Creativity in the Cane Fields: Motivating and Engaging IT Students Through Games

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ABSTRACT

In this paper we discuss the influence of the unique local environment and culture on students and teaching styles in the IT degree at James Cook University Cairns Campus. In this degree program games are used to motivate self-directed study and increase student engagement in first and second year programming subjects, and also to generate interest in learning new technologies such as programming for mobile devices. We discuss the use of a mixed reality location based game to improve attitude to teamwork by integrating students in a games subject and a general IT software engineering subject. Students learn the value of community engagement through links to a local primary school for design and evaluation of games, to ensure a balanced approach to user requirements, game design and implementation. Students have explored niche applications of games through the development of a game for children with disabilities.

Categories and Subject Descriptors

K.8.0 [**Personal Computing**]: General - Games, K.3 [**Computers And Education**]: Computer Uses in Education - *Collaborative learning*, H5.2 [**Information Interfaces And Presentation**]: User Interfaces - *Prototyping, Theory and methods, User-centered design*

General Terms

Management, Design, Human Factors, Theory.

Keywords

Games, Community, Collaboration, User interaction.

1. INTRODUCTION

The Cairns campus of James Cook University in Far North Queensland, Australia, is 200 miles from the main campus and 1000 miles from the closest major city. The economy is built on traditional industries such as agriculture and mining, and more recently industries such as tourism and creative industries. Cairns hosts a diverse range of cultures—traditional sugar cane and dairy farmers, those seeking an alternate lifestyle, indigenous inhabitants, and an artistic community attracted by the reef and the rainforest.

The regional characteristics produce a unique student profile. As the only university to run courses locally the university has a social responsibility to service the needs of all types of students. This results in classes containing students with a broad range of abilities, generally resulting in a bimodal distribution of academic achievement in first year IT subjects. The student base presents considerable challenges when compared to universities in large cities with entry requirements to target students with high academic achievement. Thus, subject delivery and teaching style must be adapted to get the best out of each student, encouraging them to higher levels of commitment and achievement so that the academic integrity of the degree program is not compromised.

First year students include those with varied attitudes towards self-directed study and commitment to academic achievement. This commonly arises from lack of familiarity with the larger world outside of the local community. At universities in larger cities the draw of high salaries and the understanding of the levels of expertise required for these positions is a significant motivational factor for students. Possibly because of their limited knowledge of the rewards of top level IT positions in larger companies in capital cities and overseas, our beginning IT students are often lured away from study by jobs that require only limited expertise. In response we have developed techniques to motivate our first year programming students until they develop an understanding of the rewards for high achievement and the relevance of the material being taught; and the commitment required for self-directed study.

There are other social issues that effect motivation, commitment and performance in isolated regions. The Cairns campus of James Cook University is a little over 10 years old. There is little family history of university education and many students (>50%) are the first in their family to attend university. Their families have little or no understanding of what is required to obtain a university degree, especially the time commitment needed.

Games can provide motivation for self-directed study and increase student engagement, especially in first year programming subjects. In later subjects gaming is employed to generate additional interest when teaching technical principles. In the group projects the shared interest and experience of students in games is employed to facilitate group cohesion and commitment to the project. In addition game projects provide an avenue for

development of social responsibility through projects, for example, developing games for children with disabilities.

It has been said that Generation Y, or the Millennials, have a greater focus on self satisfaction than preceding generations. Whether or not this is true, there is no denying that university education is currently competing with entertainment for the attention of students. Entertainment for Generation Y and later is dominated by gaming on devices from phones to networks of desktop PCs. Games as part of a teaching and learning strategy provide an effective tool for focusing student attention on learning.

2. BACKGROUND

James Cook University in Cairns offers IT degrees with a range of strands including eBusiness, IT Professional, Networking and Multimedia Games Development.

The development of the Multimedia Games Development strand was driven a number of years ago by a recognition of the strength and importance of creative industries in the local community and economy, and in response to the demand from potential students in year 12 that was identified by local high school promotional talks and university open days. Providing a degree based on the general interests and activities of high school students helps promote the opportunity and interest in future tertiary education.

The core programming languages in the general computing subjects include C/C++, Java, Python, Perl, and PHP. The games strand also includes training in Maya and the Torque games engine.

Game subjects allow introducing and developing complex human-centered design approaches to an otherwise technically focused degree. In three subjects running in second and third year, students tackle and extend themes frequently addressed in traditional human-computer-interaction (HCI). The difficulties often encountered in motivating technically focused students to place the user at the centre of their system design do not seem to be a problem when students are able to relate this to the centrality of the player experience to the success of gameplay. For example, one subject explores games from multiple perspectives of rules, play and culture and uses Salen and Zimmermann's opus [1] as the core text. The students rise to the challenge of tackling the advanced ideas from semiotics to sociology. Human-centred design principles relating to user/player experience and usability can be introduced across multiple contexts and tackle multiple issues. It is quite difficult to imagine how we could extract the same extensive debate about emotions from a large group of young people (mostly men) in other contexts! Play gives all people a safe place for self-expression: which we believe is at the heart of innovative, human-sensitive design.

The following sections describe the place of games in our course structure chronologically, from first year undergraduate study to graduate research.

3. GAMES AS A TOOL FOR INTRODUCING PROJECT DEVELOPMENT TECHNIQUES

In the first year multimedia subject which is taken by both IT and non-IT students are required to develop a multimedia project that includes interactive elements. Multimedia projects are developed using the Adobe/Macromedia Director MX 2004 environment. Students are encouraged to use the built-in Director features as well as writing their own scripts using the Lingo scripting language. The interactive elements required include real time text entry, data storage and access, keyboard and mouse control. The incorporation of these elements into a game-like artifact is a natural extension of the students own experiences as game players and also allows them to experience the favourable response of others to an interactive multimedia experience that they have created. For many of these students this is their first experience of computer programming and the use of game-like examples during practical and tutorial sessions provides an effective motivation for them to struggle with the complex task of getting their own game to work as planned. During the development process many are also inspired by the responses of their beta testers to correct faults in their game design and add elaborations to enhance the game's appeal to the end user. In this way students gain first hand experience of the need for testing and refinement during the project design and development process in a context where the main driver is their own motivation to create something pleasing to the end user. The resulting projects show a very high level of development in the students' programming and project development skills in a very short period of time and it is evident that the experiences gained in this process inform their later work in other games and project development subjects.

4. GAMES AS A MOTIVATIONAL TOOL IN FIRST YEAR NON-GAMING PROGRAMMING SUBJECTS

In the first year first semester procedural programming subject (based on C/C++) the assignment completion rate is improved by prescribing the development of a game for the first programming assignment. Over the past four years the assignments have been a cricket game, a tennis game, a number guessing game and a golf game. The first assignment is a critical piece of assessment as it establishes the students' confidence in their ability and their subsequent attitude to programming. Good academic performance in the first programming subject is essential as students who perform poorly in this subject have significant problems recovering from a lack of basic programming for the remainder of their degree.

The use of a games based assignment has been introduced into the subsequent second semester C/C++ object oriented programming subject to ease the transition between procedural programming and object oriented programming. Last year the first assignment was an object oriented, text mode adventure game which introduced students to object oriented programming in an enjoyable and motivational way. This resulted in improved commitment to assignment completion.

Games are also used in the second year Java programming subject. Here games are used to teach and motivate students to learn graphical and GUI programming. Games used in this subject in the last few years have been GUI controlled single player games, including a game of Pool, the Snake game, and the Game of Life which used a mobile phone emulator.

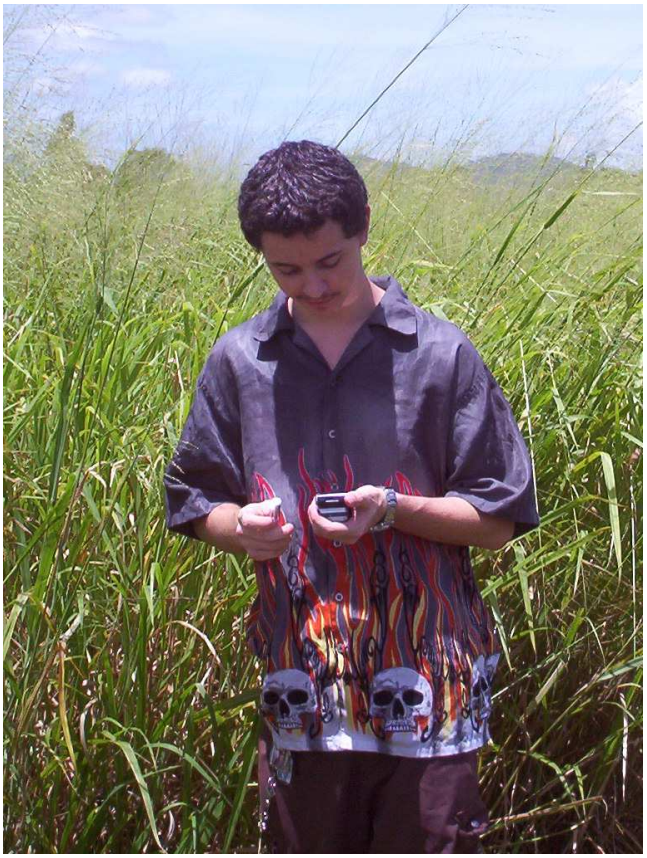

Figure 1. Gameplay design of mixed reality location based game using mobile devices

5. GAMES AS A TOOL TO IMPROVE ATTITUDES TO COLLABORATION

Games are used extensively in Java and software engineering subjects to generate interest in learning new technologies. They also provide a good way to illustrate the relationship between design and development processes and different communication forms. Recently, an innovative mixed reality *location based game* (LBG) has been used to integrate a project into the work of students in two subjects. Games students design a location-based multi player game and the IT students implement the game. The activities are summarized in Table 1.

The first step in the process involves the games students investigating the constraints of the world and the technology using smartphones and GPS in situ and bodystorming game ideas. They then iteratively refine a game concept by lo-fi prototyping and evaluating it using the Wizard of Oz protocol before presenting the game concept as a set of rules to the students in the Games strand [2].

The IT students take the game design and develop a distributed games engine to implement the game. This process of games implementation teaches the IT students concurrency, synchronization, socket programming, wireless networking, GPS and midlets using Bluetooth to enable cell phones with GPS capabilities.

The IT students are required to develop the games engine and system framework including login, interface and game framework. This framework is then used to implement the mixed reality LBG. The current game is a version of battleship in Java using the Bluetooth enabled location aware mobile phones. The code is developed firstly using midlet emulation and execution then later ported to physical devices where the games are played between cell phones as illustrated in Figure 1.

The use of games technology to teach programming on mobile devices maintains interest and motivation for group members who do not choose programming as the first priority in their studies. This allows them to benefit from being able to relate project work to real world applications in an interesting way. Having input into the project increases their tolerance to the frustration inherent in learning how to program.

Table 1. LBG activities in cooperative game development between IT students and Game students

<table>
<tr><th>2nd Year Games Subject</th><th>3rd Year IT Subject</th></tr>
<tr><td>Observing the basic gameplay of paper-based battleship</td><td rowspan="2">Speculative project development,
and generation of inception artifacts, of a basic
Non-LBG Battleship game for a mobile phone</td></tr>
<tr><td>Bodystorming and capturing LBG game ideas using Smartphones and GPS in situ</td></tr>
<tr><td>Visualisation and abstraction of LBG concepts</td><td rowspan="3">Elaboration iteration based on technical development of
Non-LBG Battleship game on phones
Programming Java Midlet & Servlet Connectivity</td></tr>
<tr><td>Evaluating lo-fidelity LBG prototypes using Wizard of Oz</td></tr>
<tr><td>Refining and communicating LBG design concept</td></tr>
<tr><td rowspan="3"></td><td>Major change to project requirements by incorporating LBG concepts into the Non-LBG mobile game</td></tr>
<tr><td>Demonstration of Client-side Java Bluetooth programming</td></tr>
<tr><td>Elaboration Iteration 3 & 4</td></tr>
<tr><td colspan="2">Play and evaluate LBG software components</td></tr>
</table>

Using a real world multiplayer platform which can be run on real phones further enhances student interest and participation in the project. Object-oriented software design techniques allow students to adapt to changing requirements, concentrating on the inception and elaboration phases of agile UP. This engenders a specific kind of procedural reasoning and systematic thinking about large-scale software problems using UML diagrams, and software design patterns. In previous offerings of the subject students developed a non-location based game on mobile phones which engaged their interest in applying patterns for system design and specification. The LBG project addresses the changing requirements aspect of the subject's learning objectives and industry's need for graduates to be responsive to dynamic and temporally evolving contexts. Thus, the subject links theoretical perspectives directly to the

project as a concrete framework for students to clearly and concisely express software specification design ideas. This is compatible with requirements of Industry and professional organisations (e.g. Australian Computer Society) that graduates be able to design effectively for an increasing breadth of technologies. The project also enabled students to practice working with cross-functional teams.

A noticeable benefit of designing learning activities compatible with students own game experience is their frequently improved attitude to teamwork. Experienced lecturers remark that students who have extensive Massively Multiplayer Online Game experience are better able to recognize the importance of all individuals to a team and that good team outcomes result from combining individual skills and strengths rather than indulging in 'lone ranger' behaviour.

6. GAMES & COMMUNITY

Links to a primary school provide second year students in the games directed project subject with an ideal opportunity to design for people apart from themselves. In this way teaching of games technologies is firmly linked to the critical importance of player-centred game design. Students learn and practice the skills needed to develop prototypes using the Torque game engine in a series of 11 structured practical workshops which incorporate 3D modeling tools. Focus on the player is developed early in the project and maintained throughout the project so that the technical skills of the Torque game engine are integrated with powerful design techniques based on the Fullerton and Swain textbook [3]. Students brainstorm, create a physical (paper-based) prototype, develop and evaluate concepts, prepare preliminary design documents, and then prototype and test software with the 11 year old children who are the target audience. Students visit the primary school every 6 weeks, firstly to evaluate a large number of physical prototypes (see Figure 2) and then to test a smaller number of refined software prototypes. In the process students encounter implementation issues fully embedded in the design process and are motivated to create an innovative, internally complete and balanced game. This approach discourages a view of games design and development in which the player becomes almost a subsidiary issue.

Changes in student behaviour and attitudes as they evolve their group prototypes in games directed project subject strongly suggest that our human-centred approach to teaching IT supports both a sense of community and a more effective approach to design. The degree to which students demonstrate a central concern for gameplay, playability and the fun of their games for junior play-testers is palpable. For example, an interesting aspect of links to the primary school through the Directed project this year was the significant environmental and socio-economic impact on the community of Cyclone Larry, a category 5 cyclone. The catchment area for the target primary school is closer to the centre of destruction than the university and the students' ideas for games with elements compatible with the children's potentially unsettling experience was quite heart-warming.

Links to past students who work in school IT departments or as IT teachers in local schools has provided the opportunity for these classes to become involved in the evaluation of beta versions of games developed by students in the games strand. This provides the school students with an understanding of the game

Figure 2. Physical prototyping game concept ideas with school children

development process (design as opposed to merely coding), a practical example of what they may learn at university and also allows them to talk personally with current students and ask questions regarding the possibility of enrolling in an IT/Games degree in an informal and non-threatening atmosphere. School-based testing of beta versions of games provides valuable knowledge about human behaviour and the characteristics of their target audience for the games students. The feedback received in the testing process also highlights the importance of the design process and develops a deeper understanding of human computer interface issues. Students also learn the importance of an iterative design process.

It is important that students completing the degree are able to apply their knowledge and skills to obtain employment and fulfill the needs of the community. Apart from the obvious mass market for games we encourage students to understand the wider applications of their skills to niche game markets and non-game markets.

The third year project subjects require that students develop a software system for a real client over a year. The project subjects have been highly successful and received a national citation from the Carrick Institute for outstanding contributions to student learning in higher education.

This year three games students completing the project subjects worked as a team to develop a game for children with disabilities. Working with the *Switched on Learning Project*[1] gave the students access to a niche market and required them to deal with unusual requirements: The game players interact with the game through two large switches rather than a mouse, keyboard, or joystick. The switches control the actions of the player in a 3D simulation of a shopping centre. Tasks include finding appropriate shops to purchase items from a shopping list, interacting with shop staff, and making a purchasing including receiving change.

Beyond the practical activities described above, a major point of the game is to explore independence. The children that play the game have restricted mobility and few opportunities to choose

[1] http://www.switchedonlearning.org/

their own activities. Even in the early stages of development when the game included only one activity and so many bugs that it seemed hardly playable the children were overjoyed with it. Although they had often seen their siblings play 3D games with high quality sound, they had never had the opportunity to play one.

Fulfilling a real client's needs or wants is a significant step in the transition from student to practitioner, and a highly rewarding experience for our students.

7. GAMES AS AN INTRODUCTION TO RESEARCH

As a consequence of student catchment the option of pursuing post-graduate studies is not obvious to students. Now deemed to deserve both serious academic research, as well as major industry and business uptake, techniques used in computer entertainment translate well into advances in research and enable us to leverage student interest in the processes of research. For example, several students' observations of multi-player behaviour in one assignment fed into a paper on the efficacy of different visualisation forms for wayfinding large-scale simulated worlds [4]. Second and third year student development activities for mixed reality LBG also formed the basis of another paper [2] in which students were eager to be involved. This year an Honours student's project was based on games. An interesting aspect of games as a research area is that students will so willingly adopt good research practices in order to pursue a pet theory they have developed in their own gameplay. It appears that because proving or disproving their theory has so much relevance to their gameplay and, for some students, game design, they will engage in protracted and detailed observation sessions and workshops to explore and articulate their experiences and develop sound theories [5].

8. CREATIVE INDUSTRIES

Growth in the creative and technology industries of remote Australia requires cultivating an entrepreneurial spirit amongst students in local universities to inspire them to develop their own enterprises. We endeavour to encourage views of technology futures that are sensitive to our locality; while also exposing students to technologies that are encountered in large or metropolitan universities but not, contemporarily, in our region.

In the games strand students are encouraged to draw upon our unique natural environment and locational context to inspire their game designs. For example, in one second year subject they have to consider design constraints created by the mountains and rainforest surrounding our campus for their mixed reality LBG. This provides a direct and engaging way for students to attend to the environmental demands and constraints associated with pervasive computing. In a third year subject one assignment requires them to create visual and audio representations that capture specific qualities of nature and use these to convey particular emotions and themes. Through immersion in their environment students learn to realize the special opportunities for creativity afforded by our visually spectacular scenery and the advantage this may afford local creative industries.

The ethos of creative volunteer work associated with game culture seems to instill students with a particular sense of entrepreneurial spirit. As well as contributing to the community through multimedia presentations and games created for volunteer groups several students currently or previously involved in games subjects have created their own local businesses, for example, www.redbackgames.com.

9. CONCLUSION

In addition to motivating and engaging students to learn to program, game design helps stimulate students to develop human centered design skills. Through community engagement with school children, students develop games using an iterative development process resulting in an appreciation of the balance between the needs of the user and the requirements for coding. Students are also encouraged to learn technical skills through development of location based games on mobile devices and to apply gaming skills to niche applications as well as the mainstream games market.

10. ACKNOWLEDGMENTS

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