



## Using Project-Based-Learning in a mobile application development course—An experience report



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### ABSTRACT

In this paper, we report the experience gained in a Mobile Application Development course. We involved students in Computer Science at the University of Salerno, who in teams had to conduct a project. The goal of this project was to design and develop applications (or simply app) for Android-based devices. The adopted teaching approach was based on Project-Based-Learning and enhanced collaboration and competition. Collaboration took place among members of the same team (intra-team), while competition among different teams of students (extra-team). To allow intra-team collaboration, students used GitHub as Computer-Supported-Collaborative-Learning tool. It provided support for implicit and explicit communication among members in each team and for distributed revision control and management of software artifacts (e.g., source code and requirements models). Developed apps underwent a final public competition prized by IT managers of national and international software companies. This is how we implemented extra-team competition. IT managers expressed a positive judgment on both students' competition and developed apps. Also, students provided very good feedback on used teaching approach and support GitHub provided.

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## 1. Introduction

Internet and mobile applications for smart devices are converging. This is manifesting an increasing interest of business users and customers in mobile devices and applications [1]. The effect is that digital enterprises are becoming mobile enterprises also because mobile devices offer a rich set of embedded sensors, such as accelerometer,

digital compass, gyroscope, GPS, microphone and camera. Sensors and internet connectivity allow mobile applications (also simple apps, from here on) to be suitable for a variety of application domains. In this scenario, the role of mobile application developer is one of the most demanded in IT market.<sup>1</sup> Nevertheless, design and development of mobile applications is not an easy task [2]. This kind of developers has to master a wide range of technologies. A good computer skill is also needed to deal with design and development issues. For example, developers need at least knowledge on

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<sup>1</sup> <http://www.itcareerfinder.com/it-careers/mobile-application-developer.html>

programming languages (e.g., Objective C, C++, C or Java), operating systems (e.g., Android and iOS), and so on. For these reasons, many universities decided to enrich their Computer Science program with the competencies related to the design, development, and maintenance of Android mobile applications.

In this paper, we present a teaching experience gained in a Mobile Application Development (MAD) course at the University of Salerno. The main goal was to adopt a Project-Based-Learning approach to foster teamwork and encourage students to explore new ideas in the context of mobile app market. The MAD course was organized in blended learning modality: lectures on the Android operating system were given in presence, while students' projects were remotely conducted. As for projects, students arranged in teams were required to propose applications for smart devices by considering market needs, usefulness, audience, and viability. Once the MAD lecturer had accepted students' proposals, they were asked to design and develop their proposed apps. Collaboration took place among members of the same team (intra-team). Students were asked to use GitHub as Computer-Supported-Collaborative-Learning tool since it provides support for implicit<sup>2</sup> and explicit communication among team members and distributed revision control and management of software artifacts (e.g., source code and requirements models). GitHub is a tool largely adopted in software development areas and recently in education as well [3]. This is why GitHub was used in the MAD course.

The lecturer and two tutors supervised the projects by fixing strict deadline and monitoring their status on GitHub. A distinguished panel of corporate IT managers were asked to judge and give a prize to the three best apps produced during this course. The adopted selection process was based on a team live presentation conducted during a public event organized at the University of Salerno. For each app, IT managers judged its originality, its estimated business value, the pleasantness of user interface, the estimated technical quality, and quality of the team live presentation. This competition among teams of students implemented the second step of our teaching approach: extra-team competition. At the end of the MAD course, we administered a questionnaire to the students. The collected responses allowed us to conduct a qualitative evaluation on student's opinion concerning their learning experience and the used supporting technologies (e.g., GitHub).

The work presented in this paper extends that we reported in [4]. With respect to this work, we provided here the following new contributions: (i) related work has been extended and improved; (ii) feedback from the lecturer perspective has been provided, and (iii) discussion of results has been improved and extended.

*Paper structure:* In Section 2, we discuss background. In particular, we consider the concept of Project-Based Learning and highlight possible technological solutions to support this teaching paradigm. Main issues related to

mobile development for Android framework are also discussed in Section 2. Then, we present our teaching experience in Section 3, while in Section 4 we present the evaluation performed by IT managers and discuss on students' perceptions on their learning experience. Final remarks and future work conclude the paper.

## 2. Background

### 2.1. Project-Based-Learning

Project-Based-Learning (PBL) can be exploited to organize learning around projects [5]. This teaching approach considers both cooperative/collaborative learning [6,7] and constructive learning theories [8], where learners become active constructors of their knowledge. Students exploit PBL to cooperate in solving real problems and accomplishing tasks typical for world of work. It is easy to follow that PBL requires high student involvement. Producing an artifact that is of interest since others can use or view it represents a very motivating factor. It is recognized that motivation can do the difference between success and failure of a learning experience more than any other factor. In this scenario, the lecturer has a less central role and students result to be responsible for their own learning (learner-centered education [9]), while learning is the result of their interaction (learner–learner interaction) [10]. When technology supports this methodology it empowers the capability of engaging learners by providing rapid compelling interaction and feedback.

In the context of Computer Science courses, the adoption of PBL is growing [11,12]. One of the main reason is that it enables to train students in principles, methods, and procedures under conditions similar to those characterizing development in actual software projects [13]. Software product development is the result of team effort requiring both technical- and soft-skills. These skills include the ability to communicate, to work as a team, to partition, assign and monitor the progress of the tasks, and to assume responsibility for making choices. Beside the attention for the coding activity, each project phase also needs the production of documentation satisfying determined standards [12].

A PBL approach based on collaboration and competition has been previously proposed [14]. A framework supports both individual competitive setting and collaboration by means of two interconnected modules: *competition*, which addresses individualized competitive learning by following the logic of UEFA Champions League tournament, and *intergroup competitive setting*, where groups of students compete among them. Individual learning was based on the resolution of programming exercises, while the group work was automatically evaluated.

Regueras et al. [15] experiment collaboration and competition to support learning. Students collaborate in a project consisting in the creation of a Wiki and in preparing questions to be submitted to other students, while they compete to be the quickest in answering questions.

Project-based learning and game theory tournaments have been also combined [16]. Groups of two students

<sup>2</sup> It is a knowledge transfer process based on communication through a shared mental or abstract model.

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