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Using games to raise awareness: How to co-design serious mini-games?

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ABSTRACT

Serious mini-games are promising tools to raise awareness. They motivate and enhance players' interest in a particular topic, and only require a small time-investment. The games should focus on a single concept or learning goal and should be carefully designed. This study therefore explores the usefulness of informant design when developing such serious mini-games. Informant design is a framework that involves stakeholders at different stages of the design process depending on their expertise, which maximizes the value of their contributions. When developing awareness campaigns, various stakeholders, with different goals, need to be involved. Therefore, this paper suggests the use of informant design to increase the support of every stakeholder. The informant design framework provides an excellent design methodology for games as it is very flexible in time, place and number of participants in the co-design activities. The current study shows a case study indicating the usefulness of informant design when developing serious mini-games to increase advertising literacy among adolescents.

1. Introduction

Over the years, serious games have grown considerably in its use as educational tool. The goal of these serious games is twofold: the games have to be fun and entertaining, and they have to be educational (Bellotti, Kapralos, Lee, Moreno-Ger, & Berta, 2013). Research has shown that in contrast with more conventional media formats, these games draw attention, increase engagement in their topic and incite a positive attitude toward learning and changes in behavior (Bourgonjon, Valcke, Soetaert, & Schellens, 2010). Therefore, the value of serious games to support curricula objectives in educational settings is undeniable (Brom, Preuss, & Klement, 2011; Guillen-Nieto & Aleson-Carbonell, 2012; Hwang, Wu, & Chen, 2012). Nonetheless, many serious games are very complicated (simulation) games that necessitate the players mastering a wide range of mostly new and hard skills. Serious games likewise require many hours of practice before one can become adept at playing the game (Juul, 2012; Prensky, 2005; Trefry, 2010), making it hard to incorporate them into the curriculum. Hence, serious mini-games can be a more adequate alternative, since these are short games that concentrate on a single concept or learning objective and only need a little time-commitment from players (Illanas, Gallego, Satorre, & Llorens, 2011; Jonker, Wijers, & van Galen, 2009). Research has demonstrated that the utilization of serious mini-games is significantly all the more

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encouraging if a set of these games is employed in studying a subject from different angles (Frazer, Argles, & Wills, 2007). Serious mini-games can be easily incorporated into the curriculum, but can also be used as a supplement to the in-class lectures (for example, home assignments). In this manner, a set of serious mini-games can be the ideal tool to create awareness of various aspects of a subject in a quick, engaging and collaborative way.

Nonetheless, the inquiry on the design approach for a platform for serious mini-games emerges. For instance, companies in charge of creating awareness campaigns that concentrate on societal problems must consider many different stakeholders who may have distinctive (at times even conflicting) targets. Hence, during the development stage of serious mini-games these diverse partners should all be heard. The target group ought to be very much included in the development process to guarantee a decent comprehension of their preferences and requirements. To improve stakeholder involvement, this study proposes the utilization of co-design when developing serious mini-games. In spite of the fact that co-designing is generally used in designing new technologies, as far as we are concerned, no research has studied how to successfully include different stakeholders in the design procedure of serious mini-games. Therefore, the present study shows a case study that utilized a methodological co-design framework for designing serious mini-games.

1.1. The instructive value of mini-games

As of late, a new wave of massively prominent casual video games that interest a wide group of audience has emerged, having over 200 million players around the globe (Juul, 2012; Trefry, 2010). These mini-games are brief games that are easy to learn and clearly differ from regular videogames (Illanas et al., 2011; Jonker et al., 2009; Juul, 2012; Smith & Sanchez, 2010; Trefry, 2010). Regular videogames have grown to be progressively complicated, and demand some time to master the rules and setups (Juul, 2012; Prensky, 2005; Trefry, 2010). Mini-games comprise of basic, usually familiar, game mechanics and available content making it easy for players to achieve great mastery of it within a short period (Trefry, 2010). The rules of the game are basic and direct, and stay unaltered throughout the game (Illanas et al., 2011; Jonker et al., 2009; Smith & Sanchez, 2010; Trefry, 2010). When the game mechanics are easy to master and the degree of difficulty increases when the game advances, players can become addicted to outperforming their past high scores and competing with other players (Aldrich, 2009; Illanas et al., 2011).

The popularity and flexibility of mini-games has motivated serious game designers to develop serious mini-games. On top of that, the development costs of serious mini-games are much lower ($17.000 in this case study) compared to regular serious games (costs estimated between 10 and 300 thousand dollars) (Marfisi-Schottman, George, & Tarpin-Bernard, 2010). Serious mini-games, or conceptual mini-games (Illanas et al., 2011), are mini-games that focus on a single learning goal or concept (Illanas et al., 2011; Smith & Sanchez, 2010). Although more research is needed to confirm the learning effects of these games, studies advocate the pedagogical and practical value these games can provide in educational settings (Frazer et al., 2007; Illanas et al., 2011; Jonker et al., 2009; Smith & Sanchez, 2010). First, since serious mini-games comprise of basic game mechanics and standards, no significant learning time is squandered on figuring out how to play the game; rather, the player can quickly concentrate on the learning objective (Jonker et al., 2009; Smith & Sanchez, 2010). Despite the fact that the game can become progressively complex at higher levels, the standards remain the same, making it simple to assess students' educational progress (Illanas et al., 2011). Moreover, students have a tendency to better comprehend concepts when they are shown with pictures (Clark & Lyons, 2010). Nowadays this need is mostly answered by using passive approaches, for example, motion films. Games create the opportunity to build an immersive setting where players can engage with the pictures, which makes for a much better learning opportunity than conventional media formats (Illanas et al., 2011). Besides, on account of the games' brief time frame, they effortlessly fit within a class period and can be played frequently during that time. Therefore, learners can practice and master the learning objective (Illanas et al., 2011; Prensky, 2008; Smith & Sanchez, 2010). In addition, the serious mini-games can be used outside the official curriculum by letting students play the mini-games as a homework assignment or introductory exercises to a pedagogical package. Thus, there is no loss of time in the classroom as teachers already have a full curriculum.

Serious mini-games' educational value and their potential to attract a vast audience of trivial and hardcore gamers is what makes these games potential tools for creating public awareness, as the objective of such campaigns is to enlighten members of a community on a social issue (Sayers, 2006). Moreover, the most ideal awareness campaign messages are “short, simple, flexible and memorable”, which portrays the format of serious mini-games (Sayers, 2006, p. 30). Some authors feel that serious mini-games are excessively trifling, making it impossible to provide any genuine educational value (Frazer et al., 2007; Prensky, 2005). Frazer et al. (2007, p. 5) provide an answer for this perspective in “uniting a number of different mini-games, incorporating different gameplay mechanics which focus on a single learning topic, into a single compendium”. Thus, a learning unit or social problem can be converted into a serious mini-game platform by choosing particular learning objectives and after that designing a serious mini-game based on each objective. Hence, each serious mini-game speaks to an educational unit that explores a more extensive learning area from different angles (Illanas et al., 2011). While serious mini-games can stand alone as an educational approach, their pedagogical capabilities can be improved by inserting them as part of a blended learning approach in which serious mini-games are included in an educational package comprising of lectures and in-class discussions (Frazer et al., 2007; Smith & Sanchez, 2010). Indeed, Sitzmann (2011) showed that serious games are more effective when they are embedded in an instructional program than when they are used as a standalone experience.

1.2. The use of co-design in game design

When awareness campaigns are created for a societal problem, various stakeholders ought to be considered. Consequently, this study utilizes a co-design framework as a design method to include various stakeholders (as well as end-users) in designing serious mini-games. Co-design alludes to the process of designing together and the utilization of combined creativity all through the design procedure (Sanders & Stappers, 2008).

Whenever stakeholders and particularly adolescents are incorporated into the design process, two imperative co-design strategies ought to be considered: informant design and cooperative inquiry. In cooperative inquiry, each stakeholder is added on a central design group, which consists of an entire team of designers with equal participation rights and all decisions are mutually agreed upon. Since adolescents and adults are equal on this group, a new power structure has to be constructed in which both sides figure out how to collaborate, which usually requires several months (Druin, 2002; Williamson, 2003). In contrast, informant design supports the involvement of stakeholders in the design process in a way that maximizes the value of their contributions (Scaife, Rogers, Aldrich, & Davies, 1997). Various stakeholders, for example, educators and end-users, contribute specific information that may shape the design at various phases based upon the stakeholders' skills and knowledge. The project director decides which stakeholders are incorporated in each phase of the co-design process. Because of the intensive cooperation and time-investment that is asked of stakeholders in cooperative inquiry, the design groups are usually small in size, hence barring an expansive group of stakeholders and reducing the level of representation for the sessions' results (Moraveji, Li, Ding, O'Kelley, & Woolf, 2007; Williamson, 2003). Besides, longevity and time are crucial to the effectiveness of cooperative inquiry, since each partner in the design group has to initially learn how to collaborate as an equal design partner and each decision must be mutually agreed upon (Druin, 2002; Guha, Druin, & Fails, 2013). This is especially challenging when generally autonomous organizations holding their own particular basic objectives, (for example, profit and non-profit associations) have to collaborate. Hence, informant design is a more realistic and applicable alternative as it requires less time-investment from stakeholders and involves a bigger part of the target audience bringing about incredible adaptability in the time, number and place of members in co-design activities.

We selected informant design as a framework for serious game design as there is no specific or standard set of guidelines to design serious games. However, in the past, many researches have indicated that design aspects employed in popular games can be used in the design of serious games (Bowman, 1982; Malone, 1981; Prensky, 2003; Provenzo, 1991). For example, Dickey (2005) investigated how the design of popular video and computer games might inform instructional design by looking at the aspects of narrative, role playing, learner positioning, and interactive choice. More recently, many frameworks therefore exist that provide general design considerations by identifying different design concepts or elements (Annetta, 2010; Dondlinger, 2007). However, these frameworks do not provide a fixed design approach and are often high-level as well as theoretical design models. The informant design framework, on the other hand, defines four specific phases of design and what to accomplish in each phase (Scaife et al., 1997). Moreover, most frameworks for serious game design integrate theories from two fields: pedagogy and game design. For example, Amory and Seagram (2003) proposed the Game Object Model (GOM) that is based on educational theories to support the design of educational games. In their model, they attempt to create a dialectic between game elements (concrete interfaces) and pedagogical elements (abstract interfaces). In addition, these frameworks merely include pedagogical and game experts in the design process, without including other stakeholders such as the target audience. Marne, Wisdom, Huynh-Kim-Bang, and Labat (2012) designed a conceptual framework with six facets of serious game design and clearly specified the role of the pedagogical and game experts in each phase. Marfisi-Schottman et al. (2010) also only included pedagogical and game experts in their seven step design model. The informant design framework includes other stakeholders in the design process (e.g. end-users) as different stakeholders add important benefits to the project, such as knowledge, skills, and understanding and create support for the campaign topic (Hage, Leroy, & Petersen, 2010; Reed, 2008). Specifically, besides game experts and pedagogical experts, the current case study incorporates end-users, academic experts and industry experts in the design process. Furthermore, in most frameworks for serious game design, it is often not specified which experts or stakeholders should intervene in which steps of the process, while the informant design framework specifically indicates which stakeholders should be included in which steps of the design process based on their expertise. For example, Yusoff, Crowder, Gilbert, and Wills (2009) define the steps to be taken when designing serious games without specifying the different types of actors involved in the different design phases. Finally, contradictory to the informant game design, the target groups and other stakeholders rarely participate in the early design phases of the design process (Zaman et al., 2012). In the informant design framework, the target audience is already included in phase 1 of the design process.

The informant design framework has mainly been used for designing different technologies. For example, Xu, Mazzone, and MacFarlane (2005) conducted two informant design workshops to design an interactive interface for schoolchildren in a museum environment. The authors only needed schoolchildren's experience in the outset stage to develop early design ideas. During these workshops, children were asked to sketch a technology device with creative materials, similar as in the current case study. Further, Pommeranz, Brinkman, Wiggers, Broekens, and Jonker (2009) adopted the informant design framework to construct guidelines for the development of negotiation support systems (NSS). The informant design framework has also been used in combination with other methods. Masterman and Rogers (2002) for example designed an interactive multimedia environment to facilitate the learning of abstract concepts by combining a top-down method with the informant design framework. The target audience (young children aged five to seven) was only involved in the testing of the prototype. Metaxas et al. (2005) also combined informant design with another method (Rapid Iterative Testing and

Evaluation Method) to design a reality game to support and trigger social interaction (i.e. social gaming). The end-users (8- to 12 year-old children) showed to be most useful in the testing phase of the early prototypes. Thus, previous studies using informant design as design method mainly involved end-users in the early design phases (early design ideas and prototype testing) of the design process. Nonetheless, to our knowledge, informant design has not been employed as a design strategy for designing serious games.

In a methodological framework, Scaife et al. (1997) characterize design into four stages: 1) defining the problem, 2) identifying the product requirements, 3) creating and testing low-tech prototypes and 4) testing high-tech prototypes. In every stage, distinctive stakeholders are incorporated based on their expertise. In this model, phase 1 of the design process already involves end-users by having conversations with them to identify problem areas of the learning domain. The only brainstorming session with end-users occurs in the prototyping stage (phase 3), after the early design sessions. However, All, Van Looy, and Castellar (2013) demonstrated the extra value that comes from co-design and brainstorming sessions before developing a prototype since this empowers the integration of unique concepts and game attributes from the brainstorming into the early design stages. This guarantees that the stakeholders' perspectives, needs and inclinations are incorporated from the start. Hence, we included a brainstorming session with end-users in stage 2 of the model. In that manner, the end-users' views and ideas are integrated in the early design sessions, before the development of a prototype. A more comprehensive clarification of each stage is provided in the case study below.

1.3. Case study: informant design of a platform of serious mini-games to improve advertising literacy among adolescents

Adolescents are now a very significant target audience for advertisers. They are seen as fully-fledged consumers who have their own personal spending money as well as an impact on the purchase decisions of their parents and peers (Cauberghe, De Pelsmacker, Hudders, Panic, & Destoop, 2012). Advertisements can aid adolescents in making informed decisions, in the event that they consciously and critically process the advertisements. For this to happen, adolescents need to recognize and comprehend distinctive advertising methods and be critical toward advertising. However, recognizing advertising messages as such and understanding advertisers' commercial intentions is difficult as advertising content is nowadays heavily integrated into popular media content, very interactive and proposes new commercial goals (e.g. personal data collection). For inexperienced consumers, such as adolescents, this is practically unrealistic. Since adolescents are generally not aware of advertising strategies, they are not effectively searching for information concerning these advertising strategies. In this manner, there is an increased requirement for awareness campaigns and instructional tools to educate adolescents about these new advertising formats (Cauberghe et al., 2012).

Games, specifically serious mini-games, are perfect instruments for creating awareness of a social subject in an approachable way since they are exceptionally interactive and engaging exercises that can be played by a vast populace. Besides, the serious mini-game platform can be designed in such a way that each game concentrates on one learning objective of the campaign, for example, advertising recognition or attitudinal advertising literacy, therefore assessing advertising literacy from various angles. When creating a campaign of this manner, it is imperative to include various stakeholders, such as marketers and educational specialists, as every stakeholder has his or her own particular perspectives and approaches regarding the subject, which should be considered to progress in the direction of the shared objective of making adolescents critical consumers. Adopting Scaife et al.'s (1997) perspective, we viewed the stakeholders in our project to be unique informants; every stakeholder was chosen because of his or her expertise, knowledge and skills. An overview of the stakeholders incorporated into our case study can be found in Table 1.

Table 1
Stakeholder overview.

Stakeholder group	Organization	Number of individuals	Function
Industry expert	Duval Guillaume	1 (m)	Managing Partner
Industry expert	BBDO	1 (m)	Head of Digital
Industry expert	Mortierbrigade	1 (m)	Strategic Director
Academic expert	University of Antwerp	1 (m)	Marketing professor
Academic expert	Ghent University	1 (f)	Postdoctoral researcher on advertising literacy
Pedagogical expert	Ghent University	1 (f)	Educational professor
Pedagogical expert	DvM Secondary school	1 (m)	Teacher (economy)
Pedagogical expert	MS Denderleeuw Secondary school	1 (f)	Teacher (religion and ethics)
Pedagogical expert	KTA Liederkerke Secondary school	1 (f)	Teacher (religion and ethics)
End users	DvM MS Denderleew KTA Liederkerke	109 youngsters between the age of 12 and 18	Students
Game developers (Development team)	Bazookas	2 (m)	Game developers

2. Material and methods

A procedure for informant design is described below and four phases are identified (Fig. 1): 1) definition domain, 2) brainstorming and definition requirements, 3) design game scenario and testing, and 4) development alpha version and testing. In this case study, the procedure for informant design was completed over a period of seven months (October, 2014–April, 2015). Phase one of the design process was conducted in the first month (October, 2014). The second (November, 2014–December, 2014) and third (December, 2014–January, 2015) phase of the design process were both completed in approximately two months. Finally, the last phase was executed over a period of four months (January, 2015–April, 2015). A more detailed time frame of the procedure is presented in Table 2.

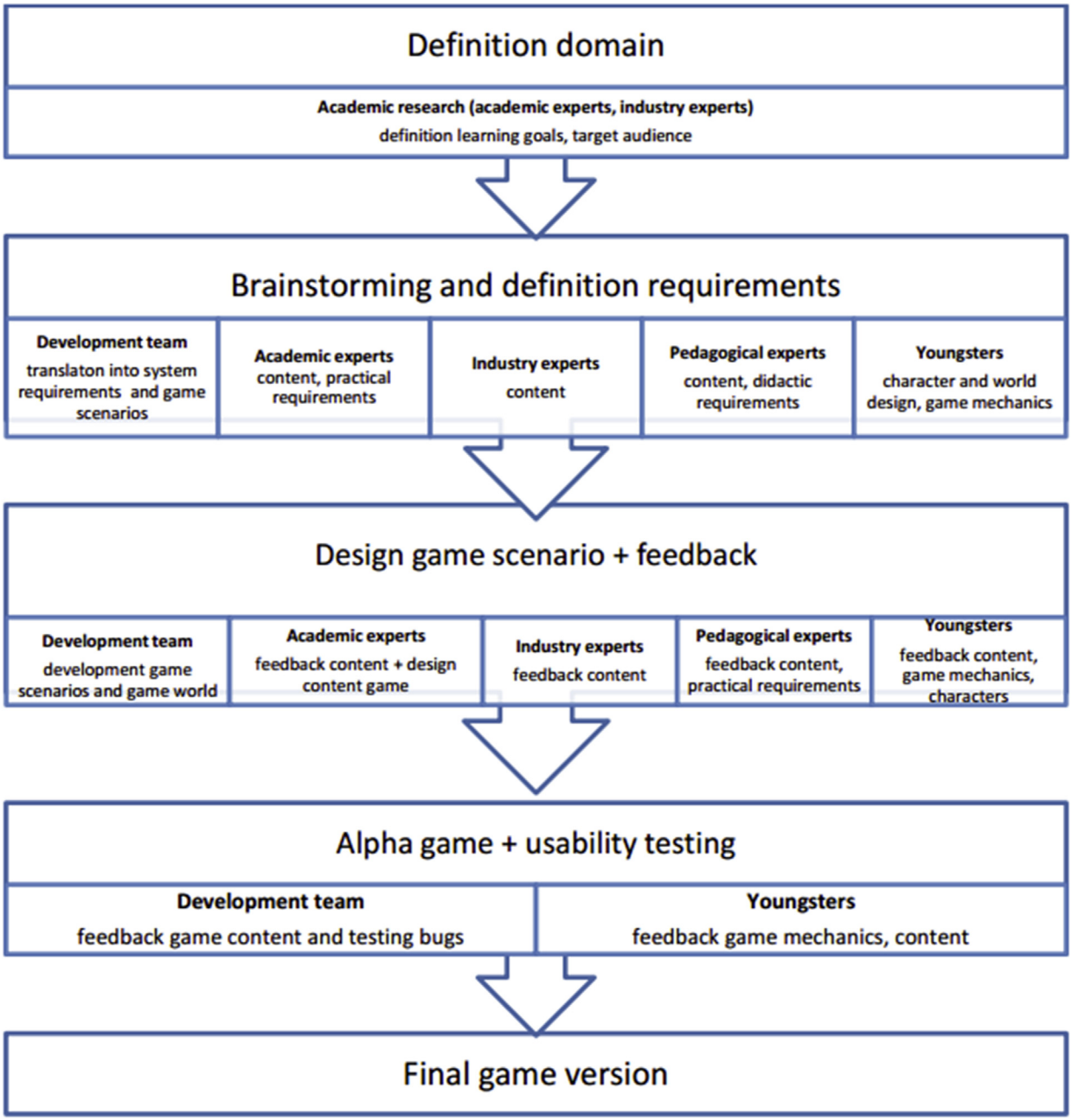

Fig. 1. Methodological framework used in the study.

Table 2
Time frame.

Phases	Time frame	Progress
Phase 1: Definition domain	October 1, '14	Start project
	October, '14	Identifying problem areas of learning goal[a] + briefing game developers
Phase 2: Brainstorming and definition requirements	November, '14 – December, '14	Brainstorming sessions with development team, industry experts, pedagogical experts and adolescents
Phase 3: Design game scenario and testing	December, '14 – January, '15	Brainstorming sessions with development team and academic experts + development of game concepts
Phase 4: Development alpha version and testing	January, '15	Development of alpha versions of the games
	End of January, '15 – February, '15	Testing by target audience
	End of February, '15	Processing of small changes
	Mid-April, '15	Delivery of serious mini-game set
	End of April, '15	Launch of serious mini-game set

[a] As we used useful insights from a study the authors conducted earlier to identify the problem areas, less time was spent. However, when more research is needed, more time will be spent on this phase of the procedure.

2.1. Phase 1: definition domain

The primary stage concentrates on identifying the appropriate learning objectives and recognizing the problem aspects of the learning domain (Scaife et al., 1997). For this stage, we utilized insights derived from a large-scale research conducted by the authors earlier to investigate adolescents' level of advertising literacy and the problems that emerge in this context (Cauberghe et al., 2012). Advertising literacy is a three-dimensional conceptualization comprising of:

- Conceptual advertising literacy, i.e. the conceptual knowledge of advertising;
- Advertising literacy performance, i.e. the utilization of conceptual advertising literacy while processing advertising;
- Attitudinal advertising literacy, i.e. an individual's general critical attitude toward advertising (Rozendaal, 2011).

Cauberghe et al. (2012) conducted both qualitative and quantitative research to comprehend and assess adolescents' advertising literacy levels. They interviewed 11 marketers and 2 youth specialists, and conducted a survey with 503 adolescents between the ages of 12 and 21. The results demonstrated that adolescents' conceptual advertising literacy for traditional advertising formats spanned from medium to high, but adolescents' conceptual advertising literacy for integrated and interactive advertising formats was much lower. Besides, even when adolescents identified these non-traditional advertising formats (e.g. advergames and social media advertising), they failed to critically process them. This ensures that adolescents are an extremely susceptible target audience, especially as the advertising industry views them as fully-fledged consumers with their own purchase power. Cauberghe et al. (2012) proposed several recommendations for government and educational mediations to neutralize this vulnerability. The authors characterized awareness campaigns as the essential instrument for reaching adolescents between the ages of 12 and 16. These campaigns should concentrate on improving adolescents' critical thinking skills, particularly toward non-traditional advertising formats. Hence, the objective of the set of serious mini-games is to offer a secure environment for adolescents that gives them the opportunity to rehearse online advertising recognition, experience the impact of advertising and stimulate their critical thinking skills with regard to advertising.

2.2. Phase 2: brainstorming and definition requirements

Brainstorming sessions were conducted with the development team and industry experts ($N = 3$), pedagogical experts ($N = 5$) and adolescents ($N = 109$) to additionally identify the game prerequisites. The development team consisted of two parties; a research team ($N = 3$) and two game developers (one software engineer and one designer). The research team was responsible for briefing the game developers and for delivering the final content of the games. The game developers developed the artwork in the games, fine-tuned the game play mechanics, and programmed the games. In the brainstorming sessions with the industry and pedagogical experts, two subjects were discussed: 1) problems concerning adolescents' advertising literacy for non-traditional advertising and 2) the design of a set of serious advertising literacy games. The industry and pedagogical experts were informed that the serious advertising literacy games should mainly focus on enhancing adolescents' recognition of integrated and interactive advertising, and on enhancing their critical processing of new advertising formats. The brainstorming sessions were recorded, coded and analyzed by the authors. The most imperative concern of the industry experts was that the games would be excessively abstruse, therefore decreasing the entertainment and immersive impact of the games. Hence, the games ought to initiate stop and think reflection when the players are faced with advertising, making adolescents acknowledge how easy it is to influence them. One expert suggested the concept of a 'Where is Wally' game focused on online advertising, which would teach adolescents an automatic reflex that identifies advertising when they are browsing online. The pedagogical experts, who concentrated on the games' didactical aspect, stated that the

games could serve as motivational tools to begin a subject debate in class; in this manner applying Frazer et al.'s (2007) blended learning approach. Hence, the specialists thought that it was essential that the games were short, could be played autonomously and concentrated on various aspects of advertising. This information was utilized when the low-tech prototypes of the games and the game platform were created.

Brainstorming sessions were held in six classes at four schools with 109 adolescents aged between 12 and 18 years. Each session took about 50 min. First, a short introduction to non-traditional advertising formats was given since the large-scale study from phase 1 showed that adolescents have more difficulties recognizing and understanding those new advertising formats compared to traditional advertising formats. This was important as we wanted the adolescents to especially consider new advertising formats during the brainstorming session. The adolescents were then instructed to form teams of four or five students and list their most favored game features (subjects, genres, characters and music) on Post-its. Thereafter, each team was given A3 sketching paper, scissors, game visuals and markers, and was tasked with making a game storyboard designed to enhance adolescents' online advertising literacy performance. A sample game scenario was given from a stimulation board game. Fig. 2 presents an example of a created storyboard and Fig. 3 shows the setting of one of the brainstorming sessions. The outcomes were coded and examined with All et al.'s (2013) procedure. The storyboards were exceptionally useful in determining popular game worlds, characters and game genres. We inferred that adolescents prefer simulation games, human characters, city game worlds and shooting assignments. Adolescents also like choosing or designing their own character, which they can name and navigate through the games.

2.3. Phase 3: design game scenario and testing

In the third phase, the development team had several brainstorming sessions with academic experts to create the game world and determine the storylines and the game mechanics. In this phase, the results from the brainstorming sessions with the other stakeholders from phase 2 were incorporated. The brainstorming sessions resulted in the creation of a game world and game concepts. The game world that was created, was a skate park with a skateboard ramp, a bench, graffiti on the walls, etc. In total, five game concepts were constructed. Four were directed at enhancing conceptual and attitudinal advertising literacy and advertising literacy performance, whereas the fifth was created as a quiz for players to find out how critical they are as regards to advertising and how knowledgeable they are on non-traditional advertising formats. Every stakeholder was then instructed to analyze the game concepts. After the project director displayed the game scenarios, the experts were interviewed, and the adolescents were given a questionnaire on topics such as color use, character style, scoring format, storyline and challenges. The experts concentrated on the content of the games while the adolescents expanded on the game mechanics. Based on both parties' feedback, the development team decided to omit one game (i.e. 'Can we trick you?') that was negatively evaluated by both the industry stakeholders and the adolescents. In this game concept, players have to choose between two pictures that promote the same product. In one of the pictures, a 'marketing trick' is used (e.g. celebrity endorsement). The player loses the game when (s)he chooses the picture that uses the 'marketing trick'. However, adolescents did not perceive this as a game.

2.4. Phase 4: development alpha version and testing

The input from the third phase was handled by the development team and converted into the final game design document. This document served as the basis for the development of the alpha versions of the games. At this point, merely small alterations could be done to the games, and if required, some new elements could be included. The main function of this stage is to test the games' usability (i.e. game mechanics and perceived complexity). Hence, only the target group was involved in the testing. The games were tested by eight adolescents aged between 12 and 16 years. They played the games and provided feedback on them using the think aloud method. Some game elements such as the scoring system and the controls were altered based on their input. The development team also focused on the reactions of the adolescents as they played the games and recorded any difficulties they encountered. These comments were handled by the development team in addition to their own bug testing and content review.

This fourth stage prompted the development of the final version of the serious mini-game set (see Fig. 4). First, players choose a character and pick a name. With their character, they navigate through the skate world by playing four different serious mini-games. The first serious mini-game is a 'skate game' in which players need to dodge obstacles and simultaneously click on advertisements when they appear. The second serious mini-game is called 'count the ads'. Players need to click on all the advertisements (banners, native advertisements, etc.) that are presented on a webpage. In the third game, players need to log in with their Facebook account and play a regular game (similar to Candy Crush) which is personalized with pictures from their own Facebook page. These three serious mini-games focus on improving adolescents' advertising literacy and their advertising literacy performance. Finally, the last game is a quiz that tests adolescents' knowledge about new advertising formats and their critical reflections on advertising. Players need to answer ten different questions, such as "Can companies continue to follow my surfing behavior after I have closed their website?".

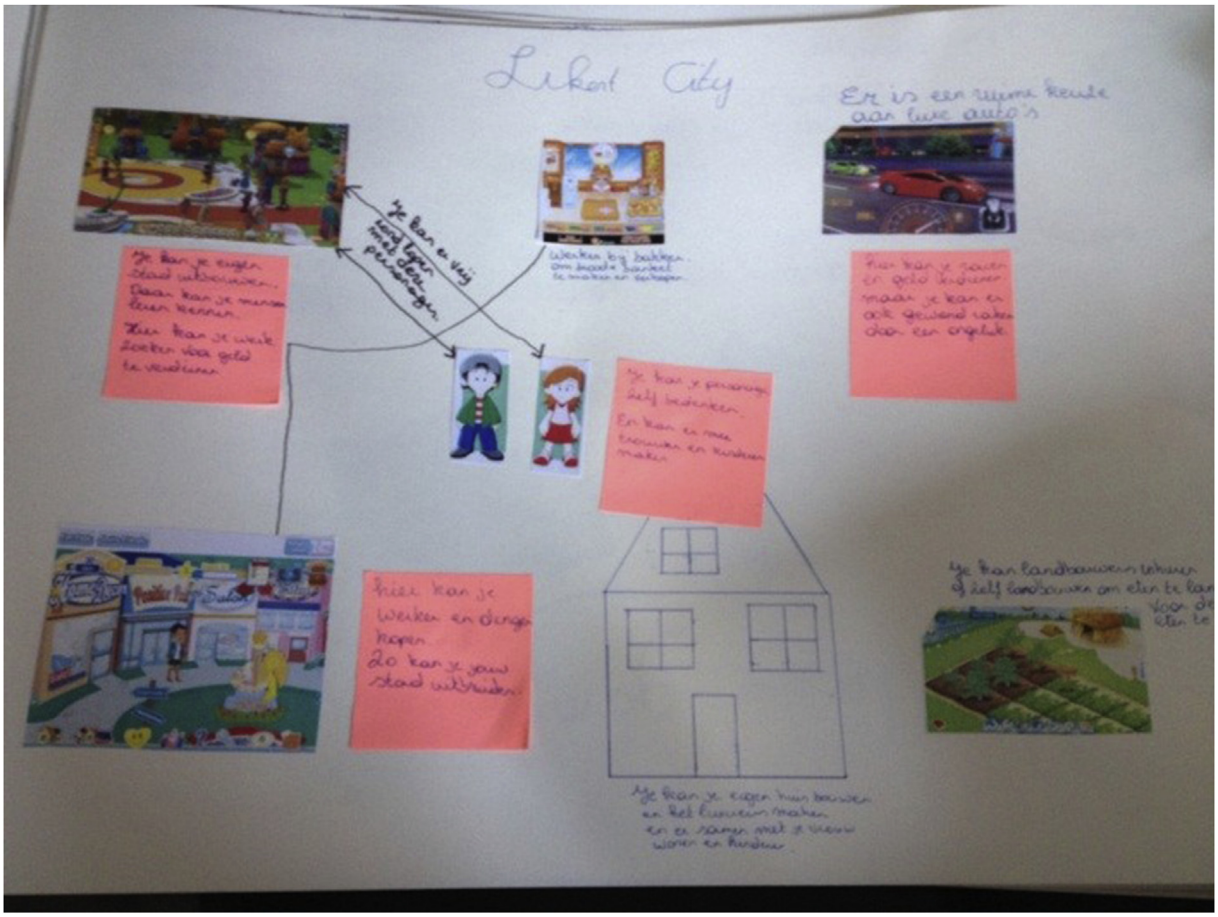

Fig. 2. Scenario created in the participants' brainstorming session.

Fig. 3. Example of a brainstorming session.

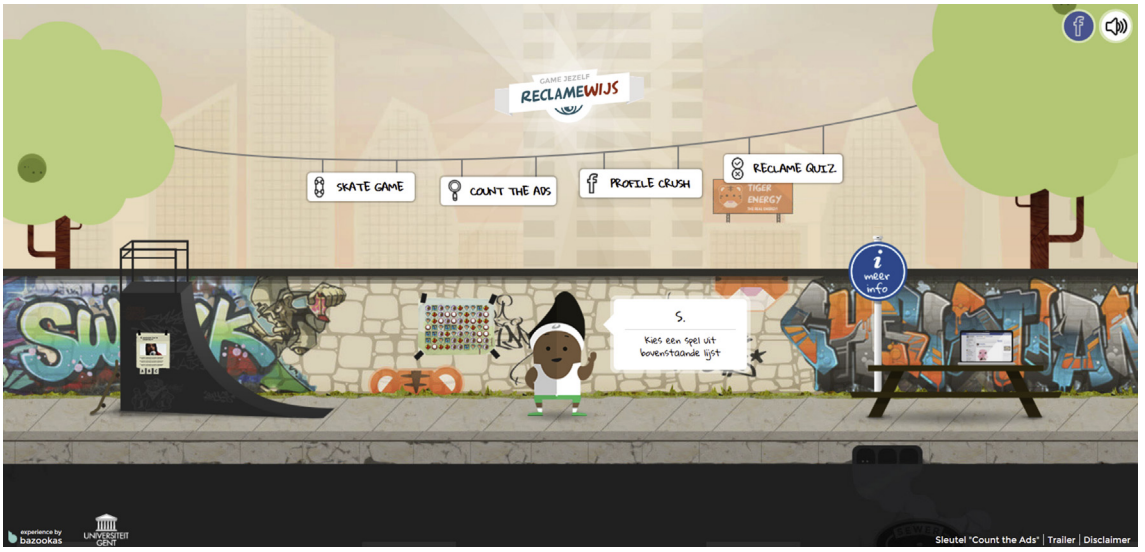

Fig. 4. Final version of the serious mini-game set.

3. Discussion

Serious games have become more and more prevalent in the educational context, and previous research has proven the effectiveness of such serious games (Backlund & Hendrix, 2013; Boyle et al., 2016; Connolly, Boyle, MacArthur, Hainey, & Boyle, 2012). Moreover, serious mini-games provide a more time-efficient and budget-friendly alternative to more complex serious games (Illanas et al., 2011; Jonker et al., 2009; Juul, 2012; Smith & Sanchez, 2010; Trefry, 2010). Furthermore, thanks to their simplicity and ease of use, they can be played by hard-core gamers as well as casual gamers of all ages and thus are an efficient tool for reaching a broad public. Thus, serious mini-games can be useful tools to improve students' learning performance and experience. The serious mini-games can be incorporated into the curriculum to drive lectures. In addition, the serious mini-games can also be a supplement to the in-class lectures by integrating them as an introduction or a closing of a pedagogical package, where the students play the serious mini-games as (mandatory) homework. This approach is very time-efficient since teachers already have a full curriculum.

However, designing a set of serious mini-games can be challenging since various stakeholders must be consulted and included. This research therefore used informant design as a framework that included distinctive stakeholders as specialized inputs in the design process of the games (Scaife et al., 1997). The informant design framework was chosen as we wanted to design a set of serious mini-games to raise awareness about a social topic. Specifically, the aim was to increase adolescents' advertising literacy. This design framework gave us the opportunity to include the preferences and needs of all different stakeholders, including the needs and preferences of end-users. As a result, the designed serious mini-games do not reflect the sole vision of one stakeholder. The added value of the different partners was distinguished in each stage of the development procedure. Whereas end-users contributed to game world design and game mechanics, the industry, pedagogical and academic experts concentrated on the game content, didactic and practical prerequisites. Albeit every partner's feedback was considered in each stage, their role varied over the course of the different stages. First, in the domain definition stage, stakeholders behaved as informants, stating their perspectives on the social topic. In the brainstorming stage, stakeholders were informants and designers who again expressed their perspectives on the subject in addition to designing possible game scenarios. This stage was important to decide the needs and game features that ought to be utilized in the design stage to answer the requirements and inclinations of every stakeholder. Lastly, in the feedback and testing stage, the stakeholders acted as testers who gave feedback on the scenarios and recommended conceivable adjustments. Although stakeholders are generally only needed in this final testing phase of the game design procedure (Pagulayan, Keeker, Wixon, Romero, & Fuller, 2002), this study demonstrated that stakeholders can provide the development team with valuable insights. When stakeholders are only involved in the final testing phase, in which only small adjustments to the game can be made, inevitably, a lot of potentially interesting input will be neglected. In spite of the fact that this project concentrated on the development of a set of serious mini-games to create awareness concerning a societal problem, we believe that the informant game design framework can be utilized for any serious game project where contribution from various stakeholders is considered beneficial.

The informant game design framework has several advantages as regards to other frameworks for serious game design. First, the main concept of this framework is that every stakeholder is asked to join the project at the moment his or her expertise is required the most, which maximizes the value of each stakeholders' contributions. As a result, stakeholders have

different roles in one project. Other frameworks for serious game design often do not indicate which stakeholders should be involved in which steps of the design process, but merely describe the steps to be taken in designing serious games (Yusoff et al., 2009). Further, other frameworks for serious game design do not include the target audience in the game design process, but only include pedagogical and game experts (Amory & Seagram, 2003; Marfisi-Schottman et al., 2010; Marne et al., 2012), or only include them in the final testing phase (Zaman et al., 2012). This framework ensures that the preferences and needs of the target audience are integrated from the beginning as they are already engaged in the early stages of the design process. Finally, the informant game design framework is very flexible in time, place and number of participants in the co-design activities, making it a more realistic framework for co-designing serious games than cooperative inquiry.

Despite its apparent advantages, the informant design framework for serious game design also holds certain risks. First, informant design provides a design method that is rather subjective. In phase 1 of the design process, the model proposes conversations with end-users to identify the problem areas of a learning domain. It is however extremely difficult for end-users, especially for children and adolescents, to objectively define problem areas. In the current case study, we decided to identify the problem areas as objective as possible by using insights from a large-scale study on adolescents' level of advertising literacy. However, we acknowledge that this aspect might be strengthened in further studies in which, besides the objectively defined problem areas of a learning domain, these objective problem areas would be verified by end-users in focus groups or in-depth interviews. Second, this aspect of the design process is even more difficult when it concerns topics that end-users are not consciously aware of. The sensitive topic in the current case study of embedded advertising formats, which have a subconscious working, was another reason to decide to objectively identify the problem areas. Finally, there should be sufficient variation in stakeholders so that the needs and preferences of all possible stakeholders are equally considered and integrated in the design process, especially when dealing with societal issues.

To ensure this project is successful, certain rules must be adhered to. First, the main objective of the game needs to be clearly stated. In this stage, various stakeholders, of whom the end-users are always one, ought to be recognized to act as informants who share their insights regarding the topic. Second, a clear learning objective should be established as a short mission statement so that every individual on the development team fully comprehends the objective of the serious game. Third, stakeholders' feedback ought to be collected prior to any design sessions in order for the development team to know which game mechanics and content should definitely be integrated into the game scenario.

The present paper is also subject to some limitations that may provide guidance for future research. First, because of the project's strict timing and the agendas of various stakeholders, the experts were interviewed independently. Additional information could probably be collected from bigger brainstorming sessions where a focus group of experts is consulted. A second possibility is to conduct one collective brainstorming session where various focus groups comprising of industry experts, pedagogical experts, end-users and a single group comprising of a delegate of every stakeholder group participate. In this session, each group can initially brainstorm on a conceivable game design and via a transfer system each group could give input on the ideas of other groups, perhaps bringing about a better game concept. Future studies could evaluate distinctive brainstorming scenarios. Another limitation of this study is the survey used as a part of the third stage to structure the input of adolescents. Albeit a few open inquiries were incorporated, the survey likely directed the responses of adolescents. Additional input could be gathered by conducting some in-depth interviews. Lastly, both the brainstorming session and the feedback session with adolescents was conducted in a school setting within the limited duration of the lecture. This could have limited the adolescents' imaginative feedback. When working with volunteers, the project director ought to ensure that there is a decent blend of casual gamers and hardcore gamers to give feedback on the project.

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