Ingame Design Framework

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Abstract. The paper presents the framework on the educational online game design for social inclusion. Authors are analysing the pedagogical approach and technological solutions for the game design and planning educational online games. The focus is placed on the social and civic skills development and values along with associated knowledge to be gained by the players during the gameplay. We are suggesting pedagogical aspects framework for the game planning in the INGAME project and technological framework for game design.

Keywords: Online game · Education · Technological framework · Social inclusion · Civic skills

1 Introduction

Nowadays learners have an opportunity to gain deeper skills by playing games in the educational process. Games have been recognized as a type of media that can engage students in experiential educational experiences [1].

Moreover, games are popular among younger generations and technology has always been part of their lives, therefore the use of gamification within education is ideal. Players are spending many hours developing their problem-solving skills in games. Gamification has a great potential to motivate students, consequently making school more attractive. However, it is important to note that although the use of gamification in education comes with many benefits, it is necessary to balance this alongside traditional teaching methods [2]. Many authors [3–5] declare that game thinking and motivational design have a positive influence on intrinsic motivation, by providing a meaningful and engaging experience, to promote an internal desire to play.

Digital Taxonomy [11] was created to help educators understand how to use technology and digital resources for improving learning experiences and outcomes. Its application suggested by Churches includes using digital tools in the educational process, in order to improve the process, in some cases, without even additional costs [11]. Further-

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more, ICT-enhanced activities can also be adapted to different learning styles and, as a set of digital activities, a didactic database for both teachers and students may be created [12].

In recent years, the implementation of gamification in the field of education proved to be a success. It has also been shown that gamification can be effective at all levels of education, from elementary school to university. Students' motivation, commitment, and academic achievement were all improved as a result of using gamified learning, according to the systematic analysis [13]. Gamification of the educational process has multiple uses, as it is commonly applied to improve achievements at school but may also be used with teaching methodologies such as project-based learning or in online learning environments [13].

As it was discussed by Parra-González et al., presently, as a result of technological advancements, games have undergone a digital transformation, allowing users to learn content ranging from conventional games to cutting-edge video games with large digital loads. Gamification may be used at various stages of education, showing its value at an early age, in adolescence, and even in university contexts. All of this leads to the conclusion that ICTs play an important role in gamification because they allow the development of various training scenarios through online games, and they can generate learning in any context, whether formal, non-formal, or informal, due to their ubiquity [14].

As it was identified by Spieler and Slany (2018) the game design elements can be broken into three subcategories: (1) gaming-world (e.g., level design, theme, genres, like adventure, action, puzzle, simulation, strategy); (2) game-structure (the rules of the game and the goal, MDAs); (3) game-play (e.g., the story, the player and their actions, strategies, and motives) [6].

Meanwhile, Zou et al. (2018) are focusing on the assessment dimension in the educational online game: (1) Performance (commonly used to judge the learning outcomes directly, including measures like task completion time, test scores, reaction time, interaction time, and accuracy of interaction); (2) Usability (the ease of use and learnability of a tool, device or an application); (3) Cognitive states (one of the crucial factors determining whether the learning is successful. Cognitive load, engagement, attention are widely used cognitive states in learning); (4) Affective states (In learning, affective processes are intertwined with cognitive processes); (5) Social interaction (Social interaction refers to the learner's interactions with peers and teachers) [7].

According to the literature review, we can identify 6 main areas of the game design and implementation in total, i.e. (1) Interface, (2) Challenges, (3) Time penalties, (4) Leader - board, (5) Music and (6) Feedback or reflection.

2 Methodology

The educational scope is one of the most important aspects if we are planning an educational online game. The authors focus is on the social and civic skills development ,

values along with associated knowledge to be gained by the players during gameplay. Required skills for players to interact with the game and the skills and knowledge will gain via interaction and gameplay, also see relevant learning outcomes – which of the game activities help to reach the learning outcomes.

The narrative and storyline - which relates to the background story of the game – the 'world' of the game, including the description of the characters and how they interact, the settings, the action fields, plot points, ethical dilemmas, the resolution of conflicts at the end of the game and also design the problems of the game. Design one or two scenarios and possible solutions.

The game genre - relates to the genre category of the game (puzzle/adventure/narrative game in our case) as well as to the single-player, the NPC and their interaction (dialogue, conflict, etc.). What are the motivations for action and types of actions that the player can take, for how long and what will the outcome be?

The experience of the players relates to the emotions that players develop during the gameplay. Moreover, it is important to consider the following aspects. How music or narration will be used? Can learners get any feedback at a different level? How maps or menus and score tables will be used? Is it planned that learning results to be provided?

All these educational aspects and technological solutions are identified in the paper.

3 Results and Discussion

This section presents a technological discussion on educational game implementation. The result authors are describing in the paper is based on the INGAME project results related to social inclusion (https://ingame.erasmus.site). The component of Visual and Audio Adequacy will refer to what the INGAME content under development actually looks like. Areas of concern include the interconnection of images, animations, text and music, and the type and format of content communicated to the user.

However, the technological aspect is not the only one when speaking about educational game design. The pedagogical implementation is also very important by possibly choosing a useful taxonomy [11] for the assessment assurance in the online game (see Fig. 1).

Technological advances, availability of digital tools, can help to improve student skills eventually leading to the emergence of taxonomy. However, pedagogical aspects are important in planning achieving learning outcomes.

The next step is choosing technologies and implementation. The specifications and guidelines for audiovisual content can be divided into the following parts: audio-related guidelines (background music, sound effects, audio dialogues), video-related guidelines (graphics, models), and general technical guidelines for game creation (execution environments, game engines, and development environments).

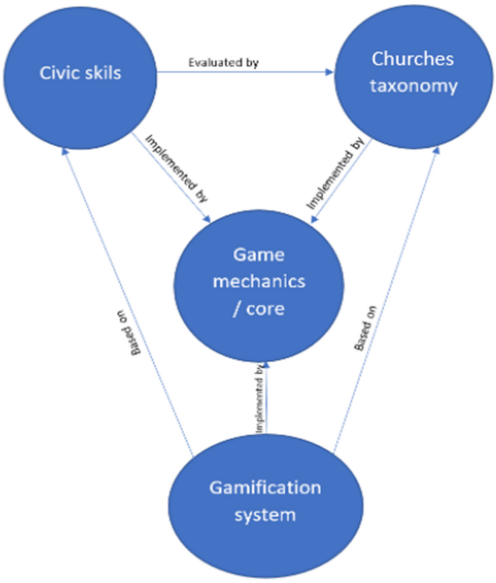

Fig. 1. The pedagogical aspects for the game of INGAME project.

All the above-mentioned specifications are connected to a single game mechanics model (Fig. 2).

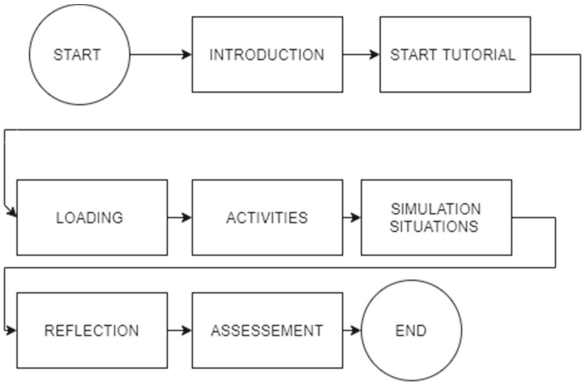

Fig. 2. Game mechanics.

INGAME ideas for civic engagement and social inclusion are focusing on the steps for game implementation (Fig. 3).

The technological framework includes a full learner journey from the beginning to the assessment by identifying the achieved learning outcomes.

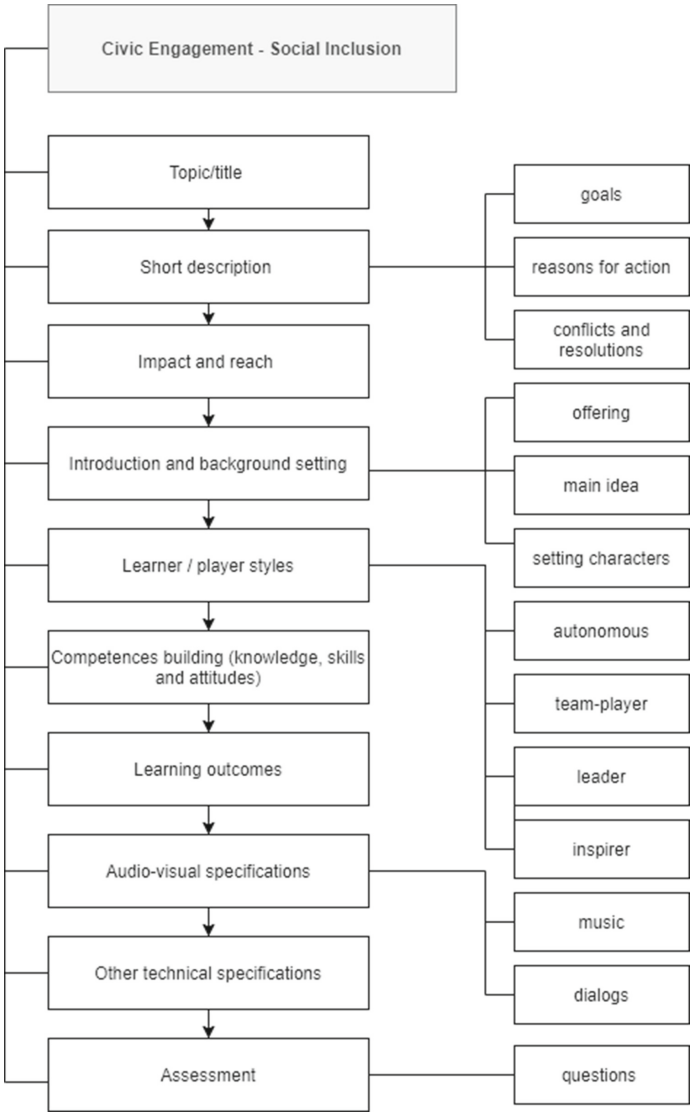

Fig. 3. The technological framework for game design.

3.1 Audiovisual and Other Technical Solutions for Educational Game Design

The following are audiovisual qualities that enhance the fulfilment of Action Fields. The right music is crucial in the game. We should define what the music will achieve. Music may perform several different functions. The genre and mood of the game have to be clearly defined. This is an important step, as it sets the tone and creates the ambience of the video game.

Possible type of background music: (1) ambient music for games, (2) battle music for games, (3) fast music for games, (4) instrumental music for games.

Moreover, in video games, music is critical because it contributes to the player's sense of immersion as one of its functions. Munday distinguishes [15] three main functions of video game music:

1. Environmental: how music supports the perception of a gameworld.
2. Immersion: how music supports the player's involvement in the game.
3. Diegetic: how music supports a game narrative.

Meanwhile, Peerdeman [16] identifies several different uses of sound effects, achieving preferred results, one of the main uses being to *attract attention*, for example, when interacting with an object, like picking up an item. Another audio feature that is often used in games is the ability of sound to *evoke an emotional response* by using certain sound effect when the player completes or fails a certain task. Audio can also be used to create a certain *ambience or suggestion* by choosing a type of music suitable for a particular scene or situation. The ability of audio to *enhance the structure* and *add a sense of location* in the game world is the final attribute on this list, helping the player with the orientation.

From a technical standpoint, there are a variety of sound formats. The music can be considered of good quality if it is encoded using a sampling frequency of 96 kHz (16bit) or 192 kHz at 24bit. The preferable formats for downloading are the lossless formats such as WAV, AIFF, FLAC. On the other hand, popular formats such as MP3 or AAC are sufficient.

Another important part of the game is the dialogue. Dialogues in video games should be carefully designed as they help to identify with characters and also written in a convincing style for the intended audience [18]. However, an emphasis should be put on the collaboration and individual work of the protagonist. Churches [11] even claims that 'Collaboration is not a 21st century skill, it is a 21st century essential'. UNESCO's publication [17] identifies collaboration as one of the four pillars of education: (1) learning to know; (2) learning to do; (3) learning to live together; (4) earning to be.

3.2 Video-Related Choosing Between Two- and Three-Dimensional Graphics

Two-dimensional games use flat graphics, called sprites. The sprites do not have three-dimensional geometry, although three-dimensional models might be used before converting them to sprites. These sprites are drawn to the screen as flat images.

Three-dimensional games are created by using objects with three-dimensional geometry. Besides geometry, the materials and textures are used to make geometry appear as solid environments, characters and objects that make up the game world.

Some two-dimensional games use three-dimensional geometry for the environment and characters but restrict the gameplay to two dimensions. Sometimes, the games that follow this approach are called the "2.5D games". In this case, the three-dimensional effect is used to enrich visual appearance.

When choosing what kind of a game should be created, it is necessary to consider the following criteria: (1) the team competencies, (2) the game development pipelines, (3)

the animation, (4) the volume of data, (5) technical limitations, (6) the game performance, (7) the game level creation, (8) the game usability (9) the chosen devices, platforms, and execution environments will impose specific technical requirements (Fig. 4).

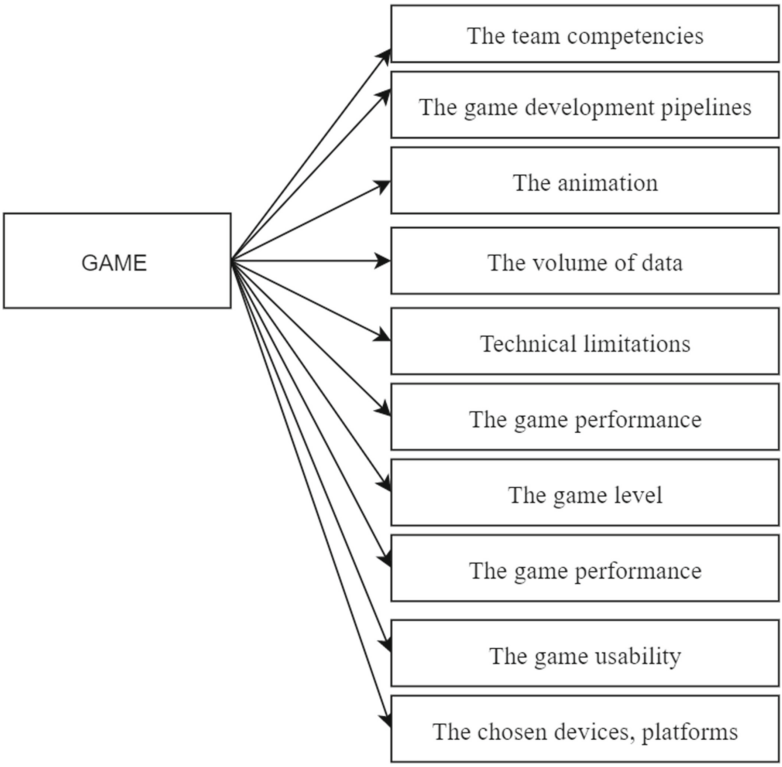

Fig. 4. Requirements for game planning.

The requirements for game implementation should be discussed in the online game planning process.

3.3 General Technical Requirements

Nowadays, a game can run on desktop computers, consoles, laptops, tablets, smartphones, TVs, smartwatches. Each group of these devices differs by a big margin in computing power. For example, smartphones have a hundred times less computing power in comparison to desktop computers. Because of the computer power, it is not possible to create such immersive environments for mobile devices. Therefore it is necessary to identify the target group and identify the preferences of the target group. Other factors also impact the choice. For example, if we wish that the game would be played during the breaks or travels - we would prefer to use mobile devices.

Moreover, the chosen devices influence the platforms. Some devices impose a specific platform (for example, Android, iOS, or Windows solutions), but there might be

cross-platform solutions as well. There are two approaches that allow the creation of games for different platforms:

1. Choose an engine that is able to create native applications for different platforms.
2. Choose an execution platform that runs on different operating systems and devices.

Modern game engines, such as Unreal Engine, Unity engine, Godot, allow packaging games for different platforms (the 1-st approach). The most widespread execution platform for the 2-nd approach is a browser. It runs on virtually any device. The second approach is better if our priority is the spread of the application because we don't need to target specific platforms. On the other hand, browsers do not provide such capabilities as native applications. Therefore - it is not possible to achieve such realism and immersiveness using this approach.

However, the games are not only an entertainment product but also a complex technical system with the aim to give the end-user a satisfactory, often entertaining, experience, game development is a complex task where system engineering and creative competencies in art and design must be handled in the same project infrastructure [8–10]. Video Game Engines are complex pieces of software capable of 3D rendering, high-end physics processing, particle effects, entity management, artificial intelligence, UI, player control and interaction, terrain transformations and internal game economies [8]. Choosing the game engine depends on various criteria we discussed. When choosing one needs to take into account:

1. development team competencies (are the team members able to use the specific engine?) and learning curve;
2. supported platforms (can the game engine export game for the required platforms?);
3. required level of realism (can the game engine render immersive and realistic environments?);
4. licensing costs.

There might be many more factors considered when there is more information available about the game to be created. In this section, we will overview 3 popular choices.

Unreal Engine. This is a popular game engine created by the Epic company. This game engine is able to produce visuals and interactions required for AAA games. Such a popular game as Fortnite was created using this engine. The Unreal Engine supports many different platforms, but the support for browsers is discontinued; therefore, the development team should not choose this engine if the target platform is a browser. The licensing model is friendly – developers are free to use this engine until they earn a specified amount of money. The learning curve is steep as it is necessary to learn the internal structure of the game engine and the specific pipeline.

Unity Engine. This is also a popular game engine created by the Unity Technologies company. This game engine is able to produce quite good visuals and interactions, but there are limitations. The Unreal Engine is better in this regard. Such popular games as Tarkov, Hearthstone, Gwent, Wasteland were created using this engine. The Unity Engine supports many different platforms, as well as supports export for browsers. So,

the development team could choose this engine if the target platform is a browser. The licensing model is friendly as well, developers are free to use this engine until they earn a specified amount of money. It is easier to learn this engine when compared to Unreal Engine.

Godot. Godot is an alternative to more sophisticated game engines such as Unreal and Unity engines. You can not achieve such good visuals and interactions as one can using mentioned engines, but it is easier to learn and to use, and it creates smaller execution files. It also supports export for browsers. Godot is a good choice if the priority is to create a simpler game dedicated to browser execution platforms.

4 Conclusions and Recommendations for Game Design

When choosing what kind of a game it is needed to create, it is necessary to consider the following criteria:

1. The team competencies. Creating two-dimensional games is easier because the math behind 3D games is far more complex. The programmers need to know effective 3D data structures. The game engines that support 3D games are more sophisticated and the learning curve is steep.
2. The game development pipelines. It's about - how the game assets are being created and integrated into the system. Three-dimensional games usually have more complex pipelines, and game engines require the use of specific pipelines.
3. The animation. Animation in two dimensions is just a compilation of flat graphics frames. When creating a three-dimensional animation one needs to deal with separate animation assets, bones, skinning, etc. On the other hand, sometimes it is easier to acquire required animations as the model contains all necessary information in contrast to 2D pictures.
4. The volume of data. If the amount of data might be a problem (for example - games for mobile), one needs to keep in mind that three-dimensional games usually contain a lot more resources.
5. Technical limitations. One needs to keep in mind various restrictions imposed by target devices, platforms, and game engines used.
6. The game performance. There are game performance requirements imposed by the market, device makers of publishing stores. Specific platforms and devices might severely limit the choice. If the game is dedicated to VR devices - strict performance requirements are imposed by publishing platforms.
7. The game usability. When creating 3D (or even - 2.5D) games, the game creators have to deal with camera tracking. It is a sophisticated task to implement intuitive control of a character in a three-dimensional world. Some users that didn't play 3D games before might struggle to learn the navigation.

The given list of criteria indicates that it is harder to create a 3D game. On the other hand, 3D games increase impressiveness, realism, versatility. Therefore the choice should be based on both - the aim of the game and the existing possibilities. The chosen devices, platforms, and execution environments impose specific technical requirements.

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