education courses, the teaching team has conducted in-depth research on the theory of the metaverse, accurately grasped students' learning styles and interests, and innovatively proposed the "two flat and four end" teaching mode from the perspective of the metaverse, constructing an immersive programming system from "visual programming to gamified programming, and then to gamified programming.". The analysis of course data shows that teaching effectiveness has been comprehensively improved and teaching quality has been comprehensively enhanced.

Keywords: Metaverse; Two flat and four ends; Visual programming; Gamification programming; Gamification of programming.

1 Introduction

The metaverse has three characteristics: ①online. The metaverse is an online world that spans reality and virtualization. The Internet connects objects in the real world with virtual objects in the metauniverse; ②Virtualization. The metaverse can simulate the real world in a virtual form and provide a high degree of immersion and interactivity; ③Big data. There are massive and diverse user data in the metaverse. Ku Xiaowei and others explored the "Internet plus Education" from the perspective of the metaverse [1], Wen Zhen and others explored the teaching method of the C language programming course from the perspective of virtual simulation [2], Wang Dong discussed the teaching reform of computer courses [3], Wang Huashu discussed the development prospect and practice path of translation education from the perspective of the metaverse [4], and Shi Qing took immersion experience as one of the criteria for testing results [5].

Our school's programming computer general education courses mainly include "Introduction to Computational Thinking", "Python Programming", "Fundamentals of C Language Programming", "Database Counting and Applications", "Python Data Analysis", etc. The blended teaching model of "one flat and three ends" is adopted in

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teaching, which refers to the "mobile end", "classroom end", and "management end". Among them, "mobile end" refers to mobile phones, through which students can preview before class, interact during class, and review after class. "Classroom end" refers to a large screen, which is used to create interactive classrooms for teachers. Before class, teachers build MOOCs, use large screens for classroom teaching during class, and use mobile devices to manage classes and courses after class. "Management end" refers to the use of big data analysis to intuitively assist managers in evaluating teaching, learning, and teaching management. "one flat" refers to the teaching platform, which is the cloud brain of the teaching process. Although the "one flat three end" teaching model has achieved a new teaching ecology in a smart environment, there are still the following problems.

2 The Problems in Programming Computer General Education Courses

Problem 1: The learning space of "one flat and three ends" has poor immersive learning experience for students

Due to the insufficient integration and weak interactivity of virtual and real learning spaces in the learning spaces of mobile devices (Learning Platform), smart classrooms (Classroom), and management devices (Smart Academic Affairs), the immersive experience effect of students is not good. Therefore, it is imperative to build a learning space based on the combination of virtual and real in the metaverse - classroom, mobile, management, and game simulation.

Problem 2: Almost all programming courses are focused on mathematics, algorithms are difficult, and programming is challenging

Programming courses are mostly focused on mathematics and difficult algorithms, and students find the programming process dull and boring, gradually distancing themselves from or fearing programming like a tiger. So the key is to increase students' interest, make them feel immersed in programming, and generate strong behavioral stickiness. Usually, unsmooth platforms or poor programming cannot make students develop stickiness. Therefore, optimizing the learning experience and enhancing the stickiness of programming behavior is imperative.

3 Curriculum Reform Practice

In response to the above issues, the teaching team has innovatively proposed a "two flat four end" learning space and a programming system that goes from visual programming to gamified programming, and then to gamified programming. The innovative ideas are shown in Figure 1.

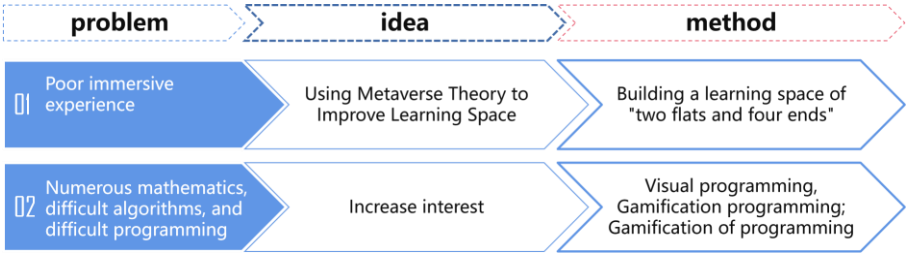


Fig. 1. Innovative ideas for curriculum reform

3.1 Building a "two Flat and Four End" Learning Space for Problem 1

Relying on our school's Building Electrical and Intelligent Beijing Experimental Teaching Demonstration Center, we will build a "two flat and four end" learning space based on the combination of virtual and real elements in the metaverse. "Two flat" refers to the online teaching platform and game programming platform, while "four end" refers to the teaching room end (smart classroom), mobile end (learning communication), management end (smart academic affairs), and game end. We choose the Chaoxing platform for teaching and the Geek Chronicles website for programming. In immersive game programming, teachers can create tasks, set scenes, students can create characters, choose programming languages according to requirements, complete tasks, pass levels in the game, and earn points after passing. As shown in Figure 2.

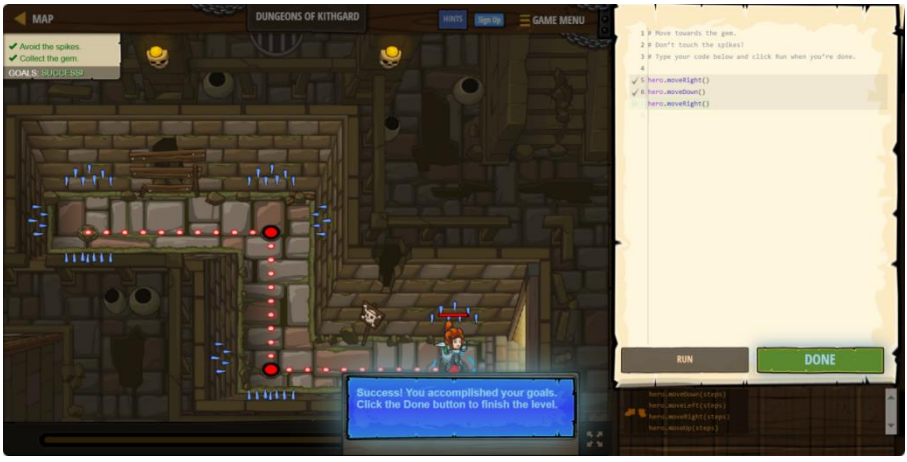


Fig. 2. Online game programming experience based on the metaverse

3.2 Build a "Gamified" Programming System for Problem 2

In order to increase interest in programming, we divide programming questions into three types. The first type is visual programming using Raptor, with simple questions as the main focus, as shown in Figure 3. The second type is gamified programming[6-8], which involves writing small games using programming software, as shown

in Figure 4. The third type is gamification of programming, which involves setting programming tasks on programming websites. Students can improve their programming skills while completing the tasks, as shown in Figure 2. The first two types of programming, although mainly focused on game programming and WYSIWYG, lack immersion and programming viscosity. The third type of programming is immersive programming, where students can integrate well into their roles and actively stimulate their programming enthusiasm, greatly improving the programming effect[9].

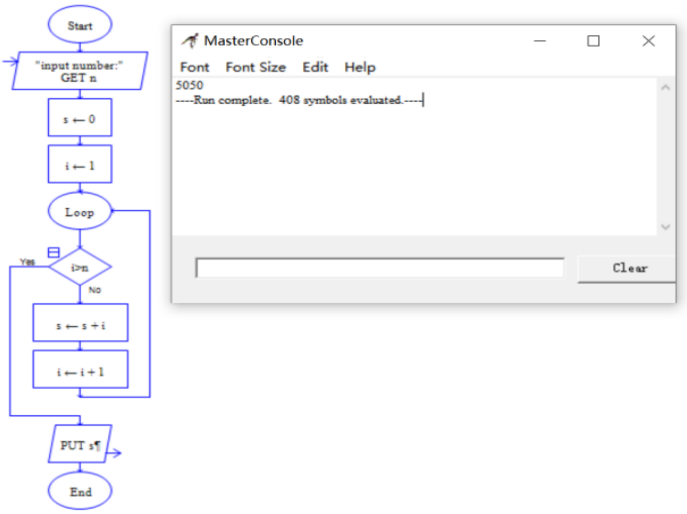


Fig. 3. Raptor Visual Programming

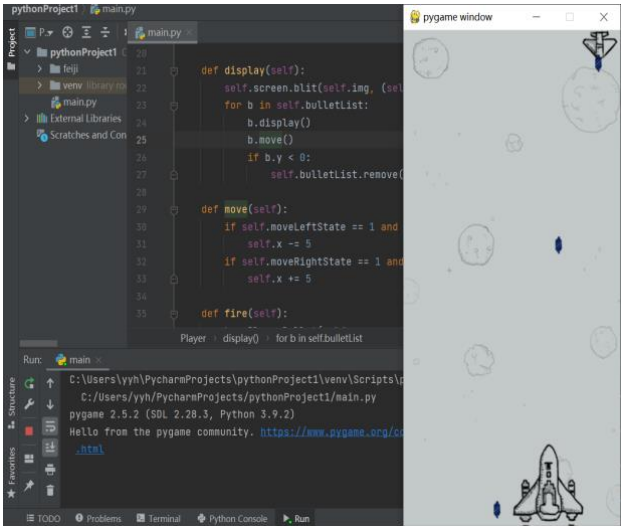


Fig. 4. Gamification Programming in Python (Aircraft Battle Game)

4 Analysis of the Learning Effect of the "Two Flat and Four End" Learning Space

Taking the course "Introduction to Computational Thinking" and Class Shui221-2 as an example for statistical analysis, some of the data comes from the direct download of student academic performance data from Chaoxing Learning Pass, while the other part comes from website data statistics[10]. We use the Pandas package for data preprocessing, the Matplotlib package for data visualization, and Orange3 software and machine learning algorithms for data mining and analysis.

4.1 Learning Platform Data Analysis

(1)Analysis of video time periods

We have made statistics on the viewing time of teaching videos, as shown in Figure 5. This semester has a total of 82 days, and most students study during four peak periods: 08:12, 12:16, 16:20, 20:24, and before each unit test. A small number of students are from 0-04 and 04-08, and they are concentrated on a few people, which raises suspicion of skipping classes.

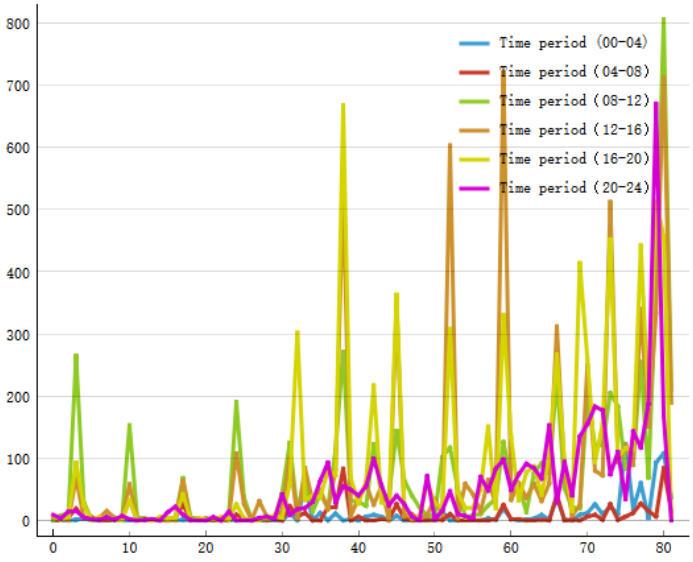


Fig. 5. Distribution of video learning time periods

(2)Analysis of Learning Style and Grade Distribution

There are a total of 84 students in the class, and Figures 6 and 7 respectively show the distribution ratio of the final grade of the five level rating and the analysis of the average classroom score distribution for each category.

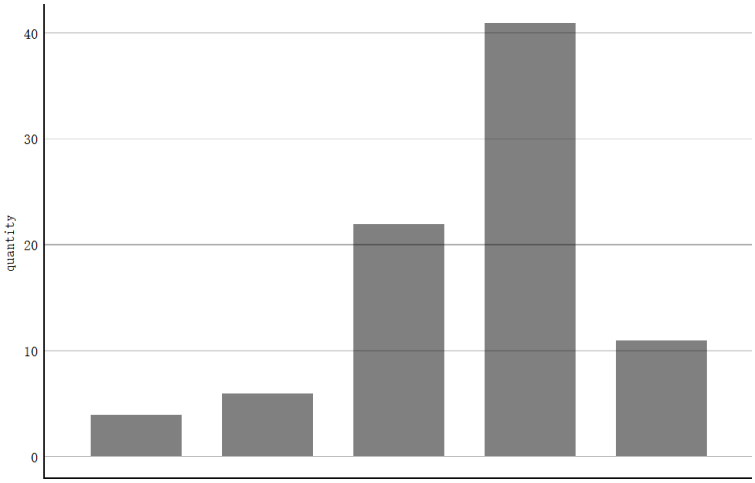


Fig. 6. Distribution of Five Pole Scores for Academic Performance

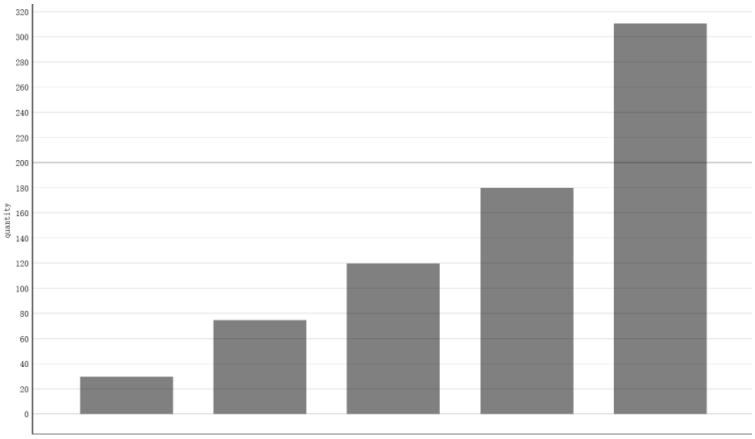
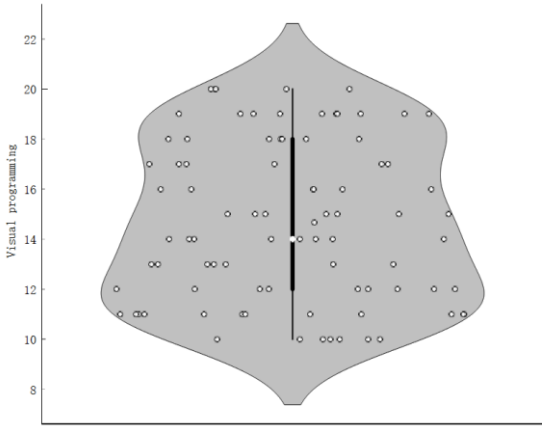


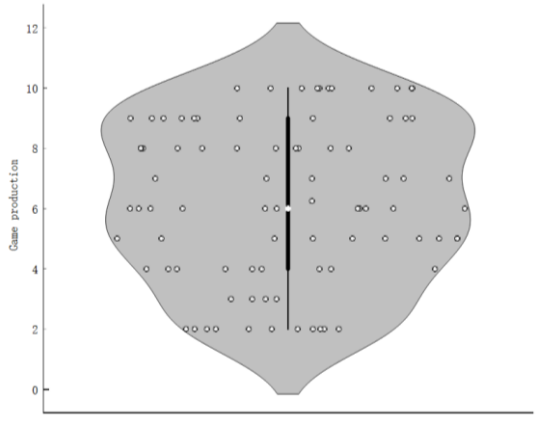
Fig. 7. Distribution of Classroom Points

4.2 Game Programming Analysis

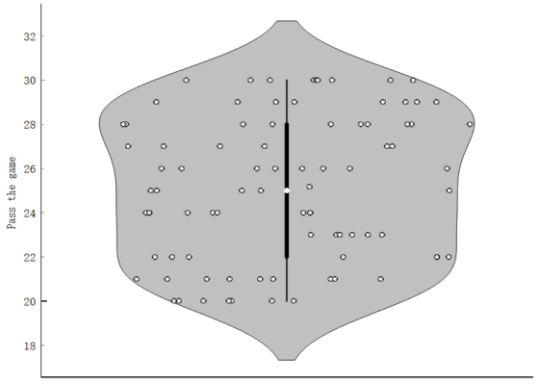
There are 20 questions in visual programming, 10 questions in game production, and a total of 30 game levels to complete. From the distribution analysis, it can be seen that there are more clearance games than visual programming, and visual programming is more than game production. That is to say, game production is relatively dull, difficult, and visual programming is relatively simple. Students are also highly motivated, and the most attractive aspect to them is role-playing game programming, as shown in Figure 8.



(a)Visual programming



(b)Game production



(c)Game completion

Fig. 8. Distribution of Gamification Programming Types

4.3 Correlation Analysis

From Figure 9, it can be seen that the correlation coefficient between the completion percentage of game task points and grades is greater than 0.8, indicating a highly linear correlation between the two; The correlation coefficient between the completion percentage of game task points and the duration of video viewing is 0.777, indicating an explicit linear correlation between the two; The correlation coefficient between grades and video viewing time is 0.720, indicating an explicit correlation between the two, while there is no linear correlation between student ID and other attributes.

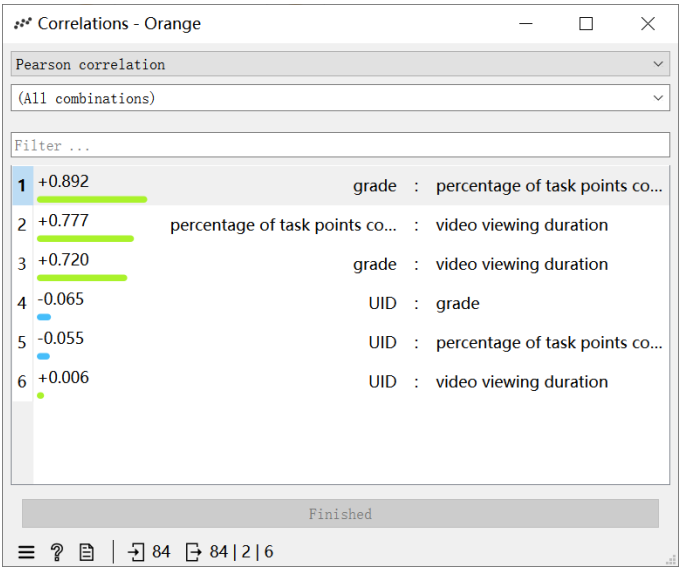


Fig. 9. Correlation between completion percentage of game task points and grades

5 Summary

After years of construction and practice, the programming computer general education course has been guided by the concept of "metaverse" and constructed a learning space of "two levels and four ends"; Guided by output, from visual programming to gamified programming, and then to gamified programming, we continuously enhance students' immersion in programming and have achieved good results.

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