Introducing a Videogame Project in a Mobile Software Development Academic Course

Fabrizio Balducci(✉) and Paolo Buono

Computer Science Department, University of Bari 'A. Moro',
via E. Orabona 4, 70125 Bari, Italy
{fabrizio.balducci,paolo.buono}@uniba.it

Abstract. In the 2020–2021 academic year, the 'videogame design' topic has been introduced in the 'Mobile Software Development' bachelor degree course. Consequently, it has been proposed to students a related project theme in addition to apps oriented towards productivity and mobile services. The *ArkanApp* project concerned the re-design and the introduction of specific features into an *Arkanoid* game clone; the other proposed apps were related to safe meeting organization, documents and project data management and a free-theme app. The exploration of data collected during the main part of the academic year related to student preferences and projects delivery, highlighted how leaving the choice about the theme, as well as the introduction of the videogame one, involved the majority of students to finish the project before the starting of the new course edition. Moreover, it also emerged that *ArkanApp* featured the highest female participation.

Keywords: videogame · education · mobile software

1 Introduction

This paper describes a case study related to the *Mobile Software Development* academic course held in the Computer Science (CS) dept. of the University of Bari 'A. Moro' (Italy). For the final exam assessment, this course requires the delivery of a practical project to be carried out in group and to be discussed in an oral presentation after a written test related to lecture contents. Each group of students has to design and develop an Android mobile app chosen in a pool of different themes and requirements, according to the explained topics.

In the 2020–2021 academic year, the *Mobile Software Development* lectures started in September 2020 and ended in December 2020 featuring 9 exam sessions allocated from January 2021 to May 2022. As the topic regarding videogame design and development was introduced, one of the proposed project theme consisted in a variant of the the 80's arcade game *Arkanoid*[1] where students were

[1] Arkanoid, https://en.wikipedia.org/wiki/Arkanoid, last visit: 2022-05-10.

M. Clayton et al. (Eds.): INTETAIN 2023, LNICST 560, pp. 31–39, 2024.
https://doi.org/10.1007/978-3-031-55722-4_3

asked to re-design and modify some aspects of the game introducing gameplay variations and interactive features; the other themes were 1) Covid-19 safe meeting organization; 2) school document and project management; 3) a free-theme app proposed by a group and approved by the teacher.

To depict how a specific theme like 'videogames' influences academic student preferences, it was decided to collect data about their work organization and timing for deliver the app within the main exam sessions of the academic year, before lectures of the new course edition. The description of a real use case in a CS academic course aims to provide advices on project themes to propose to students, focusing on the introduction of videogames production and design topics with the best mode to propose it to students.

Related works regarding videogame topics in educational institutions are reported in Sect. 2. Section 3 illustrates the proposed project themes while comparisons and considerations coming from student data are depicted in Sect. 4. Conclusions and future work are illustrated in Sect. 5.

2 Related Work

Kurkovsky et al. [7,8] inquire the relationships between mobile games and student interest in CS, considering the game development as a motivational and learning context and supporting such ideas through practical case studies while Boudreaux et al. [5] target handled platforms as the *Game Boy Advance* exposing students to programming environments. The adoption of the videogame topic in American computer science courses is faced in Yue and Shan [16] while Rankin et al. [10] analyzed the effect of game design on student attitudes in attaining a CS degree. In Rodrigues et al. [12] are depicted guidelines adopted in 2010 for the first game development bachelor degree in Portugal, pointing out the importance of project themes that promote entrepreneurship and provide practical professional experiences.

In their work, Wood and Costello [15] perform two analyses on setting, mood and aesthetic data exploiting outcomes coming from five-years of a game design course where student groups developed videogames at school, highlighting their creativity and involvement. It is know that videogames can elicit satisfaction and emotions not only in those who create them but also in people who play such creations [2,3]. Almeida et al. [1] introduce a pilot experiment about computer games creation by primary school students while Doran et al. [6] present a CS course exploiting the *Game Maker* framework for middle school ones. Moreover, the relationship between technology and female students through videogame development is faced in [4] where game design within the *Coding4Girls* project is considered as a method to addresses equal opportunities in CS professions regardless gender or background.

Aspects relating to an industry-academia alliance for game development are in [14] and in [9] in which is described an educational curriculum created by the International Game Developers Association (IDGA); in the work of Sato et al. [13] there is the proposition of the TRIAD education model which sees together contributions from academy and industry. Finally, Restrepo and

Figueroa [11] propose a videogame development curriculum in Colombia with a postgraduate program that aims to respond industry needs and reach a wide audience through a blended learning model.

3 Project Themes

Mobile Software Development is a fundamental course (86 lecture hours) held in the third year at the first semester of the *Computer Science and Software Development Technologies* Bachelor Degree. The main topics covered in this course are the Android Studio IDE, the Android framework with the Operating System architecture, app components, sensors and connectivity managements, graphic features, data persistence and Material Design guidelines for interaction and User eXperience. In the 2020–2021 academic year the *Transmedia products* and *Videogame design and development* topics, specifically declined for the mobile environment, have been added.

The third year is the final one of the bachelor degree and students had already faced courses like *Database Design*, *Computer Networks*, *Software Engineering*, *Object-Oriented Programming*, *Operating Systems and Computer Organization*; in this way they have all the necessary knowledge to develop a complete app exploiting the Android Studio IDE. The exam assessment consists of: a) written test about the theoretic part of the course, accessed after the delivery of a complete app (created in a group ranging from 3 to 4 members), and b) oral presentation, in which each student explains the part of the project he dealt with, answering any question and doubt of the teacher.

In the 2020–2021 the following themes have been proposed:

- *ArkanApp*: a variant of the japanese *Arkanoid* (1986) videogame created by Taito[2]. Since the Android documentation and repositories contains many exercises and working examples, to balance the difficulty of those who start from scratch with this topic a game template has been provided through a github project[3].
  It must be noticed that it only contains a fixed screen with four brick rows and a paddle that moves through the accelerometer, very far from what is required for the exam delivery that is: 1) a navigation structure with panels (splash-screen, menus, options section, ..); 2) at least one multiplayer mode (asynchronous, cooperative, massive, local, ..); 3) game editor that allows to save and load the creations; 4) at least one gameplay variant (behaviours, events, ...) and almost a power-up; 5) at least one alternative control system (touch, slider, virtual gamepad, ..); 6) difficulty modes (in addition to the default one related to the ball speed); 7) leaderboard that allows sharing scores with external services through connectivity (Bluetooth, WiFi, Internet); 8) audio and music features (absent in the template); 9) new graphics (open source collections allowed).

[2] Taito corporation, https://www.taito.co.jp/en/, last visit: 2022-05-10.
[3] Arkanoid github, https://github.com/Ludovit-Laca/Arkanoid-android-game, last visit: 2022-05-10.

- *ManagerApp*: a social network-like app that allows to organize, consult and promote student projects, sharing heterogeneous materials (also by their teachers) that accumulates year after year and that can be managed at different levels. The app must allow the following: 1) advanced user profiles management (guest, teacher, developer, group, ..) each with specific functions (registration, projects creation, upload or download materials, ..); 2) groups management (by people, exams, grades, ..); 3) permissions management; 4) projects evaluations and reviews; 5) search modes; 6) sharing of information with personalized communications and posts (screenshots, text, ..) through external services and apps.
- *ContagionApp*: similar to the tracking apps used by governs in the COVID-19 pandemic outbreak, it exploits inter-personal dynamics to provide and verify health statuses and allow to securely organize meetings and events using a dynamic health score. The app must offer the following: 1) manage user profiles (single person or a group); 2) provide and verify the health status i.e. a dynamic score assigned by the system, depending on events and meetings attended and on official communications (like a Covid-19 test online notification); 3) meetings management where participants can be accepted as single or group by an organizer, depending on the suggestion provided by the app and related to a 'risk score'; 4)communication between devices through connectivity to a) check the user status (for privacy the information are not visible to other people) and b) real-time communication about risky encounters.
- *FreeChoiceApp*: a group can propose its own idea taking into account the originality, the relevance and its feasibility, following the requirements and instructions given by the teacher; if not well-motivated the proposal can be rejected or modified.

Regardless of the chosen project all groups must meet specific delivery requirements, in fact the app must be developed through the Android Studio IDE and no external tools or frameworks are allowed; it is possible to call services like server-side databases, Google Play and localization services as long as they are transparently documented. The aim is to replicate the business pipeline of a company that has to design, develop, test and promote a software product

Fig. 1. Examples of app icons delivered for the evaluation of ArkanApp, ManagerApp, ContagionApp and FreeChoiceApp projects.

Fig. 2. Examples of material for the project evaluation: flyers with advertising taglines for ArkanApp, ManagerApp, ContagionApp and FreeChoiceApp.

into an app store and so, the materials required for the exam assessment aim to simulate the *Play Store* publication:

- Android Studio project (code, resources, libraries, data, external services) where the code must be self-explanatory, commented and organized in an intuitive and orderly way;
- the design document for the app *Product Icon* (Fig. 1), following the Material Design guidelines and explaining motivation, colors, approach, meaning and inspirations also through hand-drawing and sketches;
- user manual that describes the app features;
- absent or limited connectivity management, providing appropriate feedback and alternatives;
- at least two type of users (guest, paying, ...);
- multilingual features;
- a flyer featuring advertising taglines (Fig. 2) that would be distributed in conventions, social events or a website;
- screenshots showing peculiar aspects of the app;
- short video (2 to 4 min) about significant interactive session of the app, optionally with editing, graphic and sound effects (trailer);
- signed release APK file.

In Fig. 3 there are screenshots coming from some of the projects delivered by the groups, featuring two examples for each of the four themes: starting from the top-left there are ArkanApp and ManagerApp images, followed in the bottom row by ContagionApp and FreeChoiceApp respectively. From such screens emerges how students introduced peculiar features regarding user interface, graphics, visual organization, style and colors, for example the ArkanApp images show a boss fight and a space environment while the ContagionApp images features symbols related to Covid-19 and medical recommendations.

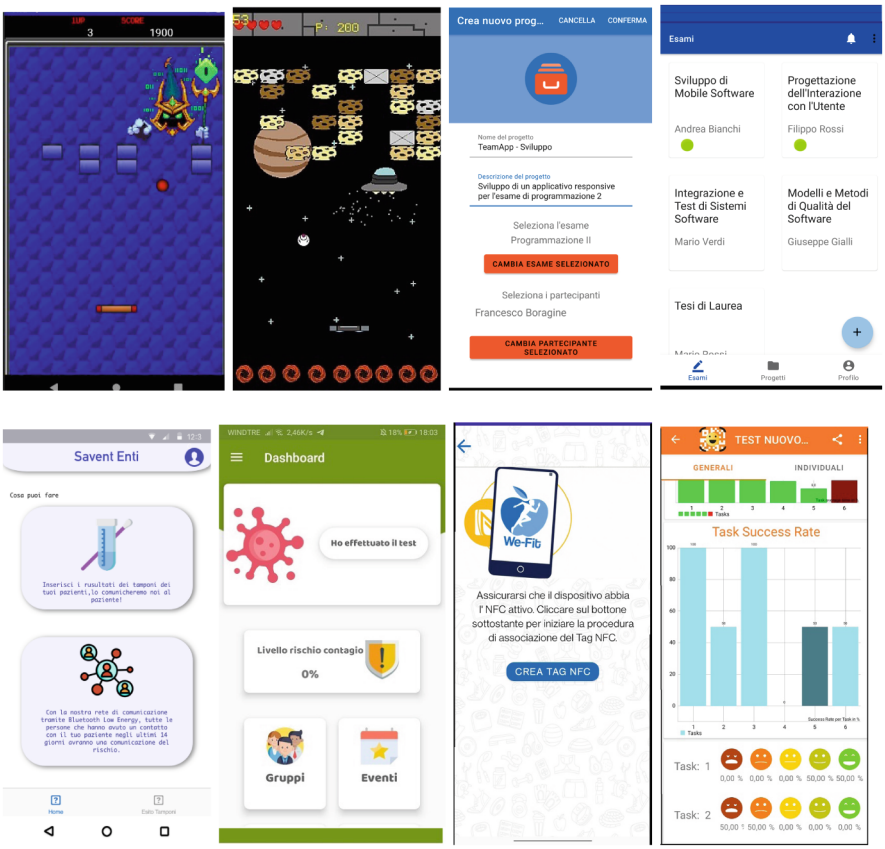

Fig. 3. Screenshots from delivered projects: by the top-left there are two images for each ArkanApp, ManagerApp, ContagionApp and FreeChoiceApp.

4 Projects Exploration

At May 2022 the academic year related to the 2020–2021 course can be considered concluded, in fact the four months of lectures and laboratory activities started in September 2020 have been followed by 9 exam sessions scheduled as: three between January and February 2021, one at May and July 2021, two in September 2021, one at November 2021 and between April an May 2022.

In Table 1 are collected information regarding the 2020–2021 assigned projects but where the 'Delivered Projects' and 'Involved Students' metrics are specific for those between January and July 2021; this time interval in fact, represents half of the time period to complete the exam and contains 5 of the total exam sessions; since in September lectures for the new academic year will start again, this interval can be considered as the reference one for the evaluation of

Table 1. Data about the projects of the main five 2020–2021 exam sessions ('F' means Female gender). All data have been collected at July 2021.

	ArkanApp	ManagerApp	ContagionApp	FreeChoiceApp
Scheduled Groups	17	12	5	6
Scheduled Students	62 (F:9)	42 (F:7)	17 (F:1)	22 (F:3)
Delivered Projects	9 (52.9%)	6 (50%)	2 (40%)	5 (83.3%)
Involved Students	37 (59.7%, F:7)	20 (47.6%, F:3)	8 (47%, F:0)	19 (86.4%, F:2)

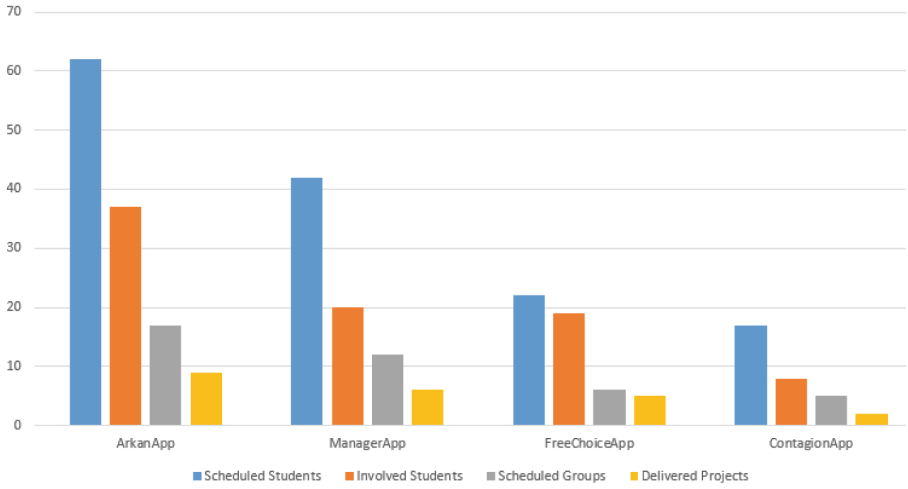

Fig. 4. Comparison of the four project themes where the 'Delivered Projects and 'Involved Students' refer to the main 5 exam sessions (January 2021-July 2021).

the delivery time goodness. It is important to underline that all the Scheduled Groups delivered their projects over time (there were no dropouts).

Scheduled Groups are considered those who sent the registration email indicating the chosen project and the participants list. It can be noticed that there have been 40 scheduled groups (for a total of 143 involved students) and their main preference (17 groups) was ArkanApp i.e. the project themes related to videogames; the others in fact were chosen from a number of groups less than or equal to 2/3 of the preferred one.

Considering the *Scheduled Students*, the majority (62) worked on ArkanApp and this project turns out to be the favorite by female members, confirming that nowadays the interest in videogames no longer knows gender limits. Unfortunately, it can be noticed that the female component is very limited (14%) within the overall course.

The *Delivered Projects* (i.e. scheduled, delivered and evaluated by July 2021) were 22 of which FreeChoiceApp and ArkanApp achieved the highest percentage in relation to their scheduled groups (83.33% and 52.94%) while, in

absolute numbers, the latter represents the greatest delivery volume (9 vs. 5 groups). About the *Involved Students* in the Delivered Projects at July 2021, it is confirmed what seen before with the majority of students belonging to the videogame project (37 vs. 20 of ManagerApp vs. 19 of FreeChoiceApp).

In Fig. 4 are compared the data depicted in Table 1. It can be observed how ArkanApp presents the highest values for the four metrics i.e. related to groups who have chosen and delivered this project and to the related enrolled people.

5 Conclusion and Future Work

The aim of this work is to provide insights on student interests and preferences when choosing projects in a CS academic course, with an overview about impacts that a theme focused on videogames can have on their involvement. Data recovered from the 2020–2021 academic year showed the preference was for ArkanApp, that, among the four themes, involved the largest number of groups, students and females with the highest delivery rate in the first 5 exam sessions.

It can be observed how the introduction of videogame development in a specific course such as *Mobile Software Development* and in the mode of a git project to be modified and extended, has captured the preference and interest of the greatest number of people. These ArkanApp iterations can be adapted into mini-games to be offered in a larger app, such as one dedicated to museums and Cultural Heritage. During an interaction started in a CH site via IoT beacons or QR codes framed by the visitor, in fact, graphics and interactive elements can be customized to the place of interest involving the player in capturing cultural artifacts moving on the screen or simulating historical events exploiting specific tools (arrows, cannons, ships, ropes, ..) instead of the actual bouncing ball.

Finally, future work will exploit the delivered materials to carry out different assessments, providing qualitative explorations and evaluation like the comparison of features and improvements introduced by the groups on the same videogame template; it will help to understand how much the creation of interactive software brings out CS students' creativity.

Acknowledgments. F. Balducci thanks the students of the 2020–2021 'Mobile Software Development' course and acknowledges the support by the REsearch For INnovation (REFIN) grant, CUP:H94I20000410008 cod.F517D521 POR Puglia FESR FSE 2014-2020 "Gestione di oggetti intelligenti per migliorare le esperienze di visita di siti di interesse culturale".

References

1. Almeida, R., Gomes, A., Bigotte, M.E., Pessoa, T.: iprog: getting started with programming: pilot experiment in two elementary schools. In: 2017 International Symposium on Computers in Education (SIIE), pp. 1–5 (2017)
2. Balducci, F., Grana, C.: Affective classification of gaming activities coming from rpg gaming sessions. In: Tian, F., Gatzidis, C., El Rhalibi, A., Tang, W., Charles, F. (eds.) E-Learning and Games, pp. 93–100. Springer, Cham (2017)

3. Balducci, F., Grana, C., Cucchiara, R.: Classification of affective data to evaluate the level design in a role-playing videogame. In: 2015 7th International Conference on Games and Virtual Worlds for Serious Applications (VS-Games), pp. 1–8 (2015)
4. Bevčič, M., Rugelj, J.: Game design based learning of programming for girls. In: 2020 43rd International Convention on Information, Communication and Electronic Technology, pp. 576–580 (2020)
5. Boudreaux, H., Etheredge, J., Roden, T.: Adding handheld game programming to a computer science curriculum. In: Proceedings of the 3rd International Conference on Game Development in Computer Science Education, pp. 16–20. GDCSE '08, Association for Computing Machinery, New York, NY, USA (2008)
6. Doran, K., Boyce, A., Finkelstein, S., Barnes, T.: Outreach for improved student performance: a game design and development curriculum. In: Proceedings of the 17th ACM Annual Conference on Innovation and Technology in Computer Science Education, pp. 209–214. ITiCSE '12, ACM, New York, NY, USA (2012)
7. Kurkovsky, S.: Can mobile game development foster student interest in computer science? In: 2009 Int. IEEE Consumer Electronics Society's Games Innovations Conference, pp. 92–100 (2009)
8. Kurkovsky, S.: Engaging students through mobile game development. In: Proceedings of the 40th ACM Technical Symposium on Computer Science Education, pp. 44–48. SIGCSE '09, Association for Computing Machinery (2009)
9. Mikami, K., et al.: Construction trial of a practical education curriculum for game development by industry/university collaboration. In: ACM SIGGRAPH ASIA 2009 Educators Program. SIGGRAPH ASIA '09, ACM (2009)
10. Rankin, Y., Gooch, A., Gooch, B.: The impact of game design on students' interest in cs. In: Proceedings of the 3rd International Conference on Game Development in Computer Science Education, pp. 31–35. GDCSE '08, ACM (2008)
11. Restrepo, A.M., Figueroa, P.: Designing a blended learning curriculum in the development of video games. In: 2014 IEEE Frontiers in Education Conference (FIE) Proceedings, pp. 1–3 (2014)
12. Rodrigues, N.F., Simões, R., Vilaça, J.L.: A digital game development education project. In: 2nd International Conference on Games and Virtual Worlds for Serious Applications, pp. 79–82 (2010)
13. Sato, Y., Hanaoka, H., Engström, H., Kurabayashi, S.: An education model for game development by a swedish-japanese industry-academia alliance. In: 2020 IEEE Conference on Games (CoG), pp. 328–335 (2020)
14. Stephenson, B., James, M., Brooke, N., Aycock, J.: An industrial partnership game development capstone course. In: Proceedings of the 17th Annual Conference on Information Technology Education, pp. 136–141. SIGITE '16, ACM (2016)
15. Wood, Z.J., Lovaglio Costello, E.: Not so different games: an exploration of five years of student game designers. In: IEEE Conference on Games (CoG), pp. 1–8 (2019)
16. Yue, Q., Shan, W.: Analyse of american academic game courses in computer science education and guidance for domestic universities. In: Int. Conf. on E-Health Networking Digital Ecosystems and Technologies (EDT). vol. 2, pp. 164–167 (2010)