# Authoring Multiplayer Serious Games

## [Extended Abstract]

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## ABSTRACT
Over the last few years the idea of using video games for serious purposes such as education, training or health has gained widespread popularity. These games are, in contrast to their commercial counterparts, often meant to be played by single players. However, it has been shown that playing in groups trains social skills, supports collaborative learning and increases motivation. Multiplayer games therefore are especially suited for serious applications, but also pose additional challenges during their development.

Since most serious games are made by smaller teams on a lower budget than commercial games, there already exist concepts to reduce the complexity of their development process. We are planning to extend one of these approaches, namely authoring tools, in order to explicitly addresses the development of multiplayer games. Our concept will include templates that reduce the complexity of their implementation and guide authors, analysis & validation-algorithms that will give hints on how balanced a game is and rapid prototyping functionality that allows a single author to test the game in place of multiple players.

## Categories and Subject Descriptors
K.8 [**Personal Computing**]: Games

## General Terms
Games

## 1. INTRODUCTION
The topic of serious games, i.e. games with purposes other than fun like education, training or health, has been researched for quite some time now. It has been argued that games enable learning using the "native language" of younger people, providing an opportunity to address challenges in today's educational system [7]. Multiplayer games offer additional benefits like the development of social skills and training of teamwork, so they are especially suited for these purposes. It has been also suggested that multiplayer games enable collaborative learning, which is more effective than learning alone, and offer additional motivation for players [10].

However, there are few multiplayer serious games, which contrasts with leisure games where multiplayer modes are ubiquitous. One reason for this is the increased complexity of multiplayer games. For example, additional requirements like involving all players to a similar degree pose special challenges for the game design and testing cannot be done without a group of players. This contributes to the fact that serious games in general are already more difficult to create then leisure games because of the inclusion of specific content. This content is mostly provided by domain experts without game design or programming knowledge, increasing communication and coordination effort during the development. These additional challenges contradict the fact that most serious games are developed by smaller teams with a smaller budget and less time than leisure games, but are judged based on the same standards by players.

One concept that decreases the effort for creating single-player serious games is the use of authoring tools, which enable subject matter experts without a background in game development to build such games. We propose to extend this approach by covering the special requirements of multiplayer games in order to address the challenge of making the development of multiplayer serious games feasible. This will include the creation of templates containing multiplayer functionality, allowing easy access to basic functions like "gather all players" or more advanced and genre-specific interaction tasks. We will also develop a model for balancing contributions in multiplayer games as well as matching validation algorithms and a rapid prototyping environment that allows authors to test their multiplayer games without the need for additional players. While these concepts also apply to multiplayer games in general, some aspects like balancing gain additional complexity when applied to serious games, for example when learning content is included.

## 2. RELATED WORK
Zagal et. al. [12] describe a design process tailored to multiplayer games and the interaction between players. Important issues include reasons for social interaction, competition and required amount of coordination. Design heuristics by Garzotto [2] cover educational multiplayer games explicitly.

If a game is meant to support collaborative learning, it must be collaborative in the first place. This means that all players must share the same ultimate goal and that they always win or loose as a team. Zagal [13] outlines some lessons and possible *pitfalls* related to collaborative gameplay such as giving players different abilities and responsibilities or preventing players from deciding for the whole group. Manninen and Korva [4] provides collaborative puzzles and finds that constraining the environment makes the players stay together more often or that having a threat of punishment increases the need for collaboration.

Collaborative learning requires the correct setup. According to Dillenbourg [1], this includes the right group size, distinct roles and symmetric knowledge of the participants. Zea et. al. [14] applies these principles to game design and derived guidelines such as individual accountability of the players, a leading role that rotates between the players.

Authoring tools are already used to support the development of singleplayer serious games. Their main features include process support by guiding the workflow, predefined templates that can be filled with arbitrary content, automated checks to prevent errors and visual programming. By offering these features, users without programming or game design knowledge can create or modify games with these tools. Some tools offer additional features such as adaptive gameplay, rapid prototyping or cross-platform publishing to further support the development process. Examples include *<e-Adventure>* [9], *SeGAE* [11] and *StoryTec* [5].

To the best of our knowledge there are no authoring tools for games that explicitly address multiplayer issues. Using game engines [6] is the most flexible, but also much more complex, alternative. Another idea would be to use mission editors from leisure games such as *Portal 2*[1]. These editors are often easy to use, but usually the resulting gameplay cannot be changed and the ability to introduce own content such as images or videos is very limited. For e-learning, there are authoring tools for collaborative settings such as *COLLAGE* [3], but these focus mainly on content and do not allow the creation of games.

## 2.1 Prior Work
In our prior work we compiled these sources into the following list of requirements for collaborative multiplayer games, covering both educational and game design properties:

- Give realistic and logical reasons for collaboration
- Require equal contribution by all players
- Minimize waiting times
- Promote communication
- Include actions to coordinate

We then modified the authoring tool *StoryTec* in order to allow the creation of multiplayer games [8] matching these criteria. The prototype focused mainly on basic adventure

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[1]http://www.teachwithportals.com

gameplay, supporting features such as scripts reacting differently for each player, but did not include specific user support for multiplayer issues. *StoryPlay*, the corresponding runtime environment, was extended with basic networking support, a simple avatar system and a text chat. After that, a collaborative multiplayer adventure game for two players was created with the authoring tool as an example use case.

An evaluation with 24 players showed that players enjoyed the game and that it fulfilled these combined requirements. The authoring tool itself, which was not the focus of that work, was deemed usable by experts. However it was also shown that using the new multiplayer features required lots of effort even for these users. We therefore concluded that in order to allow the creation of multiplayer games by inexperienced users, further improvements must be made.

## 3. PROPOSED RESEARCH
Our approach for supporting the development of multiplayer serious games by an authoring tool has three main concepts: *templates*, *analysis & validation* and *rapid prototyping*.

## 3.1 Templates
Templates are already used to encapsulate the implementation of complex features such as minigames. They serve as a guideline for inexperienced users and can be configured and filled with individual content.

We intend to create new templates based on multiplayer patterns, focusing on the interaction between players on different levels of abstraction. An example for a high level pattern is "gather all players", while "giving another player a boost" is more specific and only applies to a certain type of gameplay. For the next step we will continue to identify the properties specific to multiplayer games and to extract appropriate patterns from related work as well as from existing games. These abstract patterns will then be transformed into concrete templates.

One of the patterns we already discovered is player separation [8]. In order to promote interaction, players can possess different information, have different skills and tools or be at different locations. These types of separation can be either fixed by the author or freely decided by the players, for example by trading items.

## 3.2 Analysis & Validation
In a singleplayer setting the resulting game can be automatically checked for a set of common errors. This includes syntactic checks like "startscene given" or semantic checks such as "scene reachable under certain conditions".

For multiplayer games, these checks must be modified in order to work with different players acting concurrently. Also new checks must be introduced in order to ensure the game's balancing and workload distribution between players, which is often overlooked by authors who are not familiar with multiplayer games. The authoring tool could also calculate estimated waiting times for each player or give hints regarding the appropriate number of players if it suspects that some players will be idle for most of the time. For this, a model and formal definition for balancing as well as concepts for measuring how balanced a game is will be developed.

## 3.3 Rapid Prototyping

The idea of rapid prototyping is to let the author test his or her game without much effort, allowing short circles of implementing, testing and refining game functionality. When a game is made for one player, this can be solved by providing a preview in the authoring tool or a fast export to a runtime environment, preferably with debugging capability for internal models if present.

In order to test a multiplayer game, however, it is necessary to assemble the appropriate number of players, making it almost impossible to prototype the game as a single author. It is therefore necessary to allow one author to test a game for multiple players at once. A simple approach for this is a splitscreen-mode where the author takes turns between each player. Naturally this does not work for concurrent actions. Other ideas include a record & replay-functionality for acting in parallel or the simulation of other players, which will be developed and evaluated in order to assess their suitability. Additional overhead like setting up a network connection should also be eliminated for rapid prototyping.

## 3.4 Evaluation

These concepts will be implemented in the already existing authoring tool *StoryTec* and the efficiency of the validation-algorithms as well as the overall usability of the tool will be evaluated in user studies. We will also address whether the implemented patterns are understandable while providing an engaging experiences for the players. The focus will thereby be on the authoring tool itself and its ability to ease the development of multiplayer games, especially for a non-expert audience, and not on specific games created with it.

## 4. CONCLUSION

In this paper we described our approach for supporting the development of multiplayer serious games, which, although promising from a collaborative learning perspective, require much more effort to create then singleplayer games.

We proposed a concept for authoring tools that specifically targets the additional challenges of multiplayer games, which is based on *templates*, *analysis & validation* and *rapid prototyping*. While templates will be used to guide inexperienced authors and to reduce the complexity by hiding complex implementations, analysis & validation-techniques will be used to find errors or give hints regarding the balancing. Rapid prototyping then ensures that a single author can test the game easily, even if it would normally involve multiple players.

The overall contribution will consist of three main parts: a list of patterns commonly used in multiplayer games, their purpose and concrete templates based on them; a model for describing balancing and fairness in multiplayer games and associated analysis-algorithms; and a concept on how the interaction between different players can be tested by a single person.

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