

DESIGNING GAME DEVELOPMENT EDUCATION – FIRST EXPERIENCES OF CDIO IMPLEMENTATIONS

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ABSTRACT

Globally, the game industry is one of the most rapidly growing industrial sectors. Many universities are forced to renew their curricula based on the needs of the game industry. For example, the Information and Communications Technology engineering field is educating more frequently than ever before new engineers for the game industry. These engineers will be working in a multidisciplinary field between art and technology. At the Turku University of Applied Sciences, the curriculum of Information Technology has for years been developed systematically based on the CDIO standards [1]. Now our curriculum will be further developed from various perspectives. In this paper, we will focus on Game Development as a new field of specialization in the curriculum. We will present how the field has been organized as a new part of our curriculum structure in Information Technology. The first students started in the Game Development field of specialization in autumn 2012. Before the first students graduate in 3-4 years, we have time to prepare and test systematically our specialization course development. This autumn, in the first phase of this preparation, we selected 15 students from the Digital Media field of specialization, who will be graduating next spring and have been educated based on CDIO methods from the first courses until now. In this paper, we will show our first CDIO implementations in game development. Six pilot projects made by these Digital Media students will be reported on in this paper.

KEYWORDS

Game Development, Curriculum Design, Serious Games, Problem-Based Learning.

INTRODUCTION

Universities have faced challenges in making their curricula up-to-date, based on requirements and structural change in the industry. For example, the game industry as one of the most rapidly growing sectors is intensively recruiting engineers and artists. According to Reuters [2], global game market revenue amounted to around 65 billion dollars in 2011 up from 62.7 billion dollars a year earlier. The International Game Developers Association (IGDA), as an independent and non-profit organization, has worked for years between universities and the industry. Study of games is an interdisciplinary area and, for example, in the United States there is no accreditation for undergraduate university degrees in games [3]. Gaming culture as part of generation Y has been influenced by cultures such as rap music, break dance and graffiti in which individualism, liberality and self-expression are characterized. In this context, universities and other pedagogical institutions have challenges to operate. Moreover, the future of gaming will be solidly mobile [4]. That is, high-quality games will be played anywhere and at any time.

Therefore, it is essential to notice that the game industry needs experts, not only in graphical design, manuscripts, audio-visual design and programming, but also in new fields of expertise, such as ubiquitous computing and geoinformatics.

In this paper, we will show our first CDIO implementations in game development. Six pilot projects made by these Digital Media students will be reported in the paper. The pilot topics are 1) an advertisement game for the local shopping center, 2) an interactive advertisement application for the local adventure park, 3) a digital brochure for the local machine building factory, 4) a car game for a global game contest, 5) a further development of a virtual environment for a local serious game company and 6) a short demonstration movie for the local planetarium.

BACKGROUND

The information and communication technology departments of three higher education institutions in Turku, Finland have worked in the same building since 2006 and cooperated in education and research. One of the results of this cooperation has been the so-called ICT ShowRoom event, a student project exhibition and competition open to all students of the joint campus. This event has become an established and integral part of the academic year, attracting students, staff and industrial representatives [5]. The B.Eng. Degree Program in Information Technology at the Turku University of Applied Sciences (hereinafter TUAS) has been developed systematically based on the CDIO standards. For example, the recent problem-based learning (PBL) implementation of the first semester course in Product Development has been successful [1]. The first-year students have faced a learning assignment each week, and these assignments have been solved and reported according to the PBL cycle. Several courses contain PBL learning assignments. Now our curriculum will be further developed from various perspectives.

In this paper, we will focus on Game Development as a new field of specialization in the curriculum. In addition, the third-year curriculum will be updated towards the objectives of the Capstone Design initiative [6]. This process will also be utilized in Game Development education in order to offer our students experiences in real life projects. Game Development has been one of the fields of specializations in our curriculum since autumn 2012. The former Digital Media field will be replaced and part of its content will be utilized in this new field. Currently, the game industry in Turku area is relatively small in terms of the size of companies and number of employees. However, structural changes in the Finnish telecommunication industry have forced us to find new business opportunities. Finnish know-how in telecommunications and mobile computing offers the game industry an opportunity to re-educate already highly educated engineers. Game technologies have already been taught on a small scale in our university in cooperation with the University of Turku and industrial partners.

THE FIRST CDIO IMPLEMENTATIONS IN GAME DEVELOPMENT

Course Arrangement

As mentioned above, Game Development will be replacing the current field of specialization called Digital Media. More detailed information related to our design work has been reported in [7]. Digital Media courses are still arranged for second-, third- and fourth-year students. Earlier students focused on audio-visual (AV) production and 2D/3D graphics. Engineering in AV

production particularly seems to be an area in which students are no longer able to find proper thesis assignments, and there are challenges in finding working opportunities. Therefore, it has been logical to start updating the content of the main Digital Media courses called Digital Media 1 (15 ECTS credit points), and Digital Media 2 (10 cr) towards Game Development topics.

In this paper, we will report on results achieved in Digital Media 2 after the first updates. The course was arranged from September to December 2012. In the curriculum, the implementation of the course was as follows. During the Digital Media course, students will learn how to utilize digital media in various domains using new user interface technologies such as Microsoft XNA [8] and Unity 3D [9]. In the first half of the course, students will be taught theory and practice related to the above-mentioned technologies. In the second half, students will work in customer projects in which assignments are mainly collected and delivered by the game development research group of TUAS. The course assessment will be reported at the end of this paper.

The First Period

In the first period of the course, the theory and practice related to game development was introduced. This period covered lectures arranged by the teacher, visitor lectures, fact sheets arranged by game development experts from Game Tech & Arts Laboratory (GTAL), seminars, essays, expo presentations, exercises and finally excursions to possible customers. Exercises were prepared in close cooperation with GTAL game development experts. They also assisted when up-to-date details of game development were needed.

Because students studying Digital Media were mainly interested in providing content, exercises were designed so that the main focus was on graphics instead of programming. Especially in the case of Microsoft XNA, source code was mainly provided beforehand and students were asked to focus on providing new graphics for the game. In Figure 1, two versions of graphical design are illustrated.

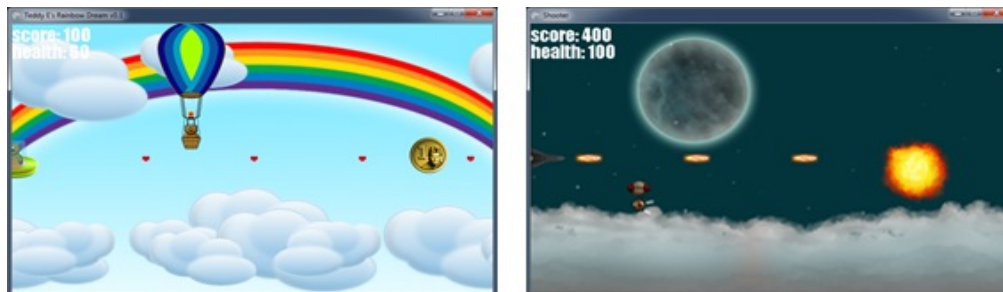


Figure 1. Two versions of graphics for a simple XNA game designed by TUAS students

During the first period, students designed our stand for the local science expo in cooperation with TUAS experts. Students were mainly responsible of the graphical design (covering posters, leaflets and other promotion material). A couple of students were able to provide a modified version of an old Pong game for public display in which multi-touch gestures can be utilized. Figure 2 shows the designed stand on the right. The public display with a designed Pong game (left hand side in the figure) was located in the shelter because of the lighting conditions.



Figure 2. The designed stand and the design graphics for the Pong game

The main part of the exercises was designed for the Unity 3D game engine. As in the case of XNA exercises, exercises were designed by GTAL game development experts. Students were again asked to change the graphics. At the same time, the basics of Unity 3D scripting were introduced. Now students were able to utilize not only 2D but also 3D graphics. Exercises covered a platform game, a car game and a first-person shooter game on a desert island.

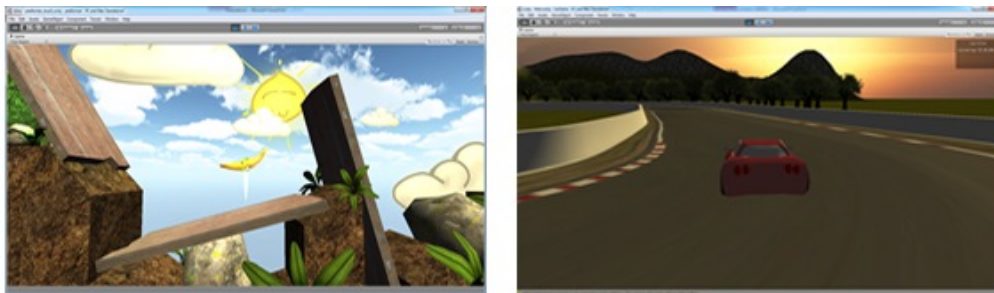


Figure 3. Examples of graphics designed for the platform game and the car game.

In summary, exercises in the first period showed the students that they were able to utilize their professional skills gained in previous courses in the new focus area. The pedagogical objectives were to open students' eyes to new innovations before customer projects started with local industry.

The Second Period

The second period was mainly dedicated to the customer project, but also included short fact sheets for current aspects such as game design, audio design, project management and game graphics. At the beginning of the period, students chose the customer project based on their preferences. As already mentioned, students were able to get information on alternatives during the first period. That is to say, during the first period a total of ten visitors presented their needs and cooperation proposals. These proposals covered topics from serious games and gamification to entertainment games. Students were asked to form groups of around 4-5 persons including different type of experts (from content providing to game programming).

The documentation of the project was designed based on the LIPS model, a project model for the Capstone project created at Linköping University [10]. The groups were asked first to sign a letter of agreement between the project members. In this document, students were asked to discuss in the group how they would organize their customer project for the next eight weeks. After signing this document, students were asked to write a project directive, project plan and gantt diagram. From the first week of this period until the end of the course, groups were told to

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organize three project meetings. In the first week, the main task was to focus on the above-mentioned documents. They were asked to keep minutes of each meeting. This document had to include information on the status of the tasks together with a list of participants.

The next step in this process was to present the project plans in a seminar. These plans were also presented to the customers. These customer presentations were organized based on the progress of each group and based on the activity of the group. Some of the groups worked very independently and were able to work straight into the customer interface. On the hand, many groups had difficulties in communicating with the customer. Also the role of the teacher in this process was difficult to stabilize. That is to say, some of the projects had links to GTAL research activities and the teacher was forced to control the communication.

PILOT PROJECTS

In this course, a total of six pilot projects were conceived, designed and implemented. Pilot topics were 1) an advertisement game for the local shopping center, 2) an interactive advertisement application for the local adventure park, 3) a digital brochure for the local machine building factory, 4) a car game for a global game contest, 5) a further development of a virtual environment for a local serious game company, and 6) a short demonstration movie for the local planetarium. Next these pilots are explained shortly. The evaluation of the pilots is explained and reported later in this paper.

Pilot #1: Advertisement Game

A small group of students (two students) implemented an advertisement game for a local advertisement company called Mainostoimisto SST. This pilot was developed by utilizing JavaScript and HTML5 technologies because this game was supposed to be an online game on a website. This caused a challenge for the students because these technologies had been used neither in the first period nor in the previous courses. So students were forced to first learn the basics of the technologies independently. The customer wanted a demo game, which would look like a Copter Game [11]. This game was supposed to attract consumers to frequently visit SST's customer's website and Facebook pages. As a result, students were able to implement a game in which the consumer's mascot was flying, collecting balloons and avoiding collisions of different types of objects on the street. The game also contained high-score lists, which were supposed to attract consumers to return and to play the game again.

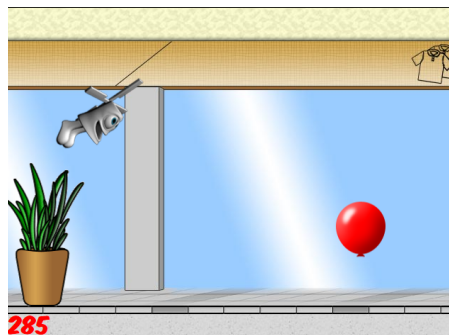


Figure 4. The implemented demo game for the Mainostoimisto SST [12]

Pilot #2: Interactive Advertisement Application

This pilot had two customers involved. The first one (Kiivert) was interested in giving the students an idea of an interactive advertisement utilizing a motion detection sensor based on Microsoft Kinect [13]. Another customer called FlowPark has an amusement park and they were interested in testing how interactive advertisements could be utilized in their business model. In this pilot, the main challenge was motion-detection, which was again a technology not used in period one. Only XNA programming was introduced. In addition, Kiivert motivated students (a group of four students) to use Microsoft Windows Presentation Foundation (WPF) libraries, which had not yet been utilized in their products. As a result, students were able to demonstrate successfully how motion detection could be used in a traditional hand-game called rock-paper-scissors.

Pilot #3: Digital Brochure

In this pilot, two students implemented a digital brochure application for a machine-building company called Macring. In this pilot, the customer was interested in how tablet devices could be utilized in marketing activities. Because iPad was chosen as a priority device, the pilot was implemented utilizing JavaScript and HTML5 technologies. As mentioned above, these technologies were not introduced for the students in the first period. As a result, students were able to implement an application, which was an interactive brochure including, for example, information of production lines as panorama pictures, 3D images with 360 rotation and extra information as more detailed pictures.

Pilot #4: Car Game

This was actually the only pilot designed and implemented based on a Unity 3D game engine. This can be explained as a side effect of flexibility in the specification phase of customer projects in this course. Another special feature of this pilot was that it was the only one without real customers. Therefore a group of four students were asked to implement a game for a global game development contest organized by Viope Ltd. In the very beginning, students were interested in designing a car game called Nieder Kart, which has influences from various car games in recent decades. Students had a lot of ideas to be implemented and had some challenges in project management. As a result, students were able to create a simple prototype, which they will further develop for the game contest after the course.

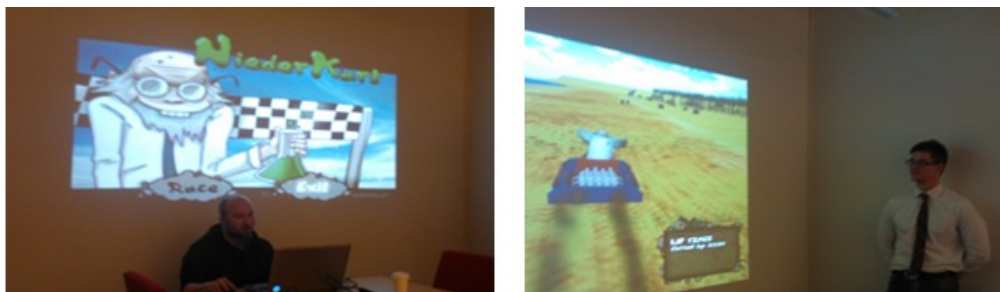


Figure 5. A final presentation of the Nieder Kart game prototype

Pilot #5: Development of Virtual Environment

Three students developed 3D models for a local serious games company called Metaverstas. This company produces a virtual learning environment utilizing the 2nd Life platform. The company has developed so called LabLife3D, which is a blended learning environment for biotechnology and chemistry [14]. Students were given pictures of objects used in chemistry as reference material. As a result, students were able to model around 15 objects, which are now being used in the virtual learning environment. Models were developed mainly using Autodesk 3ds Max software [16].

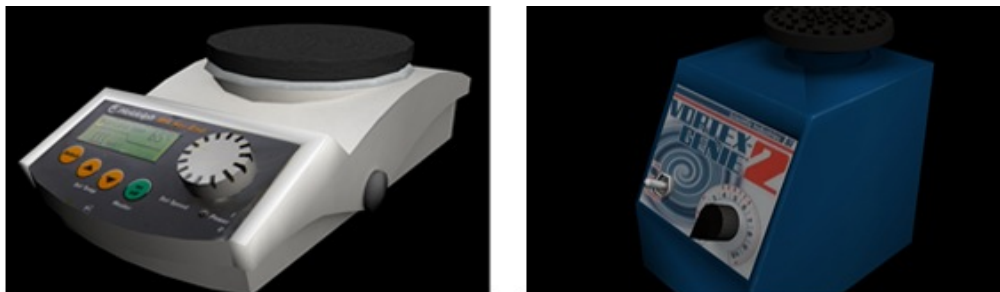


Figure 6. A couple of modeled objects for a virtual learning environment.

Pilot #6: Demonstration Movie

In this pilot, three students participated in a project in which a short movie (or trailer) for the local planetarium (Tuorla observatorium, University of Turku) will be created. The whole project group included experts from our laboratory and students from TUAS Arts Academy. The students had some challenges to work efficiently because they did not coordinate the project. They focused on 2D and 3D graphics, but they were not participating tasks related to media production, manuscript, animations and rendering for the full-dome surface. The customer had experience of content production for planetariums. In this project, the main interest was on visual elements, and on 2D and 3D animations on the full-dome surface. As a result, the group was able to create a trailer with visual elements based on the customer's specifications.

COURSE ASSESSMENT

As already mentioned, this course was a pilot for enlarging our understanding of the potential of CDIO standards in the game development field. Evaluation of the pilots requiring different types of expertise is quite demanding. As stated in CDIO standard 11 [16], assessment should cover student learning in personal, interpersonal and product and system building skills, as well as in disciplinary knowledge. In our course assessment, we tried to apply this standard together with the LIPS model in which assessment covers three phases, namely the before phase, the during phase and the after phase [17]. We applied the LIPS model especially in the before phase utilizing its documentation such as the project directive, project plan and gantt diagram. In addition, self and peer evaluation documents were designed based on the LIPS model. In addition, we utilized our learning competences reported in [7]. These competences cover innovation, curriculum specific and field-specific competences, which have links to assessments listed in [18]. That is to say, we utilized peer assessment, which will give outputs such as interest,

motivation, contribution, completion of tasks, reports and presentations. In addition, we also used teacher, expert and customer assessments.

DISCUSSION

CDIO standards can be applied in a wide range of scientific or technical areas, and there are several tools for designing course assessment. However, in our case we noticed that these assessment criteria were challenging to apply. Students participating in this course had to adapt from the field of Digital Media towards Game Development. Therefore, it is understandable that pilot topics varied a lot. This caused challenges in the course assessment. First of all, some students were not very happy to apply game engines in pilots. Technologies such as HTML5, and JavaScript were something new for the students in two pilot groups. And a couple of groups focused only on content production, which was not at the center of the course. In addition, one pilot was missing a real customer, which caused challenges in customer assessment. Furthermore, another pilot was coordinated by other students. In summary, all these aspects had to be taken into account in the course assessment.

In future, we have to consider how to schedule our course more efficiently. We found that students should already get in touch with customers in the first period. On the other hand, this can cause some limitations as well. Students should study all the required content before making decisions regarding the technologies utilized in the upcoming pilot. We also have to consider whether students should find their customers or whether they should work with customers negotiated by the teacher. Utilizing a research group as experts was a successful experiment. These experts have the latest know-how in game development tools. Their role in the assessment phase was significant, especially since the pilot topics covered not only programming but also content production technologies.

In order to motivate students more, we have to consider new methods. Students should get a flow for their work and it should last from the very beginning of the course until the end. As already mentioned, this course was a pilot for enlarging our understanding of the potential of CDIO standards in the game development field of specialization. The course covered visitor lecturers, seminars and excursions, which boosted the conceptual phase of the process. Based on the LIPS model we were able to steer students to do better design work. On the other hand, documentation is still a challenge. The implementation phase was key, especially in the pilot projects. Typically in the game industry, test-generate cycles are applied based on agile methods. Our students were asked to use two-week cycles, which was still a bit challenging and lacked a systematic approach. In future, we will focus more on applying agile methods in this course. In addition, there were challenges in scheduling. The students didn't have enough time for the operating phase, but in general the customers were satisfied with the results.

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BIOGRAPHICAL INFORMATION

Dr. Mika Luimula is a Principal Lecturer, and Head of the Media Laboratory in the Degree Program of Information Technology at the Turku University of Applied Sciences. He holds a PhD in information processing sciences and an MSc in mathematics. He is leading game development R&D activities in the Game Tech&Arts Laboratory. His research interests include game development, serious games, health informatics and location-aware systems. He has published around 50 scientific papers in the above-mentioned research areas.

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