A Case Study of Project-Based Learning for Designing a Computer Adventure Game with Blended Learning

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Abstract. The design of computer adventure game is a complex and challenging process of unravelling all kinds of problems. It requires team cooperation in order to learn and solve problems together. In this study, five students with the art and design background were guided to make a project of a computer adventure game in one year by using blended learning. The author of this paper guided the students to complete the game works through four stages of teaching strategies: plan, concept, structure and design. Through the actual process of guiding the students to make the project, we can analyze and verify the effectiveness of the teaching mode from this study. The results show that the blended learning methods can stimulate students’ autonomous learning ability, innovative thinking, teamwork, and problem-solving ability to a certain level. However, if we want to promote this way of teaching, we need to combine the actual condition of the students in order to carry out the appropriate curriculum design.

Introduction

A reflection on the current method education in schools is that we have to teach students skills and knowledge for jobs that do not yet exist. They will use technology not yet invented in their future careers to solve problems never thought of. Therefore, to cultivate the capabilities of independent thinking and problem solving is rather critical. The project-based learning is entirely consistent with this trend and the needs of innovative learning. The project-based learning is a constructivist learning method, which puts the learner through a highly complicated and practical process through planning, data collecting, and problem solving to accomplish and present productions.

The blended learning is a suggested teaching method lately. This teaching method is developed to adapt the current teaching situation. It is a combination of traditional face-to-face teaching and online one. Through the blended learning, the autonomous learning and independent problem-solving ability of students can be cultivated. The self-regulated and collaborative learning of students can be promoted as well [1]. The blended learning allows both teachers and students to do synchronous online teaching in this situation. The student teams can also discuss through various kinds of social applications in different places. The instructors can implement a variety of synchronous or non-synchronized teaching methods as well. The blended learning courses are emerging, especially the computer learning classes which seem to be more suitable for this method. The integration of ICT (information and communication technologies) teaching methods, with allowing instructors to find their own needs and tailor-made teaching methods, can also provide students more active participation in learning nowadays [2].

The production of a digital game needs planning, artistic design, sound design, programming, and so on through the collaborative work of a team with various talents to accomplish. However, artistic designers and programmers have different types of talents. Their thought processes are entirely different [3]. If art designers are taught to write programming, it benefits communication with programmers in their future careers. With the applications and the development of interactive media and digital games, a digital content designer with the interdisciplinary training of artistic design and
programming will not only become a trend of human resources in the job market, it will also become the emphasis of training in art design and related fields.

Reviewed Literature

Blended Learning

The blended learning is a combination of online and face-to-face learning method. It is a relatively innovative teaching method at present. According to different places where teaching activities taken place, it can be divided into online and offline blended teaching [4]. Compared with the orthodox classroom teaching, this hybrid teaching method has the characteristics of strong complexity and uncertainty. And it has greater requirements for teaching equipment and environment [5]. Combined with two advantages of face-to-face and online learning, teaching and learning can also be used synchronously and asynchronously. As a new learning mode, hybrid learning promotes the independent and cooperative learning by combining online teaching materials with traditional face-to-face teaching mode [6].

The blended learning is based on constructive learning theory, emphasizing student-centered learning. The knowledge and learning ability are completed by students in the process of actively structuring. The learning method combines online and offline learning which students can control independently of learning time, place, pace, and path [7]. The blended learning is student-oriented. Students can not only learn actively, but also adjust learning pace and path by themselves from using synchronous online learning or asynchronous online learning methods. They can also share and communicate to each other through the interaction of group learning communities. To compared with traditional teaching, the blended learning shows teaching advantages clearly. However, the instructors should combine the actual situation of students with the overall teaching design to improve the teaching effect while teaching. In particular, through the design of the online and offline teaching courses, different learning methods can be changed interactively to improve students’ learning motivation and interest [8].

The blended learning courses provide flexible learning methods for learners of all ages, and they can also meet various educational and social needs. The teaching which combines with the support of information and communication technology can encourage the students to participate in the learning environment more actively. The blended learning environment gives greater level of autonomy to the students. Self-regulated learning (SRL) is crucial to the learning. The adult students in a mixed learning environment often have sufficient efficiency to adjust their learning [9]. Network teaching and advanced network technology deliver an effective way for hybrid learning mode into online learning. The students can participate in learning independently, which is successful and effective for adult learners as well [10].

Project-based Learning

The project-based learning (PBL) is a learner working on a project and organizing his/her learning individually or in a team collaboratively. The “project” is usually challenging and integrates different courses, skills, and knowledge. Then, through brainstorming ideas, data collecting, peer discussions, decision making or researching, the learner can conduct activities in long-term, learner-centered, goal-oriented, independent, and autonomous learning. In the end, the learner can accomplish his/her production and display the results of research and solutions to problems [11]. It provides an optimal stimulation of situated learning. Through this learning, the learner’s capabilities of exploring and problem solving are advanced.

The learning context is more similar to real life situations, the learning is more effective. Authenticity and proactivity contribute largely in PBL [12]. Traditionally, the teacher’s lecture is the core of schooling, which is limited in teaching materials. Modern education emphasizes cultivating the student’s ability to solve problems. The PBL is based on such a belief. It is suitable for a project
oriented, thematic subject, complicated, and integrated program or curriculum, which will need knowledge and skills learned in long-term teaching and training [13].

Newell [14] indicated that the PBL emphasizes several ideas: the profound understanding of teaching content; the great comprehension of concept and principle rather than only knowing the facts; developing capabilities of problem solving rather than learning fragments of knowledge and skills; focus on the student’s interest rather than standard teaching; focus on the broader and interdisciplinary rather than the narrow and subject-oriented learning. Furthermore, the PBL connotes a student-centered learning, which will attract the student’s attention to explore the real issues, encourage students to work collaboratively, and allow them to learn in the process of exploring [15]. Students are encouraged to participate in hands-on operation and to apply learned information technology. It allows students to continuously improve their productions and results and eventually can display what they have produced and the solutions. Above all, the content of the PBL should be challenging and underlining high-level thinking skills. In other words, the PBL should give students challenging tasks or problems. Through the thematic design, the student can advance problem solving skills, promote research skills, work collaboratively, organize and use time efficiently, and accomplish the production timely.

Computer Adventure Game

A computer adventure game (AVG) is also called a role playing game (RPG) or its modification, which is controlling an in game character to explore and solve puzzles. It also stresses the story plot and development, as well as the portrayal of characters. The AVG characters have the same roles of RPG characters, but do not have the upgrade-system of RPG characters.

The AVG is not for competing or simulated games. It does not contain the control management of characters or use strategies or tactics to beat the opposition. Mostly it uses various schemes to constitute a rich and reasonable story plot. The player solves the problems through exploring, collecting objects, and thinking. Nearly all AVGs have one thing in common, that is, the puzzle solving is the spindle of the game. The reasonable and suspenseful plot is combined with the gameplay, while being not too difficult to crack so the player will think continuously to solve more problems. When the player comes up with a solution for the problem, it will motivate the player to face a challenge. His/her access method will also become a part of knowledge construction.

Rollings and Adams [16] found that early AVGs were only focused on exploring but could not involve the player in story development. They usually only gave a broad space for the player to walk around without any events happening. Later, the story plot was added to AVGs which became enormous and divided into chapters. The player can walk around in these chapters, but only solving problems and attaining special objects, can he/she move forward to the next chapter. Nowadays due to the speed of computers and applications of 3D graphics, the action AVG has appeared. Besides the extended length of stories, the sidelines or branches of the story plot, complex spaces, and loop designs were added with action AVGs.

Methodology

This case study is based on the PBL of five digital content design students over the course of one year. Each member is in charge of different jobs including character design, programming, and game scene and sound design. The authors integrated all the game design methods and the PBL theories and principles to guide students to develop their game in four stages: the mentoring teacher employed a teaching strategy that engages students in planning, concept learning, structuring, and designing to accomplish the entire project [17] [18]. The process of these four stages has achieved the pre-required knowledge, brain storming of creative ideas, setting of a topic, designing, and accomplishing the production.
Planning

Before the students create their project, the game design knowledge and skills are pre-required to introduce for linking their prior knowledge and skills. The mentoring teacher plays a role of scaffolding guidance. Before learning, the teacher has to understand the student’s prior knowledge and skills. The fundamental teaching will emphasize the related knowledge of the production project in connection with the student’s prior knowledge and skills. Through demonstrating project related learning examples, the teacher guides the students step by step to learn the required knowledge and skills.

Concept Learning

During the concept learning stage, students can begin with brainstorming, integrating, responding, and polymerizing their creative ideas. Imagination is the beginning of every game. Game ideas often will come through observing daily life and things. The integration is a process of categorizing all the ideas, and then combining and selecting suitable ideas. The story plot of the game and all the ideas are to attract the player to play. If the story plot can relate the player to the game, it will be a very effective designing method. Before the structuring, students must determine whether the creative ideas can be integrated into a good game.

Structuring

During the structuring stage, based on the dramatic creation, five focuses include style, plot, character, settings, and theme. First, the game type has to be defined. Is it a game of action and fighting? Is it an AVG and RPG requiring a large storyline? Or, does it need to develop a strategy to test the player’s intelligence? Any type of games will need some kind of background story to enhance the player’s identity. The story plot of the game should be created by the players themselves. The player is the author of the game event. Game characters can reinforce the story plot. The characters feature a certain personality and characteristics. This can inspire resonance from the player who can identify with the game. Considering the game world, time managing method creates a time line. Environmental settings describe the cultural context. Emotions allow the player to produce a desired emotional response. Morality defines the right and wrong within the game world. Game narration can use game level design to lead the player to go for their preferred theme and as the game progresses follow the story to completion.

Designing

During the designing stage, the design is conducted with visual planning, role mapping, scene design, sound design, and programming. The visual planning is concentrated on designing the game interface. The major function of game user interface is the interaction between the game and the player. The role mapping focuses on the game’s background story settings, character costumes, accessories, and dressing which should be suitable for the game style. The historical background and game style should also be considered in scene design. A realistic game should as much as possible simulate the real world. Basically, the sound design will consider the environmental sound effects, background music, non-player character dialog, action sound effects, emotional voice acting, and auditory clues for in game objects and interface operating functions. Programming is the core of the entire game. The level and story plot arrangement, the control of game interface, the movement of the character, the transferring of game scenes, the sound design operation, the fighting system planning, artificial intelligence application, and game progress saving all depend on the success of programming.
**Research Results**

**Planning**

In this case study of the PBL, the students must develop a PC AVG and accomplish it. It is a challenging integration course which requires continuously solving problems. In preparation, the teacher has to understand whether the student possesses the required knowledge and skills for developing a game. Four required skills are story planning, artistic design, sound design, and programming. The students with design or art background usually have difficulty with programming. The authors made several core learning models of programming paradigm for developing an AVG. The teacher plays a guiding role of scaffolding instruction. Students will learn how to develop the game. These programming paradigms include: coordinate system, collision detection, scene transition, mouse events, game progress save, array data access, and sound control.

**Concept Learning**

During concept learning, the background story of this game design is the player playing a role of detective school student. Before graduation, every detective school student must intern in a real murder case to access the practical experience of handling and reasoning. Through the recommendation of the detective school teacher, the protagonist, whom the player controls, is assigned as an assistant to the police chief to solve the case.

**Structuring**

The plot of this linear story is set in a level of three missions accompanied by three subplots. The gameplay is controlled by the first-person perspective to move around in the game scenes. The player operates the mouse to control the left-right direction and move to another scene. The conversion of the scene is to utilize a quasi-lens zoom in. In gameplay, the player uses the mouse to converse with the non-playing characters and collect objects. Through object collecting, analyzing clues, solving puzzles, and reasoning, the player accomplishes all the missions given by this detective game.

**Designing**

The sound design creates background music, auditory clues for picking up objects in game, and sound control on the information interface. The environmental sound effects will change when entering different scenes. Emotional sound design happens in exciting moments or calm reasoning events in the process of solving the murder case. Unity software is used to develop the game and programming. The basic applications not only connect the entire story plot but also construct the object collecting, field detection, dialog record, mouse events, and the application of coordination design.

![Figure 1. One of the AVG scenes.](image1)

![Figure 2. Game playing interface.](image2)

**Conclusion**

Theoretically, students should have complicated and high-level thinking skills to solve all the problems that occurred in the PBL. This study adopted a teaching strategy consisting four stages consisting of planning, concept learning, structuring, and designing to guide students who accomplished a PC AVG in one year. This teaching strategy is feasible. The authors found that in the
PBL, students learned new knowledge and skills by modeling the core learning examples and connecting newly learned ones with the prior ones. This process definitely develops their programming capabilities for game design. In discussions, when design students attain the ability of programming, they usually have worked on the project continuously in solving the programming problems.

This study discovered that when teaching students to design games with blended learning methods, and when guiding students from the art and design background to learn programming, the students will be able to combine with the existing visual design skills in order to complete computer adventure games. In the meanwhile, the instructors provide online non-synchronized audio and video programming examples as learning courses, plus online meetings and face-to-face discussions to enhance the teaching. As a new teaching mode, the blended learning has noticeable teaching advantages compared to the orthodox one. It also faces some challenges, especially the challenges of self-regulation and use of applying skills. Therefore, teachers must design appropriate teaching applications, teaching materials, and teaching strategies with planning the overall teaching design to improve students’ learning motivation and effectiveness.

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