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Supporting the requirement analysis phase for the development of serious games for children

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ABSTRACT

In this paper, we argue that before defining the scenario of a serious game, a thorough preparation, i.e., requirement analysis phase is needed. Before an attractive scenario can be defined, one should decide and clarify a lot of different issues that could influence the setup of the serious game, as well as the scenario(s). This can be done in plenary sessions with the different stakeholders, but experience has shown that some guidance is needed to have focused and effective sessions, as the stakeholders are usually from different disciplines and have different backgrounds and expertise. To support this phase, we developed a tablet (iPad) app usable by non-computing, as well as computing people. We discuss the tool, as well as the way it supports the users in the requirement analysis phase for the development of serious games for children.

1. Introduction

Serious games for children receive a lot of attention. They may provide added value for many issues, e.g., to deal with the lack of motivation to study (a particular subject) [1], to deal with behavioral issues (e.g., [2]), to stimulate physical activity (e.g., [3]), or in medical situations for instance to learn about a therapy (e.g., [4]). However, developing a successful serious game is not easy. One of the challenges in designing a serious game for children is to come up with a game that is appealing, fun to play, engaging, and at the same time achieves its main goal, i.e., learning (in the broad sense of the term) what needs to be learned. There is little structured guidance on how to do this. A few frameworks exist for the development of serious games, e.g., [5–9]. They are mainly oriented towards developers and not very accessible for non-developers, while in software engineering, it is accepted more and more that a participatory design [10], where all stakeholders are actively involved in the design process, helps in ensuring that the software meets the needs of the users and will be successful. Serious games are no exception.

In this paper, we report on our insights obtained from a serious game project, i.e., the Friendly ATTAC project (www.friendlyattac.be/en/), on how to start the development process of a serious game. These insights might also be valuable for other people. Therefore, and based upon our observations and experiences in the Friendly ATTAC project, we have developed a software tool (tablet application) to support the early phase of the development process of a serious game, i.e., the requirement analysis phase. The software tool can assist an interdisciplinary team (consisting of the different stakeholders involved in the project) in the first phase of developing a serious game (i.e., the requirement analysis). To guide the users through the process, it provides them a list of issues to consider, and assists the users in providing answers to these issues. Furthermore, the tool also documents choices made and issues considered, and indicates the impacts of choices.

As common in the Information Systems discipline, we have used the Design Science research methodology, which "seeks to extend the boundaries of human and organizational capabilities by creating new and innovative artifacts" [11, p. 75]. This research methodology roughly includes six steps, usually applied in an iterative manner: (1) problem identification and motivation, (2) delineate the objectives of a solution, (3) design and development of the solution, (4) demonstration, (5) evaluation, and (6) communication. The paper is structured in line with this research approach. Section 2 elaborates on the problem identification and motivation. Section 3 discusses the objectives of the solution. Section 4 discusses related work. Section 5 presents the general principles of the tool, while Section 6 elaborates on the principles used to guide the discussions in case of the development of serious games for children. Section 7 discusses the evaluation of the tool and its limitations. Section 8 concludes the paper.

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2. Motivation for the research

The research project Friendly ATTAC aims to develop digital games to modify behavior patterns associated with cyber bullying of youngsters [12]. Cyber bullying (e.g., [13]) is a relatively recent phenomenon. It occurs especially among early adolescents (12–15 year old). Cyber bullying also has a serious impact on the mental (and physical) well being of victims. A wide range of societal actors are currently involved in anti-cyber bullying initiatives. These have been contacted in the preparation phase of the project and this resulted in the observation that there is a strong need for evidence-based, appealing, ICT-related intervention tools, that help to empower youngsters confronted with cyber bullying. The exact age range of the target audience was not fixed at the beginning of the project but would be defined during the project after collecting the necessary information.

To realize the objectives of this project, an interdisciplinary research team was established consisting of social scientists, health psychologists, computer scientists, and (serious) game designers. The health psychologists were involved for their experience with the Intervention Mapping Protocol, a framework developed for health education intervention development and implementation [14], which would be used to develop the intervention strategies to be incorporated into the games. The Intervention Mapping Protocol was chosen because this method was especially developed to guide the process of intervention development and to guide how changes in health behavior should be induced, based on scientific evidence and theories.

The project team had planned to develop the scenarios of the games based on requirements and ideas to be gathered in plenary sessions involving different stakeholders (conform to the principles of participatory design). In software engineering, this phase corresponds with the first phase of the software development process, i.e., requirement analysis. Requirement analysis usually consists of three phases: elicitation of the requirements, analyzing the requirements, and recording the requirements. In software engineering, in general and in participatory design in particular, it is good practice to involve, in this phase, as much different types of relevant stakeholders as possible to ensure the success of the software developed. Note that in our project, the end-users, i.e., youngsters, were not immediately involved, as in the beginning of the project the decision about the age range of the target users was not yet taken. Later on, it was decided to only involve the youngsters once the first scenarios were created, i.e., for concept testing and later on for the evaluation of the serious game. However, the game preferences of youngsters have been investigated using empirical research, in order to be able to take them into consideration during requirement analysis and design.

Different plenary sessions were held over a period of 9 months. Some sessions (4) were held only with the members of project team (11 to 12 participants). Two other sessions were together with members from the user advisory board of the project (18, respectively 26 participants), consisting of different types of stakeholders: educational/youth stakeholders, e-safety stakeholders, heath promotion stakeholders, and technological stakeholders (professional (serious) game developers and potential valorization partners).

The discussions were mostly plenary, but the meetings with members from the user advisory board also included buzz groups. During those sessions, many different ideas and interesting issues were raised. We discussed the age range of the target users; gender issues; on which role to focus (victims, bullies, or/and bystanders); the platform on which to offer the game (PC, tablet, smartphone, the Web); the availability of the game (closed environments or publicly available); the embedding of the game in learning environments or in social networks; the involvement of teachers, parents, friends during playing, and coaching issues; issues about risks (not being inspiring for bullies) and privacy; the duration and the genre of the game; the use of mini games; the combination of the game with real life assignments; learning styles of children; type of feedback; motivation for playing the game; and much more.

As far as it concerned the actual content of the scenario or storyline, only vague directions were obtained from the sessions: the storyline must appeal to the target audience, to boys as well as to girls; the player should be able to experiment with different behaviors; it must be possible to obtain information about cyber bullying when needed but the game should not focus on knowledge acquisition.

Although the plenary sessions were quite successful in generating a lot of interactions and issues to consider, in the end and from the viewpoint of the original goal, collecting requirements and ideas for the actual scenarios of the game, the sessions were not very effective.

An important lesson we learned from these sessions is that a thorough problem analysis is needed before one can start defining the scenario for the game. Creating a serious game is not only about defining an attractive scenario. Before this can be done, one has to decide on and clarify a lot of other issues (as the one mentioned above), which could influence the scenario as well as the success of the serious game. Too often, one starts directly with the scenario of the serious game without giving due consideration to these issues, which could (in our opinion) be a reason why many serious games are a failure. Such a requirement analysis phase can be done in plenary sessions with the stakeholders but, from our observations in the Friendly ATTAC project, we believe that some guidance is needed because the stakeholders are usually from different disciplines, with different backgrounds, and with different levels of experience. In our project, the involvement of software developers and computer scientists (referred as technological stakeholders) as well as more social-oriented people caused a communication gap. The game developers were focusing on technical aspects important for the success of games, such as game genre, game modes, rewards and penalties, winning, motivation to keep playing, while the stakeholders from the target domain were, in general, more concerned about the social aspects, such as the acceptance of the game by the target users, protection of the privacy, possible abuse of the game, the need to embed the game into a broader context, and the expected gain in learning. In addition, technological concepts were not always familiar to these participants and sometimes considered as irrelevant, while the technological stakeholders were not always well aware of the relevance and impact of the social aspects. Also, technological-oriented people had the tendency to quickly jump to implementation issues, which were incomprehensible for the social-oriented people and caused their dropout.

In retrospective, we also had the feeling that the meetings could have been more efficient if there would have been more guidance. Because of this lack of guidance, we were also not sure whether all relevant aspects that could influence the success of the game had been taken into consideration.

3. Objectives

Based on our experience in the Friendly ATTAC project, we decided to investigate the possibility to develop a lightweight tool to support the requirement analysis process for the development of serious games for children. Although a lot of relevant information on the development of serious games can be found in different publications (e.g., [15–18]), as far as we know, such a first preparatory phase, i.e., requirement analysis phase, specifically targeted towards serious games for children and usable by developers as well as other stakeholders involved in the requirement analysis process, has not yet been investigated thoroughly. A concrete list of issues and alternatives to decide on during this phase is not readily

available. As argued in the previous section, such a list could guide the stakeholders and make their discussions much more focused and efficient, resulting in more thoughtful serious games. Therefore, we decided that the tool should *not only support* the users but also *guide* them in considering all relevant aspects during the requirement analysis phase. Our objectives for the tool implied that next to the practical problem of developing such a tool, we also had to solve a knowledge problem, i.e., what are the different decisions and choices that should be made during the requirement analysis of a serious game for children?

To solve the practical problem, we started by formulating functional and usability requirements for the tool. The target users of this tool are people involved in the requirement analysis phase of the development of serious games, developers as well as other stakeholders. The main requirements are summarized as follows:

R1 The user should be able to take the required decisions regarding the purpose and characteristics of the serious game to be developed, i.e., the tool should *support requirement elicitation* in the context of serious games for children.
- R1.1 The tool should *guide* the user, using a predefined set of issues, through the requirement elicitation process.
- R1.2 The tool should *provide explanations* for the different issues. This is necessary as not all people involved will be familiar with (serious) games.
- R1.3 The tool should distinguish between *issues required to consider and optional issues* because some issues may not be applicable for the case at hand.
- R1.4 The tool should provide *the possible options and alternatives* whenever possible for decisions and should provide explanations for these options and alternatives. This is necessary as not all people involved will be aware of the possible options and alternatives.
- R1.5 The tool should allow *capturing the motivations for the choices made and issues* (not) considered. This allows documenting the process.
- R1.6 The tool should *indicate the impact of choices*. The choice of an option or alternative may have an impact on the options and alternatives available for other options, e.g., the choice for a certain pedagogical approach may limit the choice for the game genre. It is important to draw the attention of the user on this.
- R1.7 The tool should be able to *visualize* the choices made. This allows the users to keep track of the process as well as of the choices made.
- R1.8 The user should be able to *change decisions* already made and view the alternative choices again. This is necessary as during discussions, it is possible that people change their mind.

R2 The tool should allow *exporting* the results in a *textual and readable form*. This is needed to support the recording of the requirements in a textual form.

R3 The tool should have an *easy to use graphical user interface*. Obvious, as the target users include non-computing people (i.e., casual users).

R4 The tool should be *usable in meetings and by different types of people* (i.e., casual users) (see higher for the motivation).

R5 The tool should be *generic*, meaning that it should be usable for different types of serious games, with different choices and options, and without the need to reprogram the tool. This requirement was formulated to make the tool as flexible as possible from a software engineering point of view (see also Section 6).

4. Related work

Before starting the development of the tool, we searched for existing or related tools. We started by investigating whether brainstorming and mind mapping tools, or their underlying principles, could be helpful for our purpose.

Brainstorming tools (e.g., iBrainstorm (www.ibrainstormapp.com/), Stormboard (www.stormboard.com)) are very general in nature and cannot be customized to provide guidance in decision-making. The brainstorming technique is more directed towards gathering a list of ideas and then selecting the most appropriate ones. This would be useful for collecting ideas for the actual scenarios, but with our tool we want to focus on the phase before this step.

Mind mapping tools (e.g., iThoughtsHD (www.ithoughts.co.uk/iThoughtsHD/), XMind (www.xmind.net/), SimpleMind+ (www.simpleapps.eu/simplemind/) and many more) are also too general, they cannot reflect optional issues, there is no way to define and select predefined alternatives and options, and they do not allow showing impact of decisions. Mind maps are more suitable to structure ideas and concepts. Although mind maps were not suitable for our purpose, we found the tools and the visualizations used very inspiring. Our tool is based on some of the principles used in mind mapping tools.

We also investigated whether ideation tools could provide a solution, but little was found in the context of (serious) game development. Agustin et al. [19] proposed game sketching as a way to explore new ideas in a fun, cheap, and risk-free manner. Smith and Graham [20] presented a similar sketching approach. Although these approaches also focus on the early development phase, the focus is on the ideation of the gameplay rather than on requirements elicitation. Kultima et al. [21] introduced idea generation games, to be used by game designers, to enhance the creative process by immersing people into a playful activity. Duin et al. [22] proposed a similar idea, the refQuest game, to structure the ideation process in the very beginning of an innovation process. Although using game principles for supporting the ideation process is interesting, at this moment we did not opt for this direction as we aimed for a simple solution usable by casual users. It is not sure that all kinds of casual users would be prepared to play games for the purpose of requirement analysis.

Vaajakallio et al. [23] described two experiments to explore the applications of co-design methods with children. For the first experiment, the authors used Make Tools (www.maketools.com) [24] and for the second the Design Games approach [25]. The aim of Make Tools is to design innovation by exploring collective creativity and is too open ended for our purpose. The aim of Design Games is to help facilitate a user-centered design process for cross-disciplinary design groups early in the design process. This approach also uses the concept of game and play to structure the design activities.

EMERGO [15] is a methodology and toolkit for developing serious games. EMERGO also emphasizes the need for an analysis phase before actually starting the design and the implementation, where the developers need to consider various issues and discuss them to gain more insight and awareness. For the analysis phase, EMERGO provides a list of questions to be answered to obtain a global description of the intended case. The questions are grouped into subjects. Although the list of questions provided are relevant (and used) for our knowledge problem, it is not clear if the toolkit is supporting this phase is some way.

Carro et al. [16] provide a methodology for supporting the design of adaptive educational game environments. The authors established a set of steps to be followed, such as identifying the types of users, and specifying the game goals. Parts of these steps can be considered as the requirement elicitation that we aim for. They also

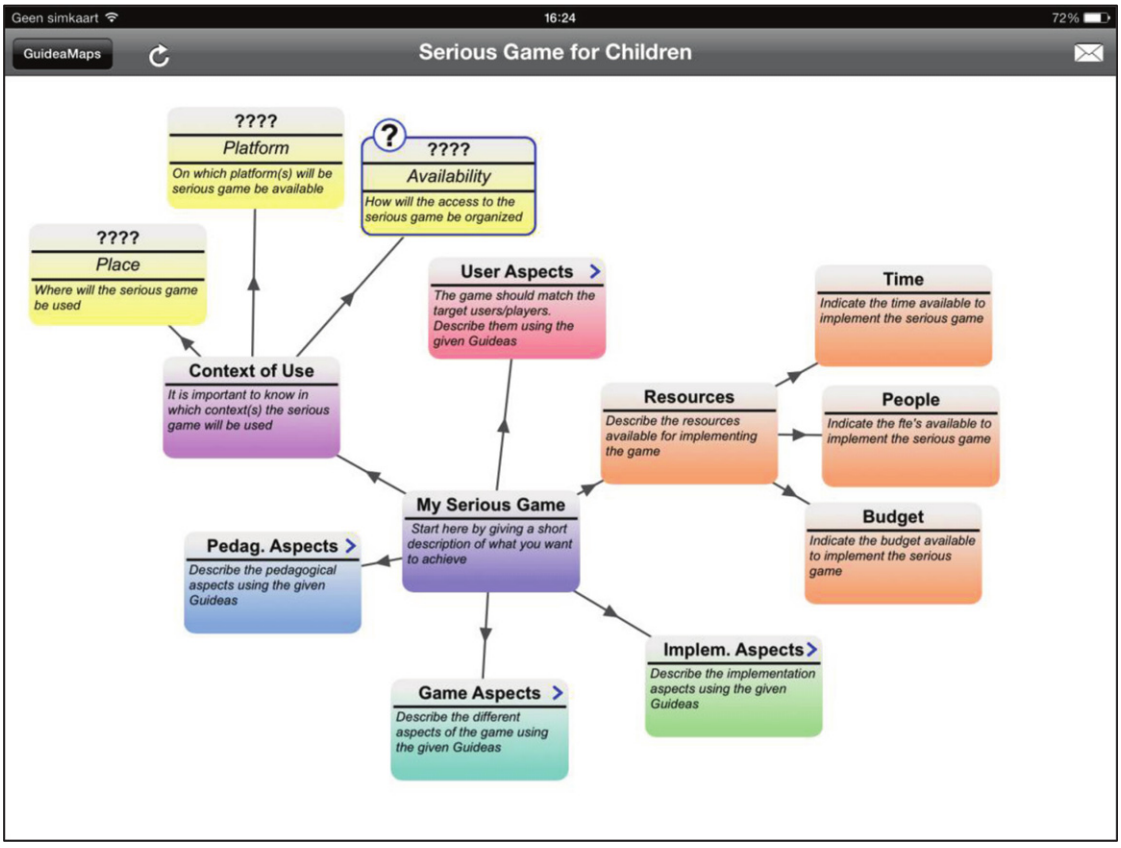

Fig. 1. A (partial) GuideMap.

developed a model for describing this information. Also this information is useful (and used) for our knowledge problem, but again it is not clear if and how a tool supports this.

The Four Dimensional Framework (4DF) of learning [6] distinguishes four dimensions to be considered for the creation of a successful game-based learning: the context, the pedagogical model or approach used, the learner specification, and the representation (immersion, interactivity). In [26], this model is used for the evaluation of educational games. A number of questions have been formulated for this purpose, which are also relevant for our knowledge problem.

In "A Channeled Ideation Approach" [27], a template-driven approach is proposed for defining new products. The authors divide products into different components and their attributes. Templates define the possible combinations and their constraints. This approach could be reused when considering a serious game as a "product", however such a template does not exist. Our approach also used a template-driven approach.

5. Guideamaps

We have opted to develop a tool that can be positioned as a structured mind-mapping tool where the mind map has a predefined structure. This predefined structure captures the issues to consider during the requirement analysis process (R1.1). During this process, the user will go through the predefined issues (in any order), select the ones that are relevant for the serious game to be developed (R1.3), provide the required information (R1.5), and make choices where needed (R1.4). The content of this predefined map will be discussed in the Section 6. Here we provide a short description of the tool.

Because our representation is based on mind maps, the user creates *GuideaMaps*, where *guidea* is a portmanteau word for "guided" and "idea". Fig. 1 presents a screenshot of the current tool showing a (fragment of the) GuideaMap for an educational game for children. The predefined map, which is loaded when a user starts creating a new GuideaMap, is called a *GuideaTemplate*. Different templates for different purposes (or types of serious games) can be provided, and the user can select the one that is most appropriate for his/her purpose (R5). For this purpose, a short description of the purpose of the template will be available.

The tool provides an easy to use "point, tap, and drag" user interface on a tablet (iPad) (R3). In this way, any user with limited exposure to computer software should be able to work with the application, and a tablet is easy to use in meetings (R4).

Each issue is represented as a guidea. The guideas are represented as rounded rectangles and contain the name of the issue and an explanation (R1.2). For example, one issue to consider is 'Resources' and its explanation is 'Describe the resources available for implementing the game'. A guidea (issue) can be decomposed into other guideas (sub-issues). For example, 'Resources' is (in this template — see Fig. 1) decomposed into 'Time', 'Budget', and 'People'. A guidea is connected to its sub-guideas by means of arrows pointing towards the sub-guideas. The starting point is the root guidea, in Fig. 1 called 'My serious Game', which allows providing a short description of what the user wants to achieve with the game, and is (in this template) decomposed into a number of other guideas: 'User Aspects', 'Pedagogical Aspects', 'Game Aspects', 'Context of Use', 'Resources', and 'Implementation Aspects', which are on their turn decomposed (see next section for a more elaborated explanation).

Not all issues (guideas) are mandatory to consider. The optional guideas are connected by dotted lines, and the mandatory guideas by a solid line (R1.3). For some issues, a set of predefined options is available from which the user can select one (or more — depending on the guidea) (R1.4). Such a guidea is marked with '????'. An

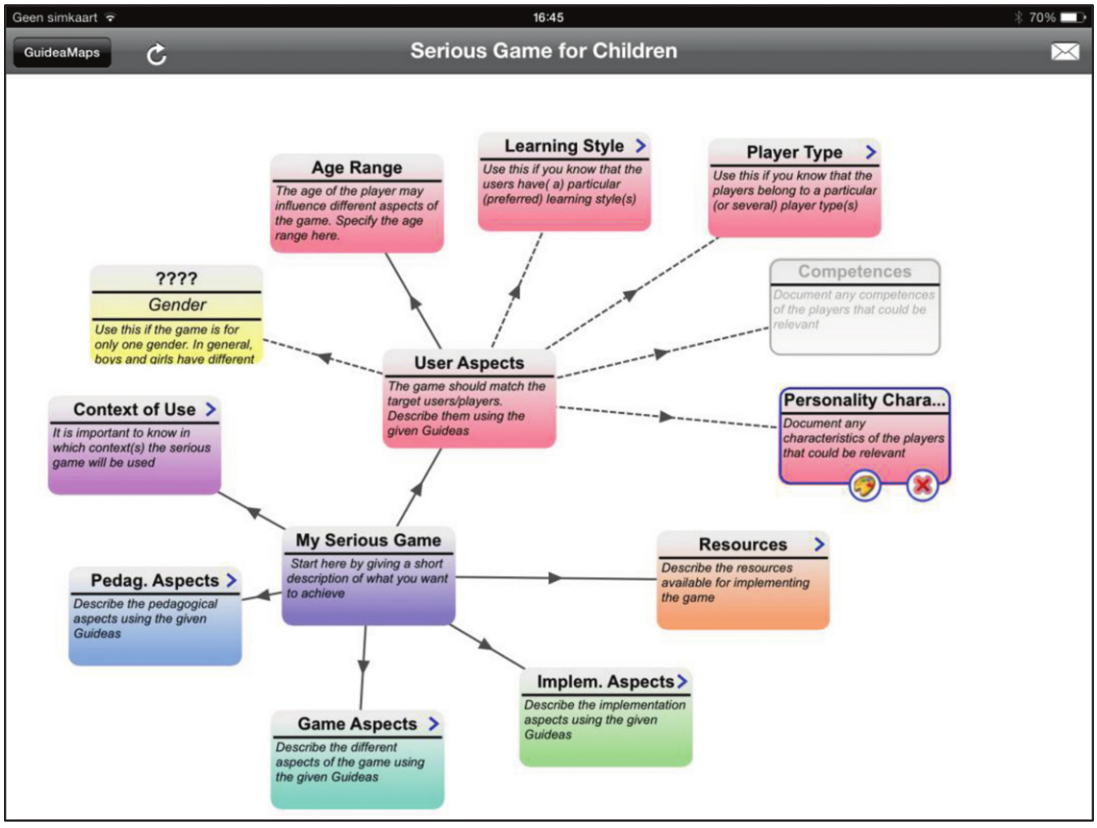

Fig. 2. Optional guideas.

example is 'Platform' (see Fig. 1), where the user can select one or more options from the available list of options, here: 'PC', 'Mac', 'Smartphone', and 'Tablet'.

The sub-guideas of a guidea can be collapsed and unfolded (R1.7), dragging and resizing is also possible.

Double tapping on a guidea will open the guidea, show the full explanation provided for the guidea and allow the user to enter comments. The comments are used to document decisions taken and their motivations, or to write down things that need to be remembered (R1.5).

An optional guidea can be deselected using the 'x' button at the bottom edge of the guidea (see Fig. 2 for an example — Personality Characteristics). When deselected, its border becomes gray (see Fig. 2 for an example: Competences), but the guidea itself is still visible so that the user can still change his/her mind (R1.8). To allow this, a '$\surd$' button becomes available when selecting the guidea.

Tapping the button at the top of a guidea that allows options will open a pop-up window to select an option (see Fig. 3). Options that cause a conflict or require the selection of other options (for other guideas) are marked with a red icon and the required and/or conflicting options can be shown in a pop-up (R1.6).

The GuideaMap created (so far) can be exported as text (R2), using email, as well as in an exchange format.

6. A GuideaTemplate for serious games for children

As explained in the previous section, a kind of predefined mind map, called GuideaTemplate, is used to define the different issues that need to be considered during the requirement analysis, as well as to define constraints and dependencies that may exist between those issues or between options for issues.

As we are well aware of the fact that it is not possible to specify a unique list of issues suitable for all types of serious games and in all contexts, the application can work with different templates.

Based on the literature, a brainstorm session with the technological stakeholders of the Friendly ATTAC project (i.e., (serious) game developers and companies developing educational software), and our own experience in developing serious games, we developed a template for educational-oriented serious games for children.

Within the space limitations of this paper, it is not possible to discuss the template in all details. Neither is it possible to pinpoint individually all the different sources that have contributed to the current list of issues considered in the template. Therefore we rather mention a list of sources that were most influential: [6,8, 15,16,18,26,28–36].

The different issues to consider are grouped into 6 categories: User Aspects, Context of Use, Pedagogical Aspects, Resources, Game Aspects, and Implementation Aspects. Each category is further decomposed. An overview of this decomposition is given in respectively Tables 1–6. Mandatory issues are indicated in bold. If alternatives or different options are provided for an issue, this is indicated next to the option in italic and preceded by '*One of:*' (if only one alternative is possible) or '*One or more of:*' (if more options are possible). If an issue is further decomposed, the decomposition is indicated in the next column. Note that there are also dependencies between issues and/or options for issues, but they are omitted here because of space limitations. Also the further decompositions of options are omitted.

User Aspects (Table 1) are used to characterize the target users of the serious game. Only the age range needs to be specified, as for children their age may influence different aspects of the game (e.g., language use, graphics). Optionally are: the learning style/preferences of the target users, their competences (skills and knowledge) (or lack of), personality characteristics, and what kind of player the user is. These issues only need to be specified if they are relevant. For the moment, we only consider the VARK learning style [37] for the learning style/preferences of the target users, but this can easily be extended.

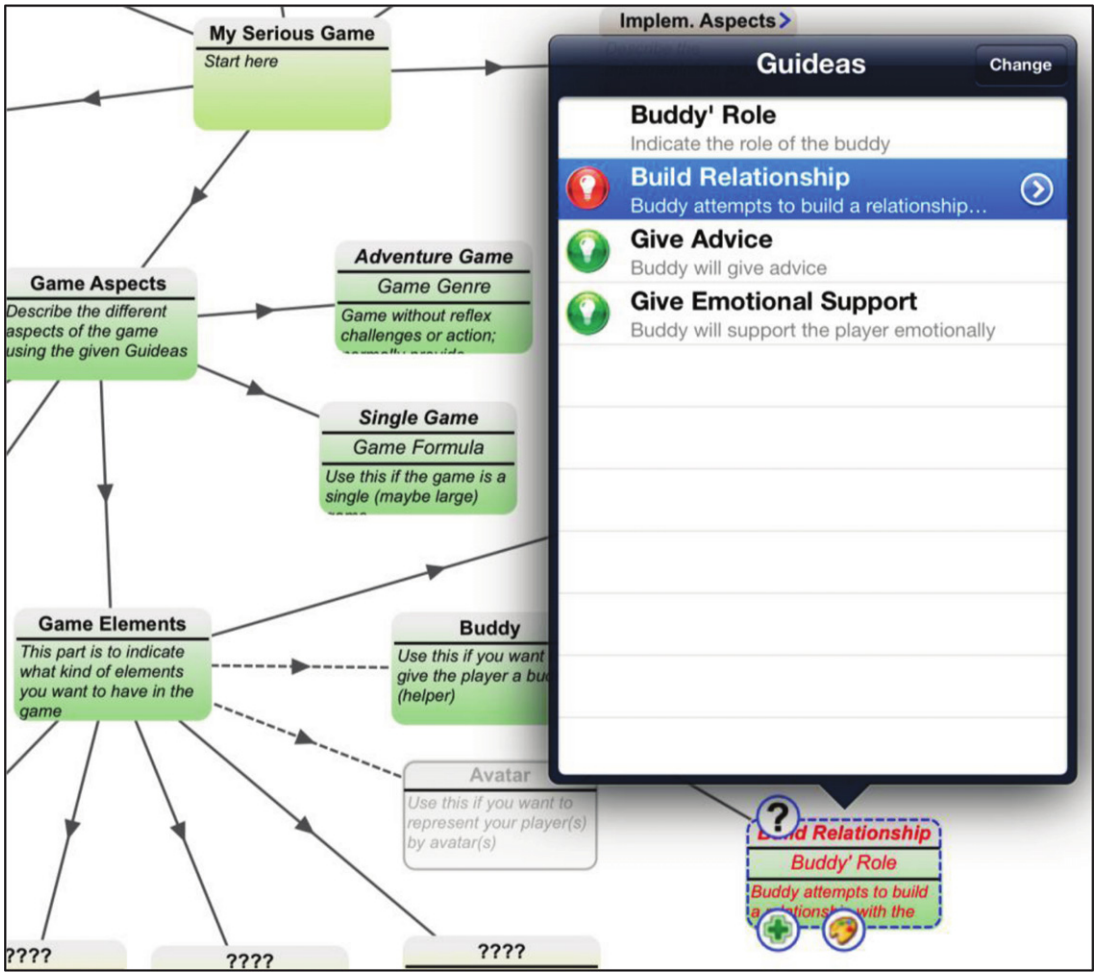

Fig. 3. Options for a guidea.

Table 1
User aspects.

Age range		
Gender	One of: Boys/Males, Girls/Females	
Learning Style/Preference	VARK style	*One or more of: Visual Learners; Auditory Learners; Kinesthetic Learners; Read/Write Learners*
Competences (Skills and Knowledge)		
Personality characteristics		
Player Type	Player Type by Motivation	*One or more of: Time Killers; Fun Seekers; Wanna-be's; Committed*
	Player type by personality	*One or more of: explorers; achievers; socializers; killers*

Context of Use (Table 2) specifies the platform (PC, Mac, Smartphone, and/or Tablet) on which the game will be played; whether the game will be used at home, at school, and/or in an organization; and whether the game is open for everybody or only accessible in a restricted way (Availability).

Pedagogical Aspects (Table 3) require providing the didactical goal of the serious game, as well as the didactical approach that will be used. For both issues different options are available (see Table 3). Also the pedagogical context can be specified (e.g., to specify that the game is part of a bigger educational program).

Resources (Table 4) are decomposed into the available budget, the available manpower, and the available time to develop the serious game.

Table 2
Context of use.

Platform	*One or more of: PC; Mac; Smartphone; Tablet*
Place	*One or more of: At home; At School/Institute or in Organization*
Availability	*One of: Open; Restricted*

Game Aspects (Table 5) cover issues such as the game genre, the game format (collection of mini games or one single game), whether it will be a single player or a multiplayer game, the concept of the game itself (e.g., "rescue the princess"), as well as the different game elements that one wants to include in the game

Table 3
Pedagogical aspects.

Didactical goal	*One or more of: Attitude change; Behavioral Change; Awareness; Knowledge Acquisition; Practicing Skills; Social Problem Solving; Cognitive Problem Solving*
Didactical approach	*One or more of: Practice and Feedback; Learning by Doing; Trial and Error; Problem-based Learning; Case-based Learning; Task-based Learning; Question-based Learning; Collaborative Learning; Cooperative Learning; Discovery-based Learning; Roleplay Simulation*
Pedagogical context	

Table 4
Resources.

Budget
People
Time

(such as a buddy, reward mechanism(s), feedback mechanism(s), avatar).

Implementation Aspects (Table 6) allow to specify some first but important aspects of the implementation: whether it will be a stand-alone or/and an application running in a browser, any specific peripherals that will be used (e.g., Wii, Kinect), and when already known, the implementation technology that will be used to implement the game (e.g., the game engine).

7. Evaluation

To evaluate our tool, as well as the GuideaTemplate presented, we decided to use case studies [38]. Setting up an experimental evaluation would require the specification of an artificial scenario, which would not allow us to evaluate the GuideaTemplate but merely the usability of the tool. The use of real life case studies would allow us to evaluate the usability of the tool, as well as the GuideaTemplate proposed. We conducted two case studies, which can be considered as explorative case studies aiming to build initial understanding of the usability and effectiveness of GuideaMaps and its current GuideaTemplate.

7.1. First case study

The first case study was an informal case study, to obtain initial feedback on the usability of the proposed tool and with the aim of deciding whether it was worth pursuing with the development of the tool. This initial case study was done with two team members of the Friendly ATTAC project (age between 23 and 30). Both had been involved in the plenary session mentioned in Section 2 and volunteered to assist in the validation session. The two persons involved had a background in Communication Science and no experience with tablets, requirement analysis, or game development.

Because, at the time we conducted this evaluation, most of the requirements for the first serious game to be developed in Friendly ATTAC were already discussed (although in an ad-hoc way), in this validation session we mainly focused on the usability of the tool, and its capabilities to document the decisions taken earlier.

After a short introduction explaining the goals of the session and a short demonstration of the tool (5 min), an iPad with the GuideaMaps app loaded with a Serious Game GuideaTemplate (close to the one described in the previous section) was handed over to the participants. The participants were asked to enter the available information about their serious game (gathered in previous meetings of the project) in the tool while we monitored their behavior. They were encouraged to think aloud. Getting started and entering the information took about 40 min.

After having entered all their information, we asked the participants for feedback, suggestions for improvement, and the completeness/relevance of the provided GuideaTemplate. This was done in an informal way. This discussion lasted 10 min.

As the participants had no experience with working with a tablet, typical tablet-related UI interactions were in the beginning a challenge, but after a few trials, the participants picked up the iPad interaction approach and used it correctly. In general, the participants provided positive feedback and were impressed by the functionality of the tool, as well as by the completeness of the template. They concluded that the tool could be "very useful in brainstorming meetings to capture, in a structured way, the different decisions and make the necessary progress".

7.2. Second case study

The second case study was conducted with a master student in Computer Science from our university who wanted to develop a serious game for children as part of his master's thesis. In this case study, we were mainly seeking for feedback concerning the GuideaTemplate. As the participant was familiar with tablets, we also wanted to get feedback about the learnability of the app for this kind of users. Therefore, the preconfigured iPad was handed over to the participant with only a very short explanation about the purpose of the tool and the question to use it for the requirement analysis phase of his project. We also asked whether he would be prepared to fill in a questionnaire afterwards and be interviewed. This participant had experience with developing a couple of games in his free time.

After he finished the requirement analysis phase for his project, we asked him to fill out an online questionnaire, the "Computer System Usability Questionnaire" [39]. The scores were as follows: on a scale from 1 (strongly disagree) to 7 (strongly agree) he gave 5 times 6 (Q1, Q2, Q7, Q8, Q14), 11 times 5 (Q3–Q6, Q12, Q13, Q15–Q19), 2 times 4 (Q9, Q11) and once 3 (Q10). The lower scores (4 and 3) were on the questions "The system gives error messages that clearly tell me how to fix problems" (score 4), "The information (such as online help, on-screen messages, and other documentation) provided with the system is clear" (score 4), and "Whenever I make a mistake using the system, I recover easily and quickly" (score 3). As positive aspects, he listed: "Easy to use", "Good overview", "Gives a good insight into the requirements of the project", and as negative aspects: "Information/descriptions sometimes not fully displayed" (known bug), "The screen showing up when typing in a description was sometimes at the bottom of the screen, making it unusable" (known bug), and "At the start of the project, I lost my entire progress" (unknown bug). Next, we conducted an interview. We prepared 17 questions to obtain more information about (a) the background of the participant: about his experience with developing games, use of tablets, and familiarity with mind maps, (b) his opinion on the GuideaTemplate, and (c) his opinion on the provided functionality of the tool and proposals for new features. The interview took 18 min and has been recorded. Overall, the interview confirmed the positive evaluation of the questionnaire. He had no problems to start using the tool, purpose and terminology was clear. Concerning the GuideaTemplate provided, he reported that the map was very detailed, he was not missing any issues, and quite some issues made him think more rigorously about his project and were even inspiring (e.g., the

Table 5
Game aspects.

Game genre	*One or more of: Role Playing Game; Adventure Game; Detective Game; Strategy Game; Concentration Game; Sport Game; Simulation Game; Action Game; Puzzle Game*		
Game formula	*One of: Mini Games; Single Game*		
Single/Multiple Player	*One of: Single Player Game; Multiplayer Game*		
Game concept			
Game length (in time)			
Game elements	**Motivating elements**	**Reward system**	*One or more of: In-game Currency; Extras; Points; Progress in the Game*
		Punishment system	*One or more of: Loss of Points; Removal of Extras; Setback; Game Over*
		Feedback system	*One or more of: Progress Indicators; Sound; Enabling/Disabling Actions or Interactions; Advices or Guidance*
		Reflection system	*One or more of: Compare against Normative Value; Self Reflection*
	Avatar	**Type of avatar**	*One or more of: Ideal Form; Blank Slave; Iconic Character*
		Avatar's characteristics	*One or more of: Similar Age; Similar Gender; Transcending; Similar*
	Buddy	**Buddy's role**	*One or more of: Build Relationship; Give advice; Give Emotional Support*
		Buddy type	*One of: Role Model; Pedagogical Agent; Virtual Companion*
	Dialogs	**Player to game**	*One or more of: Textual; Using Speech*
		Game to player	*One or more of: Textual; Using Speech*
		Player to player	*One or more of: Textual; Using Speech*

Table 6
Implementation aspects.

Type of application	*One or more of: Web-based; Stand-alone application*
Implementation technology	
Peripherals	*One or more of: Camera; Microphone; Speakers, Wii; Kinect; High Definition Camera; Sensors*

possibility to use a buddy, and the alternatives provided for reward system). Concerning the questions related to missing functionality and proposals for extra features, he was not asking for major new functionality. Two of the more advanced features that we proposed were considered as "may be interesting", i.e., to be able to add new guideas to the map or to add extra options for a guidea while using the map, and to have a more structured comment field (i.e., divided into different sections including decision and motivation). He was not interested in a functionality to automatically solve conflicts with dependencies, as he considered this too dangerous. He was also fine with the current layout and saw no advantage in using a hierarchical layout. He did mention some usability issues: need for a better zooming, the possibility to hide some information at a certain level of detail, to provide different coloring rules (e.g., per level, per sub tree), and an export function to an image format.

7.3. Limitation of the evaluation

Although both case studies resulted in a positive evaluation, it is of course not possible to generalize these results. For this, more case studies are needed. However, as we already gathered a lot of feedback (from the two case studies, as well as from our own experience with trying out the tool in our research lab with different GuideaTemplates), we decided to first improve the tool before continuing with more case studies. Currently, version 2 is under development. The improvements concentrate on improving the quality of the graphics, smoother gesture-based interaction, an improved layout, as well as fixing bugs (sometimes the keyboard that pops up to enter the comments was hiding a large part of the GuideaMap; the auto save was not always working properly). This new version will also contain some of the extra functionalities proposed in Section 7.2, such as the functionality to be able to add new guideas to the map or to add extra options for a guidea while using the map, a more structured comment field, the possibility to hide information at a certain level of detail, as well as a way to specify different coloring rules.

Note that we have not evaluated the tool in a meeting setting with different people. This is also subject of further evaluation, but we first want to add some functionality to better support teamwork, such as functionality to keep track of who has decided what, when, and why. This is also planned.

8. Conclusions

In this paper, we have argued that before defining the scenario(s) for a serious game, a thorough preparation, i.e., analysis phase is needed. Before an attractive scenario can be defined, one should decide and clarify a lot of different issues that could influence the setup of the serious game and the scenario(s). Some examples are the context in which the serious game will be used, the pedagogical principles that will be used in the game, the target users and their characteristics, the available resources to develop the game, and game aspects like the type of the game, game

elements to use or to avoid, the length of the game, and so on. Good practice is to involve all relevant stakeholders in this analysis process. This can be done in plenary sessions, but experience has shown that some guidance is needed to have focused and effective sessions. Therefore, we have presented a software tool (tablet app) developed for this purpose. The app supports the requirement analysis phase of the development process of serious games for children. The users (non-computing as well as computing people) are guided through this process by providing a list of issues (i.e., the GuideaTemplate) to be considered. The tool provides explanations for the different issues, indicates which issues are required and which are optional, provides possible options and alternatives, indicates the impacts of choices, and documents choices made and issues considered. The tool can be used in meetings or individually. Different scenarios are possible for meetings. During a meeting, the participants can go together through the issues to be considered, or they can prepare for the meeting by going through the issues in advance and discuss them afterwards in the meeting. Currently, the application is only running on an iPad tablet and is not yet publicly available.

The paper also presents the current list of issues provided for the requirement analysis of a serious game for children. Note that it is not possible to come up with a single list that will fit all serious game development situations. Therefore, an appropriate list can be loaded when starting the app. Also note that the template presented does not provide explicit support for the specification of adaptive games [40].

The tool has been evaluated with two case studies. Currently, version 2 of the tool is under development. This version will be used to perform more evaluations.

Future work includes further refinement of the current GuideaTemplate, the elaboration of GuideaTemplates for other types of serious games and for different purposes, as well as the development of a collaborative version of the tool, which should allow working on the GuideaMap with different persons at the same time.

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