

Research on the teaching of game software development

Wei Wang†, Chengxi Wang‡, Wei Li† & Shuang Liu†

Dalian Nationalities University, Dalian, People's Republic of China†

Jilin University, Changchun, People's Republic of China‡

ABSTRACT: The knowledge-driven economy requires talent with interdisciplinary knowledge, abilities and innovative ways of thinking. Aiming at the problem of how to cultivate high-quality games software development talent for the games industry, a new teaching mode for game software development is proposed. Guided by the characteristics of Dalian Nationalities University students and the special training needs for game development, the relevant educational objectives and curriculum system were designed. The details of the education process, including the studio teaching mode and the novel evaluation method are described in this article. Finally, the results show that the proposed teaching mode can improve the efficiency of game software development teaching, and leads to better results for the employment rate for graduates as compared with conventional teaching methods.

INTRODUCTION

With the development of society, including the arrival of the era of the knowledge-driven economy together with the demand for a transformation of national development, has come a strong need for a multi-talented workforce. Cultivating compound talents requires students to integrate knowledge, abilities and thought processes.

For example, a double degree is considered an effective method of fostering such compound talents in students [1]. However, long-term teaching experience reveals that obtaining a double degree does not fully meet the requirements for fostering multiple talents and the innovative ability required should also be developed in the traditional teaching process.

The games industry is a rapidly developing high-tech industry, the development of which has enjoyed national support in China. However, there are insufficient well-qualified games software developers capable of planning and developing new games software. This has limited the development of the games industry. The focus of this study was to consider the cultivation and development of compound talents for this specialty. The design of games software includes art design, which integrates science with art, literature and psychology.

An excellent games software designer and developer should not only have a good grasp of the artistic aspects of the game and computer applications, but should also be aware of the game player's psychology and expectations. As a result, the player's attention should be attracted by game scenes and roles [2]. Therefore, the training of games software developers should be concentrated on innovative ability and thinking.

At the School of Design at Dalian Nationalities University, computer educational system needs to show a blend of traditional culture and ethnic cultural education with digital media and artistic education. The research carried out by the authors is an analysis of the objectives and process of talent cultivation, the curriculum and other factors. The teaching mode proposed in this article has obtained satisfactory teaching results, and students' software development capability has been improved.

STUDY OF THE TRAINING OF GAMES SOFTWARE DEVELOPERS

Training Objectives

The School has laid emphasis on the training of the computer science department students' moral, intellectual and fitness level, as well as on their appreciation of aesthetics. This leads to a higher level of knowledge in the humanistic, social and natural sciences, as well as the fundamental theory, methods and techniques of computer science. Students

are equipped with an awareness of the need for collaboration and professional quality. They develop competence in engineering practice, with an emphasis on innovation and internationalisation of their work. These are the qualities students need to engage in game software development.

Course Components

The curriculum has the theory and techniques of game software at its core and focuses on cultivating the skills to develop game software. In addition, artistic education and the importance of a quality development process are included as part of the traditional teaching [3].

The curriculum includes image processing, scene design and art education. Higher-level courses, such as artificial intelligence and man-machine interaction, are also included, to guide students on injecting more man-machine elements into game design. Table 1 shows the curriculum for game software development.

Table1: Curriculum for game software development.

Specialised courses	Foundations of computer animation and digital entertainment (including image processing, scene processing)
	Introduction to game development
	Technical foundations of computer games
	Graphics programming
Optional courses	Computer graphics
	Principles of artificial intelligence
	Principle of compilers
	Case study of application software
	Human computer interaction

Construction of the Training System

Practical teaching is an important component in the training of compound talent. At present, the practical teaching takes place within independent courses and with different teachers. Hence, there is no joint practical teaching covering the various courses in the curriculum. To solve problems in current practical teaching, many alternative kinds of practical teaching have been investigated and a new mode of practical teaching is proposed, as follows.

Opening up of game development laboratories: in traditional teaching, laboratories are only used by students for specific experiments, and the students leave the laboratory as soon as the experimental period is over, regardless of whether they have finished the experiment or not. This has a negative impact on students' expectations and learning. In the new teaching mode, laboratories are arranged specifically for students majoring in game software design and are open and available to them whenever they wish to solve practical teaching problems. The laboratories are rich in teaching resources and software, providing an optimal environment for students' learning, for communication within project groups, for project testing and for code debugging.

Inheritance mode of practical teaching: with an emphasis on organised team co-operation, learning and tutoring is shaped with the help of upper-echelon students in laboratories. Hence, students *inherit* knowledge and ability from more senior students. The students' learning is boosted by practical teaching, with the upper-class seniors (upperclassmen) guiding and assisting more junior students. The work is carried out in teams. Upperclassmen act as project managers and are in charge of the division of labour in the team, according to the learning and abilities of the students in a team. They also supervise the scheduled completion of tasks.

The practical content should draw on, and expand on, the teaching content knowledge including the game plan, design, user interface design and game logic. Taking a program development using Cocos2d-x (a suite of open-source game development tools) as an example, a senior student, as a main designer, guided two sophomores and a junior student on developing a mobile game program displaying campus scenery. The main tasks proposed by the senior student was as follows:

1. Determine the division of labour. Labour is divided between UI (user interface) programming and logic programming. The UI covers all the effects on the user interface and their co-ordination with the game's internal logic. Logic programming covers all the logic used in the game, such as movement of the background, characters and monsters and special effects.
2. Plan, style and overall game direction.

3. A unified coding environment for all developers should be established.
4. Coding should be started. The coding should be modularised and decomposed step-by-step according to the plan.
5. Code modules should be interfaced. Debugging should be conducted in this step.
6. Post-process effect should be incorporated. Cross-platform support should be provided.

By having the upperclassmen guide more junior students, they become more familiar with project development and this improves their development capabilities.

Lectures on game development: game developers should pay close attention to leading edge knowledge and keep up-to-date with trends in game development. Developers from game companies regularly are invited to deliver special lectures to help students understand the game industry, the employment situation and companies' need for skills. Direct communication and contact between students and developers from companies enables students to clarify their learning objectives and career direction by avoiding misdirected learning and by pointing the way towards self-improvement and, hence, future employment.

Industry policy is important in guiding the development of the games market. For example, given the strategic direction of the Chinese cultural industry expanding overseas, this market has become important in the growth of China's games industry. This development is attractive given the increasingly fierce competition in the Chinese game market, coupled with the growing research and development capability of China's games companies. Students should understand the changing technical demands of developers under these circumstances.

To consider another point, as an institute of nationalities, the minority student population in the School exceeds 60 percent. Students need to consider how to make full use of this diversity of national features and cultures in the game industry. Game developers, who incorporate ethnic features and ethnic heritage with the game, can produce successful, novel, ethnic games.

Co-operation with design institutes: teaching should be integrated with the input by animation professionals from design institutes. This could include communication between laboratories, co-operation of graduation project subjects, sharing of on-line learning platforms, lectures on Photoshop and Autodesk 3ds Max and invitation by teachers from the animation major to give lectures.

The School of Design at Dalian Nationalities University has tasks and projects in professional studies, and these include editing, planning and production. At the University, a four-year study programme is emphasised, rather than 2,600 class hours.

Four years of university learning will be the basis of learning, rather than just a curriculum. In breaking the chains of lessons, a unified teaching and practice programme will contain reading, social and professional practice. Learning will strengthen and guide the students' worldview, conceptions, aesthetics, learning methods and other qualities. Thus, students improve their moral, intellectual and fitness level, providing them with essential abilities, such as self-learning, social interaction and acclimation.

An animation major provides training in basic presentation skills, theory and application ability. The aim is to produce creative graduates working for companies in cartoon production, games, film and television production, and media publishing. Teaching modes of animation majors were introduced into the game developer training.

Game Courses Sharing an On-line Learning Platform

Learning platforms are a realisation of all the functions required for teaching, including the uploading and downloading of teaching resources. Task upload and on-line communication to the platform integrates the overall game curriculum, and allows every student to read articles and task documents from various courses. Students have access to reading resources from across the whole curriculum, to add tasks into their own folders, and to read and revise at any time unencumbered by the teaching process. The platform also enables access to public user resources. The platform lays emphasis on resources' file copies and version control. This platform could inherit from and share resources from different courses. System management provides technical support for the game software developers in the compound talent training system.

Basics for Animation and Digital Entertainment is an example of the role and scene design methods taught during the course, including the use of the modelling and rendering system 3ds Max for scenes. This could be a lead into the use of the games engine Unity 3D to create scenes in the course *games development portal*. The student games gradually lead to more accomplished games in later courses, as their development ability deepens. In game developers' training, it is of great importance to stress the inheritance and sharing of class group resources.

Reform of the Examination and Evaluation System

Differing module weights have been proposed for the assessment to attach appropriate relative importance to students' analytical, operational and other intellectual abilities. The aim is to objectively assess the learning outcomes. Traditionally, students' academic records consisted of many course results and a final test result. This has been changed in this revised teaching mode.

Using the concept of plan, design, develop, and operate for a game module, the teaching progresses from simple games in the initial teaching, to medium complex game development after in-depth study. Each game design and implementation is regarded as an examination and evaluation module. Using the in-depth course content, original projects can be optimised using acquired expertise and sophisticated development capabilities. Iterative project development can re-architect a game; for example, by adding artificial intelligence modules, to optimise collision detection and find the best path, or the game could be re-architected to add new game scenes. Teachers could re-evaluate and re-examine the re-architected game.

The final score is the weighted sum of scores from several modules. Taking the *games development portal* course as an example, the Unity 3D game development has a modular assessment. The first teaching and practical assessment module is *space shooter*, which is an entry-level teaching module with a relatively detailed introduction, starting from how to create a script to game completion. Introduction includes project planning, game type, game UI, the protagonist, game-play and enemies.

In the specific game development process, content includes scene creation; the protagonist and enemies creation, physical impact, advanced enemy, sound and special effects and game manager. With modular teaching, students can understand the basic process of game development and simple game logic.

Although this small game is simple, it is still comprehensive. This project addresses the problem of having a too-independent division of labour in game development. Students should be involved in all stages of design and development. The game modules include a first-person shooter, tower defense games and fishing games. Through developing these, students should learn the practice and development of game modules. Hence, students come to have a more comprehensive understanding of Unity 3D game development, which equips them to be able to develop common casual games [4].

IMPACT ANALYSIS OF THE NEW EDUCATIONAL MODE

The teaching and training mode for game software developers, proposed in this article improves students' ability to master game development. It also promotes a deep understanding of graphic scene design and, as mentioned earlier, may improve the appreciation of ethnic culture. The graduates of the computer game major at Dalian Nationalities University, saw an increase in the employment rate for the class of 2010 over the class of 2009, while the number of students who work in domestic first-class game companies has increased greatly. The class of 2011 and 2012 students now can lead teams to develop small games, and the class of 2013 students has developed a variety of small-scale Android-based mobile games.

There are also some creative cases inspired by ethnic culture and life. The class of 2013 in its fourth semester benefited from the training mode involving inherited practice and an open appraisal model, which created a freer learning experience. Under the old training mode, this level of development was not previously achieved before the sixth semester.

Shown below is the effect of the new teaching mode for game software developers. Figure 1 shows that the number of students, who have gained employment in a Chinese first-class game software development company, has increased, from 50 percent in 2009 to 85 percent in 2010. Figure 2 shows that the number of game development students in the fourth semester, who completed an independent mini-Android mobile game development project, rose, from 15 percent in 2009 to 30 percent in 2013.

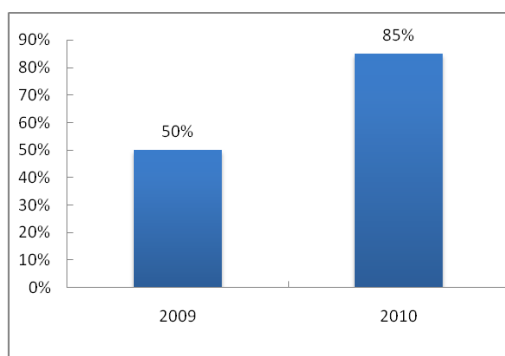


Figure 1: Graduate employment rate in high-end companies.

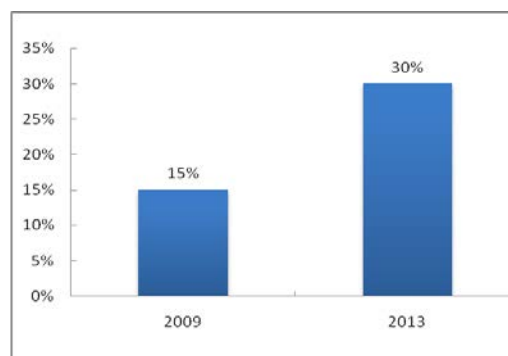


Figure 2: The fourth-semester learning effect.

As can be seen from the results, the new educational mode for game software development proposed in this article has had a good teaching effect. This method has changed the training mode away from multiple teaching and assessment methods. Compared with the traditional teaching method, students not only learn software development methods, but also expand their capacity to learn and improve their learning outcomes. Moreover, the new teaching mode shortens the learning time for the same teaching modules. The class of 2013 students could master the same material in a shorter time than the 2012 class. Hence, the teaching has been more effective.

CONCLUSIONS

In this article is proposed a new teaching mode for training computer game software developers. This followed an analysis of compound talent training, including the training mode and curriculum systems. The new mode is inspired by professional practice in game software development.

Based on this research, further work will actively explore the compound talent training mode for students, to optimise and solidify the teaching effect for software developers.

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