Learning Computer Science by Watching Video Games

Hiroyuki Nagataki
Okayama University
Okayama, Japan
nagataki@okayama-u.ac.jp

ABSTRACT

This paper proposes a teaching method that utilizes video games in computer science education. The primary characteristic of this approach is that it utilizes video games as observational materials. The underlying idea is that by observing the computational behavior of a wide variety of video games, learners will easily grasp the fundamental architecture, theory, and technology of computers.

The results of a case study conducted indicate that the method enhances the motivation of students for deeper learning of computer science concepts.

Categories and Subject Descriptors

K.3.2 [**Computers and Education**]: Computer and Information Science Education—*computer science education*

General Terms

Design, Experimentation, Human factors

Keywords

Computer science education, general education, practices, video games

1. INTRODUCTION

One of the main issues facing computer science (CS) education is the question of how to motivate students to become interested in the theory and application of computers. In recent times, most students have become familiar with computers in the form of personal computers (PCs), cell phones, and tablets since they were children. However, becoming overly familiar with computers can lead students to think less about how computers work and why they operate properly. Additionally, the theory of CS, such as algorithms, network protocol, and code theory, is highly conceptual and difficult for non-CS students to understand them in a short period of time. Therefore, useful learning materials that can be enable students to easily comprehend computational behavior are needed.

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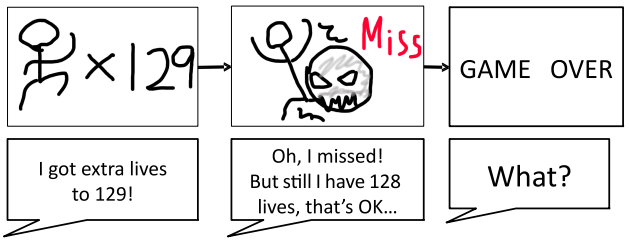

Figure 1: 1-up glitch

Nowadays, video games are one of the most popular and familiar means of entertainment in our daily life. They are also utilized as learning tools to enhance people's interest in some learning activity, including the CS field. Approaches in which video games are used for education include educational games[1, 2] and game development practice[3].

One characteristic of video games as computers is that the computational output is primarily in the form of visual, auditory and sometimes haptic (e.g. vibration) effects. The outputs often indicate the theory and mechanism of computers; for example, "1-up glitch" (Figure 1) behavior implies that the number in a computer is described as binary expressions (8-bit two's complement binary numbers). "Password error" message (Figure 2) implies that there is error-detection code in the password.

We believe that watching such behavior can be useful for learning CS. Watching the behavior of games is sufficient to see the basic technology underlying computers in an easy-to-understand and fascinating way without having to play or create video games.

2. IMPLEMENTATION

We designed an introductory CS course called *Introduction to computer science through video games*[1]. This course has a total of 15 lessons, each 90 min long. Each lesson has more than one main learning topics such as "algorithm" and "network", in which many examples of various video games are offered in the style of videos and screenshots. The primary learning goal is to get a grasp of the basic theory and

[1]Course syllabus URL (2014): `http://cfd.cc.okayama-u.ac.jp/cgi-bin/cbdb/db.cgi?page=DBRecord&did=1869&vid=34&rid=220`

Figure 2: Detecting wrong password

Table 1: Number of students in the course

Year	Students	(CS / non CS)
2010	114	(31 / 83)
2011	235	(36 / 199)
2012	62	(14 / 47)
2013	107	(19 / 88)
2014	103	(17 / 92)

technology in computer science and enhance learners ' interests and learning motivation for CS.

We conducted the course in Okayama University from 2010 to 2014. Table 1 shows the number of students that took this course. There are both CS students and non-CS students who major in areas of Literature and Economics. Most of them had never learned CS before the course. Their main motivation for taking the course was their interest in computers and video games. Figure 3 displays the answers received from students in 2013.

On completion of the course, we distributed questionnaires that were subsequently completed by the students. The answers received indicate that their motivation for learning deeper CS concepts was enhanced (Figure 4). Some non-CS students commented in the questionnaires that even though they had difficulty on some CS concepts, they could keep the motivation for learning CS because "learning through video games was really interesting."

During the courses, some students voluntarily found other examples of behavior that seem related to CS, and taught them to the teacher for deeper discussion. This is another advantage of using video games as learning materials. Students can easily try to apply the CS knowledge they learned to other examples, which lead them to consider that every behavior of the computer around them has some reason based on CS theory and technology.

3. FUTURE WORK

Designing and implementing materials for classes is very difficult for teachers. It is distant idea for every teacher to obtain information about what appropriate examples of video games that exist for learning each CS topic, and how to

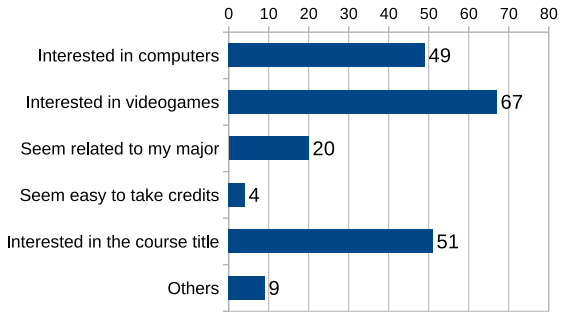

Figure 3: Motivation for taking the course (2013: multiple answers from 86 students)

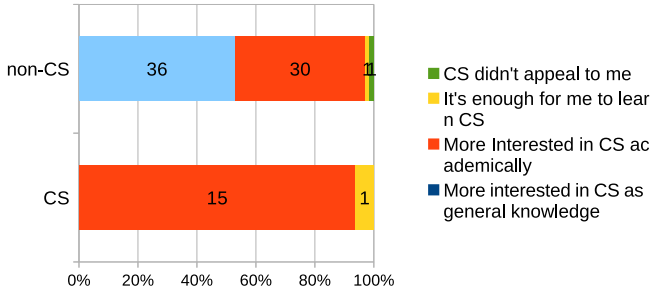

Figure 4: Interests in CS after the course (2013: 84 students answered)

get those samples to create videos or other forms of lecture materials.

In future work, we plan to not only aggregate and organize samples of video games that are useful for CS education, but also investigate expertise on how to find good learning materials efficiently.

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