Pair Teaching in Computer Graphics

Luciano Soares, Fabio Orfali

Insper, São Paulo, Brazil

Email: lpsoares@insper.edu.br, fabioo1@insper.edu.br

DOI: https://doi.org/10.5281/zenodo.7057769

Abstract

Computer Graphics is a course commonly found on Computer Science and Computer Engineering undergraduate programs. There are some convenient points on teaching computer graphics in these programs: Computer-Generated Imagery in movies and videogames are relevant examples of applied engineering and science that students experience in their lives, and this can be a potential motivation factor for students to get engaged on learning; furthermore, Computer Graphics relies on several fundamental and complex mathematical concepts, that can also be applied in other science areas, being an opportune moment to cover and practice mathematical learning goals, all connected with a base on computer science. Learning Computer Graphics depends on developing and integrating skills on computer science and mathematics, therefore, a learning plan must cover both topics. However, it must be considered that students need to relate these topics, and this is the trick, since ideally professors need the knowledge and pedagogy in both areas. The strategy presented in this document was based on two professors, one mathematician and one computer engineering, planning, and teaching an elective undergraduate course on Computer Graphics. The course was based on active learning strategies by design, heavily focused on Project Based Learning through three projects starting from scratch, each week learning and implementing new features on the projects. Students must program in regular programming languages like Python, C++ and Javascript, and build up their competence in mathematics from basic math concepts. As a result, students were able to develop a scanline renderer, and a ray-tracing renderer without any graphical Application Programming Interface and finally a 3D web application based on ThreeJS. Although students had a perception of a demanding course, they were engaged on proposed activities during all semester, and were able to implement all important features on projects, often above expectation, showing evidence that learning objectives were achieved.

Keywords: Pair Teaching; Computer Graphics Teaching; Mathematics Teaching; Project Based Learning.

1 Introduction

The foundations of Computer Graphics rely heavily on mathematical knowledge. Therefore, the proposal of a Computer Graphics course that is not limited to the mere application of ready-made programming codes requires a plan on how Mathematics will be incorporated into classes. This plan becomes even more important when considering Computer Graphics as an elective course at the end of an engineering program, as mathematics is too much concentrated in the beginning of the program, usually in the first semesters. This is a scenario in which students show less readiness for the application of mathematical concepts in the context of the discipline. As a result, many students may have difficulties with basic mathematical content, such as vector operations.

However, the development of a didactic sequence that resumes the mathematical knowledge required by Computer Graphics may represent a great challenge. As a computer engineer or a computer scientist, this professor may not master the content and/or pedagogy of the mathematical area. Furthermore, a clear understanding of the mathematics track in the undergraduate program, will allow course professors to identify topics of mathematics that were covered in previous semesters of the course, having a better view on what should be reviewed and what could be an entirely new topic for students.

In order to deal with this problem a pair teaching strategy (Andersson & Lars, 2006; Ott & Meek, 2019; Burden, Heldal & Adawi, 2012; Zehetmeier, Bottcher & Brüggemann, 2018) was adopted: two professors of different areas working together throughout the course. It is important to point out that this is not a course split in two parts having professors teaching their topics, professors have discussed and defined learning goals, planned classes and activities, and evaluated projects all together. At first this strategy may appear less efficient since there are two professors at the same time in class, but improvement on learning was very evident.