Online gamification devices as extensions of the educational printed book

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Innovative impact

In recent years there have been several commercial products designated as "augmented books". These use gamification and augmented reality technologies to provide the reader with more layers of information, thereby fostering the use of the book in new ways. So, in this article we describe part of the research and outcomes of the Portuguese project CHIC – C3, aimed at designing and developing a platform for managing the production of digital content connected with printed books. Furthermore, we developed a model for the gamification of digital content based on the printed book, mainly aimed at educational purposes. A proof of concept for the model was built in the form of a companion platform, supported by the Moodle LMS, fully integrated with the main CHIC website. Readers were able to access the platform, engage in several content related games, and interact with other readers.

Introduction

Despite the significant increase in the use of digital devices and the access to e-books by younger ages, mainly explained by the diffusion of tablets, the printed book still remains very important. Even for parents who prefer digital books for themselves, printed books remain the objects of choice for their children (Richtel and Bosman, 2011).

Nowadays, although many communication processes and information exchanges have a digital support, it is acknowledged the importance of using printed paper in many contexts. Digital media integrate with audiovisual and interactive resources, and also with the paper book, as underlined by Jürgen Steimle (2012), emphasising interactions such as tactile and kinesthetic feedback given to both hands.

The use of augmented reality (AR) technologies in the context of the printed book has also been arousing an enormous interest both from academia and publishers (Azuma, 1997). In recent years there have been several commercial products in the area of "augmented books" (e.g., *The Little Mermaid*; *Storybooks alive*; *Popar*), that is, books that use AR technologies to provide the reader with more layers of information, thereby fostering the use of the book in new ways.

Education in general, like any other human activity, has not been immune to the phenomenon of the "Internet of Things" (Gómez, Huete, Hoyos, Perez, & Grigori, 2013). The ubiquitous learning potential is reflected in increasing access to learning from collaborative learning environments and content supported by computers anytime and anywhere. It also allows for the right combination of physical and virtual spaces (Hürst & van Wezel, 2012).

In this concept paper we describe part of the research and outcomes of project CHIC – C3, a project financed by the Portuguese Programme Compete 2020. The project aimed to design and develop a platform for managing the production of digital content connected with printed books. From this perspective, the book is not anymore considered as being just made of plain paper, but something that can be enhanced and become "alive" in terms of end-user experience. Mainly through the use of AR technology and a gamification platform, the project developed ways to enhance and extend the traditional book. In this paper we will discuss and report on the latter component, namely, the development of

gamification and digital content based on the printed book, mainly for educational purposes, supported by the Moodle learning management system.

A gamification model for augmented books

Gamification is a relatively new concept that has acquired considerable momentum over the last years. It is a concept that integrates the mechanics of gaming in non-game activities to make these more effective and enjoyable (Bidarra, Figueiredo & Natálio, 2015). When used in the educational field, gamification seeks to integrate game dynamics and game mechanics into learning activities, for example, using tests, quizzes, exercises, badges, etc., in order to increase intrinsic motivation and foster student participation.

In order to develop a useful model, we built a learning environment based on the Moodle platform[1]. This is an open source learning management system with a huge user base around the world, and is widely used for distance learning. Founded on a social constructivist perspective, it is in fact a flexible enough system, to allow for the implementation of various pedagogical models (Pereira et al., 2008).

The main platform of the CHIC C3 project allowed for the creation of an "augmented" book and its connection via external interfaces to devices such as the Moodle platform. In this sense, the structure for the platform included the following modules:

- Users - provides user-type management features;

- Permissions Control - responsible for assigning permissions to various user types;

- Notifications and internal communication - provides functions of communication and internal collaboration, fundamental for a collaborative platform;

- Content Management - responsible for the storage, organization and availability of the content;

- Connection with Moodle - responsible for integrating and exchanging data with Moodle platform;

- Collaborative book project - this module provides all the collaborative and interactive authoring features for the "augmented" book;

- Web2Print - for digital printing of the book via Web;

- External API - the external API with a set of endpoints to enable the contact and transfer of relevant data, content, and information between the platform and external devices to extend the use of the traditional book (e.g.: Mobile devices and others that may arise in the future);

- Purchase - to manage the functionalities of purchase orders, payments and content subscriptions;

- Hybrid experiments - to manage the events of external devices.

The platform was integrated with external systems such as Moodle in order to provide specialized functionalities such as transmedia content, gamification strategies, interaction through augmented reality and context dependent, etc. The creation of communities around the book and the deployment of gamification and transmedia materials was done through Moodle.

The main goal to attain, with the gamification tools in Moodle, was the application of elements present in video games to other activities outside the usual contexts and with educational purpose, namely:

- Comply with rules;

- Establish clear objectives and reward achievements through scoring systems or trophies (reward and return system);

- Launch interesting challenges;

- Develop the action according to difficulty levels in order to stimulate performances and promote the creation of plots/narratives and avatars.

Moodle has been proved a suitable platform for engaging students in learning activities through gamification features (Hasan et al., 2019), and for our goals, these plugins were included:

- H5P[2], providing rich interactive content types, including gamified activities:

  o Multiple Choice quiz;

  o Find the Words puzzle;

  o Drag & Drop;

- Game[3] plugin, with several game types, of which we used one for crossword puzzles;

- Level Up!, a block for tracking and displaying experience points (XP) and levels;

- Ranking table, to show a score board of students according to their achievements.

To further integrate information on the several platforms, we made use of the Moodle web service facilities to publish an API that provides data to be displayed in the CHIC C3 main portal.

For this purpose, web services in Moodle were activated. For some of the functionalities (e.g. displaying available courses), Moodle already provides core functions to accommodate those needs. Other functions needed to be implemented as plugin web services, using templates and standard Moodle programming directives.

As users register in the main portal, they can navigate to the Moodle platform without having to register or login again. Single sign-on is achieved through a mechanism based on the OAuth2 protocol, that Moodle fully supports, and an external federated authentication server.

In this way, we demonstrated a new, seamless way to develop a narrative on multiple platforms, increasing the learning and involvement of the potential user. This also helped achieve the integration of the traditional book into a universe of a transmedia narrative.

Conclusion

The increasing availability and use of books in the digital form has not replaced the printed form. Instead of viewing digital technologies as an alternative to a physical book we proposed a model for enhancing the experience of reading printed books, integrating digital content and activities that complement the actual reading.

The proposed model was based on basic principles of gamification and included online activities with challenges, complying with game rules, and establishing clear objectives and achievement rewards through a score board. The (inter)action was developed according to levels of difficulty in order to stimulate performances and promote the creation of narratives.

Through the use of Moodle and some of its gamification extensions (plugins), we were able to successfully integrate a digital dimension complementing physical books, for the benefit of the end user. Technically, the integration was achieved through the federated authentication of users, allowing them to login and navigate seamlessly among the various platforms, and a web service API for exchanging information on games and interaction in the Moodle platform,

further adding to the sense of seamless interaction with a single system.

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