On the Provision of a Comprehensive Computer Graphics Education in the Context of Computer Games: An Activity-Led Instruction Approach

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Over the past decade the development of computer games has evolved into an accepted academic discipline, closely related to the field of computer graphics. Games courses can be found embedded in traditional computer science degrees or as dedicated degree programmes for students aiming to work in the games industry.

In this position paper, we describe a student-centred, activity-led approach to teaching computer graphics in the context of a computer games technology undergraduate degree. Traditionally, computer graphics education has been a minor specialism in computer science curricula, which in recent years has grown in popularity and importance. Recently, we have witnessed an explosion in computer games related degree programmes that usually incorporate a prominent computer graphics component. The convergence of modern entertainment media, which all rely on modern computing hardware, has resulted in computer graphics in film effects and feature animation now using the same or at least very similar techniques to those used in computer games. A similar convergence must follow in computer graphics education, as graduates are likely to find employment working with different media. Too often, however, games degrees tend to simply add a flavour of games and graphics to existing computer science degrees. We believe that a better solution is to design new degrees based on interdisciplinary computer graphics education instead.

In a similar manner, the educational methodology used must reflect the subject being taught. Since it is a necessity for graduates seeking employment in the highly competitive computer games industry to have practical problem solving skills and to be able to take initiative, any games degree programme must cater for these needs. The creative computing group in the Department for Computing and the Digital Environment (CDE) of Coventry University's Faculty for Engineering and Computing (EC) has adopted Activity-Led Learning (ALL) as the educational methodology for meeting this challenge.

Creative Computing in Coventry University's department for Computing and the Digital Environment

The games technology undergraduate degree in CDE evolved from the creative computing degrees in EC. It was designed following an interdisciplinary approach to computer science, developing the students' programming skills, as well as their creative design skills, by teaching concepts from computer science and art and design, transcending the art / science divide. The current academic year (2008/2009) is the first year in which the third level of our games technology degree is running. One of the aims of the third level of the games technology degree is to develop an interdisciplinary culture in the students, integrating a firm grasp of the technical foundations of computer games technology with an understanding of creative design principles and practice. The core aim is to prepare them for a career in the creative industries. To achieve this, students not only take a course in Advanced Games Programming, which focuses on computer graphics and graphics programming, but they also take a course in 3D Modelling and Animation, focusing on the creative and aesthetic aspects of computer graphics.

Advanced Games Programming

The advanced games programming course aims to endow students with practical low and mid-level technical fundamentals and integrative capabilities of necessity for developing and extending games engines, either from the ground up, or through the utilisation and adaptation of pre-existing off-the-shelf libraries and components. This course encapsulates many elements identified with a standard computer graphics course, although their application is not limited to the graphics domain. The course is divided into two conceptual halves. The first half is bottom-up, focusing on fundamental issues of importance for animation, interaction and synthesis of graphical representations. Students implement and investigate low-level techniques by creating interactive visualisations using a graphics API and basic input libraries. This half of the course implicitly illustrates to students through practical means the necessity of adopting a principled approach to implementation, highlighting the purpose of graphics and game engines, which are introduced in the second half of the course. This part of the course, concerned with mid-level techniques extending and integrating into pre-existing graphics engines, is top-down in nature so as to provide students with a broader perspective of the technical aspects of game engine development, allowing them to relate different components and their interactions and interfaces.

3D Modelling and Animation

Knowledge of the mathematical foundations of computer graphics and graphics programming techniques are insufficient for an inclusive interdisciplinary computer graphics education. Games technology students need to gain an understanding of the creative process, its stages and the theories behind it, to allow them to effectively communicate with artists and designers. All games technology students therefore take a course on 3D modelling and animation. The main aim of this practice-based course is to introduce students to the practical skills that are relevant to the creation and subsequent animation of 3D models. Students learn how to create 3D models and environments using a variety of techniques, providing them with an insight of the processes involved in producing content for interactive multimedia applications and computer games. This course is closely linked to the Advanced Games Technology course which reiterates many of the concepts covered in 3D Modelling and Animation from a computer games perspective and also helps students to develop an awareness of the requirements and limitations of current 3D rendering engines and related technologies, which in turn informs their creative practice.

Activity-Led Learning

Activity-Led Learning (ALL) is an educational methodology pioneered at Coventry University. It can be viewed as a generalisation of Problem Based Learning (PBL) [Iqbal et al 2008] and takes a student centred approach to the learning experience, encouraging students to “learn by doing” and therefore to assume responsibility for their student experience. Problem Based Learning is concerned with problem solving “without the traditional lecture and tutorial provision” [Iqbal et al 2008], which has also been a source of criticism of this educational approach [Kirschner et al 2006]. ALL on the other hand is more adaptable, ranging from small tasks to longer projects [Iqbal et al 2008], and thus more suitable to be interleaved with more traditional teaching techniques.

The principles and techniques explored in workshops and exercises are explained in lectures, relating them to real-world problems, as well as the activities that the students are engaged in. These activities are incremental, i.e. they build on one another, progressing from simple problem solutions to more complex digital artefacts, each taking the form of a mini-project and thus allowing the students to build a portfolio of work and construct an integrated demonstration of their capabilities for future presentation to prospective employers. Assessment is conducted by evaluating this portfolio, which provides a relatively accurate reflection of the students' progress over time.

References

[Iqbal et al 2008] Iqbal, R., James, A., Payne, L., Odetayo, M. and Arochena, H. (2008). Moving to Activity-Led-Learning in Computer Science. In Proceedings of iPED 2008

[Kirschner et al 2006] Kirschner, P.A., Sweller, J. And Clark, R.E. (2006). Why Minimal Guidance During Instruction Does Not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching. Educational Psychologist, 41(2), 75–86