An Authoring Tool to Engage Younger Audiences in the Development of Nature Preservation Games: The G4N Toolkit to Game Design

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Abstract. Although research indicates that integrating students as active agents in the development of games encourages awareness and learning by doing and can be seen as a basis for the development of critical thinking skills, it also stresses that there are some obstacles in involving students to explore educational contents through digital game design. This paper introduces the Gamers4Nature toolkit to Game Design and its use by upper-secondary (N = 53) and undergraduate (N = 114) students along several game design sessions addressing an environmental preservation theme. As result of these sessions, 66 prototypes of digital games were produced. The toolkit was used through questionnaires applied by the end of the game design sessions. Results indicate that the Toolkit was a very useful resource in scaffolding the narrative construction process and that its resources are adequate to be used by for both upper-secondary and undergraduate students, and that it can be seen as a valuable resource to support educators and trainers in educational and serious game design activities.

Keywords: Game design toolkit · Methodology · Authoring tool · Environmental awareness · Serious games · Digital games

1 Introduction

Integrating students as active agents in the development of games enhances and encourages awareness and learning by doing, promotes collaboration and the exchange of ideas, and can be seen as a basis for the development of critical thinking skills [1, 2]. Nevertheless, research also stresses that there are some obstacles in involving students to explore educational contents through digital game design [3, 4]. Aware of the difficulties faced by teachers and students when engaging in design game-creation-based learning approaches, the Gamers4Nature project developed a Toolkit to Game Design, to be used by individuals with and without experience and previous knowledge in the game design field to develop digital games able to foster positive behaviour changes towards the environment. The Toolkit was used by upper-secondary and undergraduate students (N = 167) throughout several game narrative design sessions. This paper presents the results of these sessions to evaluate its potential as a tool able to support educators and trainers in the design of activities aiming to engage students in the creation of their own digital

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games for learning. Following this introduction, Sect. 2 presents an overview of the use of games in the educational field and presents toolkits developed to support game creation activities. Section 3 introduces the Gamers4Nature Toolkit to Game Design validation process and its main results. The paper ends with considerations and potential paths for future research (Sect. 4).

2 Creating Games for Environmental Education

As research on the use of games designed to foster awareness for nature's conservation indicates an increase on biodiversity-related knowledge and student's motivation [5], and an improvement on understanding of the practical challenges of environmental sustainability [2, 6], a somewhat complementary approach based on challenging students to create their own games for learning indicates outcomes related with an enhancement on awareness and learning by doing, a promotion of collaboration and development of critical thinking skills [2, 4], and the development of digital literacy skills [7, 8]. Nevertheless, this new approach of games in education also stresses that designing a game able to provide motivated engagement can be a challenging task: low or undeveloped programming skills and low interest in the educational subject [4], a focus on storytelling and character development and a disregard to content integration and gameplay mechanics [9, 10] are pointed out as some obstacles on involving students in exploring educational contents through game design.

2.1 Authoring Tools to Support the Game Creation Process

Challenging students to design games for learning requires teachers an additional effort, as there is the need to provide students the tools and techniques that can help them complete a task whose outcome will be both pedagogical and playful in nature. Toolkits, because of its problem-solving features and support materials and resources, are considered as powerful tools able to transmit valuable insights about the production of interactive artefacts, allowing faster prototyping and supporting creative design [11]. Often developed and adopted in the Human-Computer Interaction field, toolkits are used as tools to support and influence interactive systems' design and implementation [12], emerging as a useful resource to be used in: the conceptual and methodological definition of games (e.g. [13, 14]); game ideation and/or brainstorming activities (e.g. [15, 16]); game narrative creation activities (e.g. [17–19]); and game implementation activities (e.g. [13, 20]) either by game design experts or by users with no relevant experience in the game design field.

3 Use of the Gamers4Nature Toolkit to Game Design

3.1 Background

The Gamers4Nature (G4N) project aims to develop and operationalize a set of strategies that encourage younger audiences (i.e. upper-secondary and undergraduate students) in game creation activities, while promoting knowledge about environmental preservation

and biodiversity conservation. One of these strategies is the promotion of Game Creation Sessions addressing an environmental related theme, with participants being challenged to create the prototype of a nature-related game. It was the project's premise that, in order to create the game, participants would have to access and explore information on the problem and thus enhancing greater knowledge on the addressed subject. In order to support the game creation process, the G4N project developed a Toolkit to Game Design to be used by individuals with and without experience and previous knowledge in the game design field. The Toolkit (Fig. 1) comprises several resources designed to support and encourage the participation of young public in the development of mobile games, while giving them curated information about specific environmental themes. It is composed of a game construction cards set with 12 cards each one addressing a different game element (e.g. players, objectives, rules, story); a rapid game design document, presenting a path to explore the cards; sets of 20 thematic cards addressing environmental awareness themes (e.g. microplastic pollution, endangered species, invasive species); and a set of 27 cards presenting guidelines to be followed when developing mobile games interfaces.

Fig. 1. G4N toolkit to game design

All resources were developed following a User-Centered Design approach, with experts in the game design field and potential users (i.e. undergraduate and upper-secondary students with and without experience in the game design field) being involved in the design and validation process.

3.2 Method

The G4N Toolkit to game design was used by upper-secondary students (n = 53) and undergraduate students (n = 114) with and without experience in creating games, throughout different game narrative design sessions: 2 one-day sessions; 2 two-days sessions; 2 long-term (one month) sessions and one 72 h online Game Jam. Although all students already had basic programming skills, none had specific knowledge about game design. Sessions took place from December 2019 to January 2021, and as result of these sessions 66 digital games prototypes were produced.

3.3 Results: Environmental Awareness Games

As result of the game design sessions 66 prototypes of playable digital games were produced, with several programing languages and applications being used for the game implementation: MIT App Inventor and Scratch were used by upper-secondary students, while undergraduate students used web-based games and javascript. Games' analysis revealed that the environmental awareness theme was incorporated in the game narrative, not only in characters but also along the game's story, goals and outcomes. Several games also included quizzes with questions addressing the environmental related theme. Games were analyzed by the project's research team, with several dimensions being addressed: game narrative, compliance with the theme, gameplay, graphic consistency, relation between game and game narrative. All games addressed the environmental theme either through characters or through the game story, and specific information about the theme (e.g. how microplastics are produced) was given through dialogues between characters and short quizzes or game cutouts scenes (e.g. "do you know that microplastics can be released from your clothes through washing?").

3.4 Toolkit's Contribution in Supporting the Game Development Process

Aiming to access the toolkit's contribute along the game narrative construction process, a short questionnaire was applied to all participants (N = 167) by the end of the several game design sessions. Asked to give their opinion about the Toolkit's contribution for the game narrative construction process, 80% of the participants considered that the toolkit helped to organizing ideas, 75% that it eased the narrative construction process and 73% that it helped to understand how to build a game. Only 19% considered that using the toolkit to support the game narrative process limited creativity. When asked to give their opinion about the G4N toolkit's different resources, 78% considered that texts presented in the cards and in the rapid game design document were clear, and 74% considered that the questions provided on the front of the cards helped to understand the concepts. Nevertheless, 23% considered that too much information was presented in the Toolkit's resources, and 15% considered that in order to understand the cards, previous knowledge was needed. Finally, and in what concerns participant's overall opinion about the toolkit, 75% of the participants considered that the toolkit was useful in the process of designing a game, 72% considered that its format was easy to use and 71% considered that it provided a good experience when designing the game.

4 Conclusions and Future Work

This paper describes the use of the G4N Toolkit to Game Design by 167 students in several game design sessions, where they were challenged to design and implement digital (serious) games related addressing an environmental theme using the Toolkit. The analysis of the 66 produced games evidences the compliance with the nature-related theme and the inclusion of specific scientific information about the addressed theme. It also indicates that there was a concern to not only comply with the theme but also to provide a good game experience for future players, as gameplay mechanics were

carefully integrated in the game and there was the concern to create an engaging game narrative. As for the G4N Toolkit's capability to support the game creation process, results indicate that it can be considered as a useful and valuable resource to support the narrative construction process, either by upper-secondary and undergraduate students. Overall, participants considered that the Toolkit was useful in the process of designing a game, that its format was easy to use, and that it provided a good experience when designing the game. The use of the toolkit continues to be boosted by the research team. Besides the game design sessions with upper-secondary and undergraduate students, the toolkit is also being used by secondary school teachers who are attending a training course developed in the framework of an Erasmus + project. Future additional game design sessions will be held with upper-secondary and undergraduate students, in order to strength its validation or to or discover points hitherto unconsidered. New sets of thematic cards are also being produced.

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