B.Sc. Computer Game Development …

Why not?

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ABSTRACT

We were motivated to consider proposing/adopting a new curriculum by the decrease in student enrolments currently experienced by our computing science programs. This requirement for re-invigorating program enrollment ("more bums in seats") provided the initial motivation for exploring potentially relevant curriculum/program changes and additions. Our research indicates that there exists a significant market niche in delivering suitable educational content relevant to the computer game industry. This niche, as yet remains undeveloped by the overwhelming majority of publicly funded university level academic institutions in North America.

Acutely aware of the fact that a B.Sc. degree proposal with an emphasis on computer game development will draw both friendly and enemy fire, the curriculum proposed is a careful blend of both the established ACM and IGDA curriculums. It is reasoned that this will not only satisfy game industry needs, but that it will do so without sacrificing curriculum integrity of the computing science component provided by a normal B.Sc Computing Science.

Keywords
computer science education, curriculum, game development, game programming, inter-disciplinary studies

INTRODUCTION
Since about the fall semester in 2000, computer science programmes in North America have generally experienced significant decreases in enrollments; our institution has not escaped this trend. A precipitous drop in our departmental student numbers generated numerous faculty and

departmental discussions about: "where have the students gone"; "how can we get them back"; "what are viable and exciting future employment opportunities in computing". These discussions were focused primarily on **student/academic perceptions** of the value a computer science degree can have for future employability. This exercise led us to explore various strategies for exploiting potential market niches in computer science education; the one area that immediately came to the fore is game programming and development. This field has instant student appeal, has tremendous depth and diversity of content as well as excellent economic growth potential; both in times of economic prosperity and hardship!

The current computer game market continues to have robust growth with global sales in excess of 30 billion dollars [8], which is more than the thriving movie industry. Recently the game Halo 2 by Microsoft experienced sales exceeding $125 million dollars after its first week of release! Some have even speculated that at its present growth rate the computer game industry could well exceed $100 billion [7] within the next decade.

It is ironic that game companies are struggling to find qualified applicants to fill vacant positions [1,7], yet there are few in the public academic/educational community who are prepared and willing to commit the resources to address this specific target market. How is it that such a massive economic juggernaut and one which has penetrated so deeply into our western culture has undergone so little basic research [6] and has spawned comparatively few academic programs where students can acquire the appropriate skills?

One of the obvious concerns about developing a curriculum around this particular stream is one of negative community (especially parental) perception. When the University of California at Irvine was contemplating the introduction of a multi-disciplinary program on Computer Game studies, the media was quick to write articles with titles such as: **"As if students did not already waste time on video games…"** [1]**, "Off to College to major in …Video Games?"** [2]**, "Earn an advanced degree in … Quake?"** [3], and our favorite graphic which includes the caption **"Quake University : Graduate Fraga Cum Loudly"** [4] . Although the accompanying articles were well written and generally presented a neutral overview of the proposed program of study, the initial reaction of readers seeing these deliberatively tongue-in-cheek titles was biased towards the comical and absurd. One article even went so far as to offer a back-handed compliment about one institution which had recently established a game degree program: "perhaps other institutions of higher learning will follow the leadership…and establish graduate degree programs in other disciplines such as game show hosting and fast food preparation" [5]**.**

At least as important as general public opinion is the fundamental issue of computer game studies as a legitimate area of academic study. Numerous authors have commented that "academic snobbery" [10,12,14,15], is an unavoidable problem and one which will be a real concern for those institutions looking to adopt a game oriented curriculum. These authors also state that the introduction of this sort of program (or even a couple of courses dealing with games) will undoubtedly be a controversial move which will evoke a wide range of emotions from all who come into contact with it! Squire[15], offers the following sage words to gaming educators "watch out for disgruntled colleagues, pay attention to the bottom line and be prepared to fight political battles if you want to mix electronic games with the academic game".

EXISTING GAME STUDIES PROGRAMS

The University of Abertay-Dundee rolled out the world's first degree in game studies in 1997 [9,13,14]. Although it was not a painless birth, the success of the program is certainly well established and has spawned several in-house variations on the initial degree. More importantly, its success in attracting students has motivated numerous other institutions in the UK to follow suit [U1 – U12],. In Europe: Denmark; Sweden; and Spain have also begun to establish similar degree programs [E1 – E4]. Recently Germany even named its first professor of Computer Game development [E5].

In contrast to the UK, North America has been exceedingly slow in acknowledging the relevance of computer game studies. According to Sutherland[14], "the anti-games feeling among USA academics appears to remain total and there appears to be every possibility that this, one of the largest fields in computing, will continue to be poorly served by US academia". Although several schools have begun to offer various types of singleton courses dealing with topics relevant to the industry, there are few public North American post secondary institutions who dare to offer actual degrees related to computer game design.

The graduate degree seems to be easier to rationalize (to those who approve curriculum), since it can be assumed that students entering these graduate programs come with skills acquired in more traditional programs. Hence, should they experience limited success in the computer game field; they can fall back on their previous areas of expertise.

In the fall of 2002 Carnegie Mellon University's Entertainment Technology Center [N1] introduced a Masters degree in Entertainment Technology which is a joint collaboration between the School of Computer Science and the College of Fine Arts. Students from various disciplines are admitted into the program and spend the majority of their time working collaboratively on various media based technology projects with substantive exposure to game development. CMU partnered with Disney Corporation to incorporate proprietary technology into the curriculum. In the same year, the Rochester Institute of Technology's Department of Information Technologies also introduced a Master's level degree in computer game design[N2].

Excluding the for profit institutions such as: DigiPen; Full Sail; UAT; The Arts Institute on-line; Westwood; and now even DeVry (who will be rolling out a degree program starting in the summer 2005), undergraduate degree programs have been a challenging sell to North American academics. There are precious few publicly funded institutions in the US currently offering complete four year degrees[N3, N4, N5]: DePaul University in Chicago; the University of Denver; and Champlain College in Vermont; all had their programs come on-stream within the past year. Becker College and Worcester Polytechnic Institute[N6, N7], both in Massachusetts, will be introducing new degree programs in the fall of 2005.

The availability of programs in Canada is even less encouraging. In fact the only reference to game development was from the University of Calgary's Department of Computer Science, who in the fall of 2001 boasted that it had the first of its kind (in North America) undergraduate degree in Computer Science with a specialization in Computer Game Design[N8]. Closer scrutiny revealed that the specialization includes only 1 actual game programming/design course, whereas the other game related courses listed as requirements for the specialization are actually fairly traditional Computing Science, Mathematics and Science courses. The only required

interdisciplinary content comprises of only 2 one-semester courses from either: Art; Music; Drama; English; or Communication Studies.

A PROPOSAL FOR A B.SC. COMPUTING SCIENCE (GAME DEVELOPMENT)

The province of Alberta recently included degree granting as a viable mandate for Colleges and Technical Institutes. Advanced education is currently accepting proposals for new degree programs [11] which satisfy criteria such as: being unique; have industry/professional support; have established an economic demand and where ultimately the students will meet the needs required by potential employers.

Interestingly, our situation parallels the circumstances that led Sutherland at the University of Abertay-Dundee to pursue the world's first game degree. They had just acquired a new University mandate and were looking to establish themselves ("desperately needing a niche") as a unique provider of education for the game industry. Hoping to achieve a similar end (with respect to a Canadian market) we present the following proposed academic stream at the Bachelors level.

B.Sc. Computer Science (Game Development)

Course Name	GPRC Course
Year I	
Introduction to Computer Science	CS1010
Introduction to Programming	CS1140
Data Structures and Algorithms	CS1150
Discrete Structures	CS2720
Linear Algebra	MA1200
English (Full-year)	EN1010
Digital 3D Modeling I	DD1160
Digital 3D Modeling II	DD1170
Computer Games Studies	New Course
Year II	
Programming Methodology	CS2010
Systems Analysis and Design/Patterns	CS3610
Computer Architecture I	CS2290
Computer Architecture II	CS3290
Computer Networking and Communications	CS2000
Computer Hardware	CS2210
Organizational Theory	OT3010
Fine Arts Option	DDXXXX
Fine Arts Option	DDXXXX
Computer Game Design	New Course
Year III	
User Interface Design	CS3010
Introduction to Computer Graphics	CS3110
Database Management	CS2910
Computer Science Option	CSXXXX
Computer Game Engines	New Course
Computer Game Physics and Mathematics	New Course
Fine Arts Option	DDXXXX
Fine Arts Option	DDXXXX
Approved Option	
Approved Option	
Year IV	
Computer Game Project I (6 credit)	New Course; Multidisciplinary Group
Computer Game Project II (6 credit)	New Course; Multidisciplinary Group
Advanced Computer Graphics	New Course
Computer Science Option	CSXXXX
Computer Science Option	CSXXXX
Computer Science Option	CSXXXX
Approved Option	
Approved Option	

The table above depicts our proposed four-year B.Sc. Computer Science (Game Development) curriculum. The first column is a listing of specific course titles, and the second column lists the equivalent courses as offered at Grande Prairie Regional College. Some courses are currently unavailable at our institution and therefore are marked as "New Course".

Approved Options include any 3 credit University level course.

All DDxxxx courses refer to options chosen from the Fine Arts department (Digital Design) and include such courses as DD1180 Digital Imagery 2D I; DD1190 Digital Imagery 2D II; DD1081 Introduction to Music Technology; DD1082 Introduction to Video Production; DD2081 Music Technology II; etc.

All CSxxxx courses refer to options chosen from Computing Science: for example CS3060 Introduction to Image Processing; CS3130 Telecommunications and Computers; CS3120 Experimental Robotics; CS3790 Operating Systems; etc.

All courses are 3 credits, except where noted.

RATIONALE FOR CURRICULUM SELECTION

A degree specialization should intrinsically have a unifying theme throughout all four years. This is especially important with a specialization like Computer Game Development: students must feel that they are indeed concentrating on something special. We feel it critical that the essence of *game development* permeates the entire four year program of studies, and not be just a simple curriculum patch achieved by adding a few courses in the fourth year of the program. Towards that end, the inclusion of specific game oriented courses in each year of study assures students that they are indeed making incremental progress toward their chosen careers. We expect that this should not only maintain student enthusiasm over the entire program, it will also give students a longer period over which to assimilate and integrate the various skill sets required by practitioners in the field.

Although the overall emphasis of our proposal is on computer science fundamentals as specified by the ACM guidelines[18], we have also incorporated most of the multi-disciplinary topics proposed within the IGDA curriculum framework[19]. This should ensure a solid grounding in computer game development. Of particular relevance are the 3-D computer modeling courses from the Fine Arts program which are listed as core requirements; this acknowledges the fact that as future employees in the industry they will be required to work with colleagues who are artists.

 The game industry is one which encompasses many fields, computer science and fine arts are obvious, but we must also consider the humanities including: sociology, psychology, philosophy and ethics, anthropology, history and even geo-politics. In order to accommodate individual student's interests we provide four general approved option courses.

It is the consensus both by industry spokespersons and academics teaching in the game studies area [16,17,20] that the most relevant and important experience that students should have as part of their program is extensive cross-disciplinary education with significant exposure to working in groups consisting of both technical and non-technical partners. In keeping with this principle of exposing students to a multi-disciplinary work environment, the most critical **core requirement**

of the proposed program is that students in their final year take two one-semester Computer Game Project courses: 6 credits each.

It is envisioned that students enrolled in these courses will actively interact with students from other disciplines. This will include students working collaboratively on various aspects of the game: including artists, musicians, story boarders, and may in the future include students from business and marketing. These project courses will simulate a typical game company work environment with dedicated space and equipment, ongoing multi-year projects, and guided by realistic timelines and milestones. Successful implementation will entail significant cross departmental collaboration in order to recruit students from other disciplines who will in turn get credit from their respective departments.

We are fortunate in that we have already successfully experimented in a cross-departmental project based course-collaborations with the Fine Arts department [21]. During these pilot versions of the project course, students were exceedingly motivated and dedicated an enormous number of hours working on their project. As the pilot was valued at only 3 credits these students had to carry an additional 4 courses to maintain a full course complement. This heavy workload (albeit self-imposed) may potentially have compromised their studies in their other courses. The number of credits assigned to these capstone courses (12 of the 30 credits in year 4) acknowledges the importance of this learning experience and should help facilitate students spending a significant allotment of their time devoted to the team. This should help to reduce fatigue and maintain productivity over the full year of the project.

PROGRAM VIABILITY

Some may argue that students will be penalized by pursuing a Game Development specialization. They may suggest that graduates will have too narrow a skill-set to succeed in areas outside of the computer gaming industry. We feel that this does not have to be the case, especially if the curriculum is well grounded in typical computing science topics. Our proposed program adheres, without significant differences, to the core requirements outlined by the ACM Computing Curricula 2001. Therefore if a graduate chooses not to, or is unable to find employment in the computer game industry they will have acquired the necessary foundation that a typical four year computing science degree would provide. Graduates will be employable because the skills acquired by learning to develop complex interactive games are excellent preparation for many computing careers.

It is not unusual to find a computing science curriculum where students are allowed considerable flexibility to tailor their computing science and option courses according to their specialized needs. For example, the University of Alberta's Specialization in Computing Science program lists 17 of the total 40 courses in their degree program as options. Our curriculum is similar in content and scope; however students in our program would forfeit flexibility in course selection and will be required to take core courses that **we have deemed useful** for a game programming specialist to possess.

CONCLUSION

The title of the paper asks the question, "B.Sc. in Computer Game Development … why not?", yet our proposed curriculum is entitled B.Sc. Computer Science (Game Development). Obviously this is a departure from the initial premise of a B.Sc. in Game development alone. The

change effectively mirrored the underlying direction of our on-going discussions. Although we were very excited about the concept of a degree in game design, whenever we tried to define such a curriculum we were invariably drawn back to discussions on computer science content. We could not bring ourselves to disassociate one from the other.

Perhaps we were intimidated by the likelihood of having to endure scorn from our sister institutions, afraid of bad press, concerned with getting provincial approval for the curriculum, or maybe we were indulging in academic snobbery. Most likely all played a factor in our decision making. Ultimately we came to the conclusion that we would first attend to delivering necessary and sufficient skills which computer science graduates must possess and then weave game oriented content around this central core of courses. This is not a radical departure from typical round table discussions at game development conferences, where the attendees are usually spilt on the topic of specialized versus general degrees[16,17].

The proposed curriculum strays little from accepted academic standards in computing education yet incorporates significant content relevant to the computer game industry. This was not accomplished without cost. Students in this program will forfeit flexibility in course selection which will significantly curtail their ability to explore academic content beyond those prescribed by the program. We are absolutely certain that students will not begrudge us this loss.

Acknowledging the multi-talented, multi-disciplinary nature of existing commercial game development companies, the program incorporates significant exposure to various topics in Fine Arts, Music and humanities. The inter-disciplinary nature of the field is maintained and re-enforced through all 4 years of the program. The degree culminates in a year-long capstone project where students will work collectively in a multi-disciplinary team to develop a game. This interaction will take place in a dedicated space, with dedicated equipment, which will simulate a realistic working environment.

It is our sincere belief that computer game development is an important nascent field, will continue to gain in popularity, will undoubtedly energize and excite students and will most assuredly have a significant impact on student enrollment.

Now all that remains is getting all the required approvals!

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Schools in the UK

U1. MSc in Games Programming, The University of Hull, http://www2.dcs.hull.ac.uk

U2. BSc Computer Games Development and Design, University of Central Lancashire, http://www.uclan.ac.uk

U3. BENG Computer Games and Internet Technology, University of Essex, http://www.essex.ac.uk/intro/ugport.ac.uk

U4. BSc (Hons) Computer Games Technology, University of Portsmouth, http://www.port.ac.uk

U5. BSc (Hons) Computer Games Technology, University of Abertay Dundee, http://www.abertay.ac.uk

U6. BSc Computer Games Technology, University of East London http://www.uel.ac.uk/programmes/scot/undergraduate/comp-gamestech-bsc.htm

U7. BSc (Hons) Computer Games Development, University of Glamorgan, http://www.glam.ac.uk/soc/courses.php

U8. BSc (Hons) Computer Games Technology, Manchester Metropolitan University http://www.docm.mmu.ac.uk/courses/pdf/computer_games.pdf

U9. BSc (Hons) Computer Games Technology, University of Paisley http://www.paisley.ac.uk/newcourses.htm

U10. BSc Interactive Systems and Video Games Design, University of Bradford, http://www.bradford.ac.uk/university/ugpros2004/informatics.php

U11. BSc (Hons) Computer Games Software development, Bolton Institute, http://www.bolton.ac.uk/courses/pages/bsc_hnd_cgsd.html

U12. BSc (Hons) Computer Games Technology, University of Derby http://www.derby.ac.uk/games

European Schools

E1. Center for Computer Games Research IT University of Copenhagen, Denmark, http://game.itu.dk

E2. BSc Game Development and Interaction, Malardalen University, Sweden, http://www.mdh.se/ide/eng/

E3. Master in Video Game Design, Complutense University of Madrid, Spain http://www.fdi.ucm.es/juegos3d/

E4. Master in Computer Games, Polytechnical University of Hagenberg, Austria http://mtd.fh-hagenberg.at/studium/magister/schwerpunkte.html

E5. Research Group Computer Games, University of Magdeburg, Germany, http://isgwww.cs.uni-magdeburg.de/games/

North American Schools

N1. Masters in Entertainment Technology, Carnegie Mellon University's Entertainment Technology, http://www.etc.cmu.edu/curriculum.html

N2. Masters of Information Technology, Rochester Institute of Technology, http://www.rit.edu/~625www/programs_it.html

N3. BSc. Computer Games Development and Animation, University of Denver, http://www.cs.du.edu/gameDevelopment/

N4. Bachelor's Degree in Electronic Game & Interactive Development, Champlain College, http://www.champlain.edu/major/egame/

N5. BSc. Computer Games Development, DePaul University, USA,

http://www.cti.depaul.edu/programs/2005/BachelorGAM2005.asp
N6. BSc. Computer Games Design, Worcester Polytechnic Institute in Massachusetts,
http://www.wpi.edu/Academics/Majors/IMGD/
N7. BSc. Interactive Entertainment, Becker College, http://beckercollege.edu/
N8. BSc Computer Science (Concentration in Computer Game Design), University of Calgary
http://pages.cpsc.ucalgary.cs/~becker/GamesConc/courses.html