Interactive Web-Based Programming through Game-Based Methodologies

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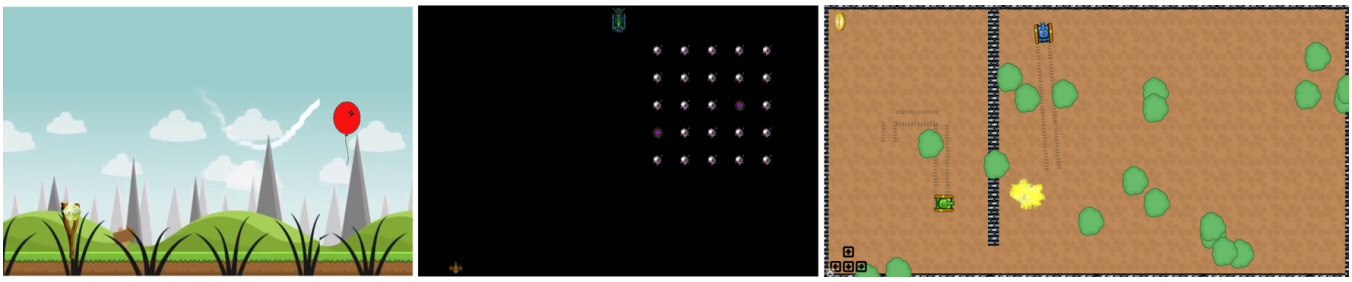

Figure 1: Example retro game projects students are able to experiment with as they progress through the course on web programming (spring board projects). From left to right: Sprout Catapult, Asteroids and Tanks.

ABSTRACT

The way we engage and communicate with students has rapidly changed over the past decade due to technological advancements. This is most noticeable in web-based subjects with the advent of smart-phones, web-based apps, web-streaming and of course social media. Students who learn and develop for web-based environments must be able to adapt and retrain constantly, not to mention, have both a technical and creative mindsets. This article presents the insights for integrating interactive digital solutions and game-based development into a web-programming curriculum (to enhance students' abilities and the learning experience). The approach both supports and encourages students on multiple levels, while nurturing experimental design and stretch goals.

CCS CONCEPTS

• **Human-centered computing** → Interaction design.

KEYWORDS

Games, Education, Interactive Interfaces, Web Technologies

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1 INTRODUCTION

The article examines the integration of game-based concepts into a technical curriculum to improve engagement and motivation by capitalizing on the strengths of playful learning. While it is said that playing video games makes people more creative [Moffat et al. 2017], we expand upon this creative mindset to encourage students to go above and beyond in their studies. Students find the gaming and social aspect of the approach both fun and challenging. For example, students who spent a large amount of time playing games, would instead spend a large amount of time working on their own game for the coursework (impacted attitude, mindset and engagement with the subject).

Why Games? The literature is scattered with information on the benefits of games and learning [Barnes et al. 2008; Kenwright 2016] (e.g., motivation, engagement and knowledge retention). The gaming element introduced a temporary heightened state of creativity which fed through into the students work (helping them to be more confident and engaged with the material). This includes, a change in attitude (to go above and beyond by trying to bring their ideas and concepts to life). The game-play aspect resulted in students having to constantly interact with the material and each other (communication and social skills). This led to students being more motivated and helped with developing and improving their abilities (impacting the student attitude towards learning). Ultimately this produced a module with students giving increased effort while having improved performance and heightened knowledge of the subject (i.e., conceptual knowledge, retention, practical and task completion) [Kenwright 2017; Sitzmann 2011].

2 WEB TECHNOLOGIES MODULE

Web technologies is a challenging, important and rapidly changing subject (students who graduate need experience in adapting to new libraries and tools). Students need to be able to keep themselves up to date, to retrain and adapt to different environments and tools.

Web-bases solutions are changing in a number of ways, such as, becoming more visual, dynamic and interactive [Schimmel et al. 2010]. The **web module is not just about 'programming'** but also about designing, managing, interacting and assessing the viability of different web-technologies (while identifying new trends and practices). This includes thinking about the user experience, back-end performance and even security aspects.

Open Source/Creative Commons. All of the module material was created to be open source and is freely shared under the creative commons license on GitHub (https://f28wp.github.io). The material (e.g., slides, labs and demos) are easily accessible (to search, download or review) and can be used in the classrooms (e.g., in discussion sessions or for a more formal lecture-based structure). The online solution meant multiple instructors could be involved in the development of the material (as new approaches and innovations were developed). Make it less problematic to update/access regularly. While the overall approach is not necessarily novel, the module and assessment bring together various important and interesting solutions. The material has shown promising feedback from students (both academics and students enjoyed the module). The material is freely available and could be easily customized and imported into other classroom modules/assignments (to reap similar benefits). Important aspects of the module/assessment are:

- Free, creative commons (open source) to encourage good practices (version control, team work, complex problem, interactive system, security, usability, optimization, platforms, interfaces (graphics), ...)
- Nurture creative freedom and problem solving abilities
- Multi-player/multi-user system
- Experimental design of interfaces and usability
- Lecture material was designed to use interactive slides (embedded demos, live coding, videos)

Details/Results (Practice). The web module was run in 2019-2020 and had the prerequisites that students have basic programming abilities (with exposure to HTML and CSS). The module could be taken by both undergraduate and postgraduate students. The class size for 2019 was 120+ students (30+ groups) for the game-based coursework. The group-size for the coursework was between 3-5 people (students could pick their own teams). The assessment was 50% for the game-based coursework and 50% for the exam. The direct contact hours timetabled was two lectures (both discussion, tutorials or formal presentation of material) and a lab session. Note students could access labs throughout the semester (self-study/manage their project and time). The module ran over 12 weeks with a generally high attendance and class engagement. The feedback pointed out that the student survey noted the 'creative freedom' and the opportunity to work on a fun and exciting project. However, it was stressed multiple times throughout the module by students, that it was difficult and challenging for them to manage their time commitments, workload, team member task/skills (weak/strong students) and team-interaction/dynamics. The coursework components included: Team work (group dynamics, different skillsets and time management), Networking (client-server), Conform to open source working practices (managed online/GitHub), Over sufficiently long amount of time (12 weeks), Take into consideration, usability, scalable solution, security, multi-user interaction and cross-platform resources.

Limitations. Students had to be reminded to be realistic in their goals (as some designs and plans while overly ambition required too much time-comittment - students had other modules/courseworks). It would not be possible to develop a state of the art triple-A game title during the allocated time. Students also had to be reminded of the 'marking critera' - as the final deliverable was not just about the visual elements and gameplay (had to show knowledge and skills in managing data, security, interface, backend development, usability and more).

3 DISCUSSION

The web Programming module discussed in this paper, shows that integrating gaming activities into a coursework problem adds a fun and playful aspect to the topic. The labs and assessments are open-ended to nurture deep learning in a fun and inviting way and encourage students to explore and play with the material (seek out answers on their own). Web programming is an important and valuable subject to a variety of curricula (e.g., data visualization, e-commerce, computer science, engineering, computer graphics and more). The topic is both open source and cross-platform, not to mention, independent of any non-standard libraries or languages. The game coursework presented has multiple levels of engagement, that all students are able to take part in (e.g., visual, interactive or technical areas) which supports students of all levels and abilities (weaker students are supported while stronger students are able to reach 'stretch goals').

The web programming course [Kenwright 2020] and assessment is easy to follow and adopt (including a wide variety of materials like support notes, crosswords, springboard game demos, code samples, data files, example solutions and other ancillary materials). Many students found the course and coursework both interesting and thought-provoking. Due to the flexibility and structure of the project, it allows students to innovate, which ultimately feeds back to the academics on the course - so they're able to provide future updates and improvements (inspiring and fuelling subsequent students in the following years).

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