Serious Game Design for and with Adolescents: Empirically Based Implications for Purposeful Games

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Abstract. Serious games have been successfully implemented in many fields in recent years. Along the way, the call for audience specific solutions rose within the game community. In the course of a project focusing on fostering social media literacy among adolescents, we have developed a design for a serious game tailored to this specific age group. We present the results of a survey conducted among Austrian youths ($N = 86$) in which the participants reported on their gaming preferences and habits. The results are supplemented with data from participatory design workshops. Considering prospective players, their resources, play environments, and the game's characteristic goal, we provide general directions for serious game design for adolescents and address ethical questions.

Keywords: Serious games · Player personality · Characteristics and demographics · Game based learning · Mobile games · Development methodology

1 Introduction

Digital games have become an ubiquitous phenomenon - their diverse technical implementations reaching all ages and genders. Drawing from the motivational potential of such games, various areas have integrated gameful solutions to achieve other, non-entertainment purposes. Summed up by the term *serious games*, these solutions have been reported to positively impact many fields [5]. Especially among adolescents, serious games have helped in diverse areas reaching from dietary education [8,23] to the support of psychotherapeutical goals [6,26].

As they are applied in various fields and settings, serious games involve highly heterogenous user groups. Therefore, one-size-fits-all solutions are hardly feasible, underlining the need for specifically tailored solutions [2,34]. With regard to these customizing efforts, the various motivational types among gamers need to be accounted for. Following a player type analysis by Bartle [1], several authors

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have analyzed the various motivations for playing games [16,33,37,38]. Nevertheless, most of these studies have, not surprisingly, only focused on gamer populations, who are not necessarily representative of serious game audiences. Another upcoming trend, gamification, has somewhat ensured an integration of non-gamers in the analysis of suitable game elements [35], but related research still lacks more systematic approaches. For example, suitable technical implementation - based on resources and user skills -, interfaces or consideration of technology usage patterns have been underrepresented in scientific analysis.

This paper aims to fill these gaps by discussing future directions for serious games for adolescents, based on empirical data and literature-based research. Data was gathered in the course of a project that focuses on social media literacy as well as transparency about attention economy and related business practices. We present the results of a quantitative study among adolescents, with further input stemming from workshops held in school classes in Vienna. In this, an analysis of gathered data demonstrates the potential of participatory methods to inform game design. We will address the following research questions:

RQ 1: How can serious game design decisions be best tailored to accommodate technology usage patterns among adolescents?
RQ 2: What game elements and interaction patterns currently best address adolescent preferences?

In this paper, we will outline our methodology and, subsequently, our results. Following this, our research questions and findings will be discussed with the help of an exemplary case study, thus contextualizing our project and its practical application.

2 Methodology

2.1 Quantitative Survey

We conducted a quantitative online survey among our prospective player group of Austrian adolescents. In total, 88 participants ($f = 36, m = 50$) filled in the survey between November 2018 and February 2019. Our sample ($N = 86$) consisted mostly of Austrians ($n = 85$), aged 12–19 ($M = 15.0$, $SD = 1.40$), and a majority lived in Vienna ($n = 72$) at the time. Most participants were high school students ($n = 74$), one participant was currently pursuing an apprenticeship, and one participant attended university. The survey was completed in German. Previously gathered data, as presented in [14,15,19], and online privacy guides tailored specifically to adolescents [30] served as a basis for the design of our survey questions which are presented in the following sections.

Gaming Preferences and Habits. To support subsequent game development, we gathered data on our prospective players' gaming preferences and self-reported practices, such as the amount of their overall weekly time investment

in games (PC/console based and mobile gaming) or duration of the gaming sessions. We asked for weekly time spent with gaming (open format) and duration of gaming sessions providing a range from: 0–15 min, 15–30 min, 30 min–1 h, more than 1 h. The survey also asked for a ranking of preferred player interaction patterns, based on Fullerton [12]: Single Player vs. Game, Player vs. Player (One vs. One), Multilateral Competition (All vs. All), Team Competition, Cooperative Play (All vs. Game), Unilateral Competition (One vs. All). To accommodate players with less well-established preferences, a "not sure" option was also provided. Furthermore, participants were asked to list situations (open format) in which they prefer to play mobile games.

Gamification User Types. The questionnaire included the Gamification User Type Hexad scale [35], which consists of 24 non-gaming related statements. Building on gamification types as developed by Marczewski [24], the scale is especially suitable to include non-gamers' preferences and analyses motivational aspects. Participants are asked to indicate their agreement on a 7-point Likert scale from "strongly agree" to "strongly disagree" and are subsequently categorized into several types: *Philantropists* are considered to be altruistic and drawn to supporting and helping others, while not expecting rewards. A *Socialiser's* motivation is framed as based on creating connections and interacting with others - even competitively. *Free Spirits* are characterized by their interest in exploring and creating, while *Achievers* enjoy learning new things, overcoming challenges and improving themselves. *Disruptors'* main motive is change, both positive and negative. Finally, *Players* are regarded as extrinsically motivated, striving for rewards, and acting accordingly in order to collect many of them.

2.2 Workshops

Following the methodology presented in [14], we held a workshop combining a variety methods to gather participatory data on the game's design. The workshop took place in a 10th grade class of a Viennese highschool and was attended by 23 pupils ($f = 11, m = 12$). Pupils were split into 5 teams and took part in quizzes, intermixed with group discussions, in order to introduce and discuss the topic of social media practices. Subsequently, game prototyping sessions took place, in which every team created their own, social media-related, prototype. Special focus was paid to character design and development. Game prototyping consisted of a phase of idea generation, which was then followed by a modified version of world café to discuss ideas with members of other teams, and then culminated in paper prototyping and sketching sessions. The prototypes were presented in a final team challenge and subsequently analyzed by the research team. Previously gathered data [14] had already determined the game's genre (jump 'n' run) and storyline: the player's character and their companion are trapped in a digital world inside a smartphone after agreeing to an app's dubious Terms of Service. They have to master several challenges to find a way out. Participants of this workshop were asked to think about and create characteristics, abilities and the appearance of the player character and their in-game companion.

3 Results

3.1 Quantitative Survey

Gaming Preferences and Habits. According to our data, 84% ($n = 72$) of the participants play digital video games, either on a PC, console or on a mobile device. This group will henceforth be referred to as gamers. Two thirds of female participants play digital video games in any form, compared to 96% of male participants. More specifically, 61% of the female participants play *mobile* games, as well as 82% of the male participants. As Fig. 1 shows, about a third (34%) of the latter reports playing on the mobile platform daily, compared to 8% of female participants. Notably, 19% of participants whose parents don't have higher education never play mobile games, compared to 10% of those with one parent with higher education and 3% among those with two parents with higher education. Similarly, 22% of participants with immigration background never play mobile games, in contrast to only 5% of participants with Austrian background. Figure 2 displays weekly video game play time. On average, participating gamers play for more than 14 h weekly (all platforms combined), but tend to invest more time on PC and console based games (9.1 h) rather than mobile based games (5.2 h). This is mostly due to a strong preference of male gamers towards non-mobile gaming, as female gamers report a total score of 6 hours per week evenly split between 3 h of mobile and 3 h of non-mobile games. In general, male gamers invest more hours in gaming, with a total mean score of 18.5 h per week.

Results on player interaction patterns are displayed in Table 1. The favored approach was team competition, as a total of 38% of gamers ($n = 33$) ranked this pattern first. This interaction pattern was the most popular with both male (44%) and female gamers (31%). Single player mode scored second in general, with 22% of overall votes, 22% of male votes and similarly, 22% of female votes. Female gamers were more undecided concerning interaction patterns, as "Not sure" ranked second in their preferences (25%). Among male gamers, 4% could

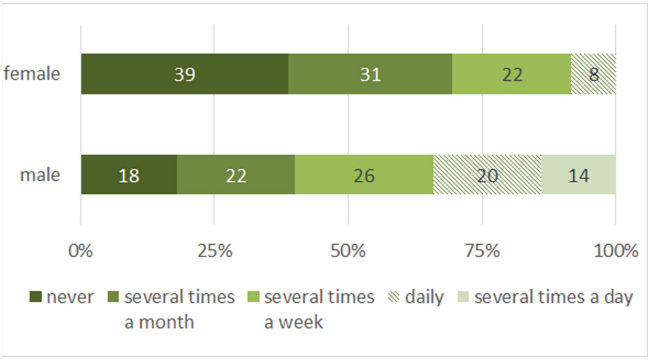

Fig. 1. Frequency of playing mobile games among participants (in percent)

Table 1. Favored player interaction patterns

	Overall	Female	Male
Team competition	38%	31%	44%
Single player	22%	22%	22%
Not sure	13%	25%	4%
Cooperative play	9%	14%	6%
Player vs. player	8%	6%	10%
Multilateral competition	6%	0%	10%
Unilateral competition	4%	3%	4%

not decide on a specific interaction pattern as well and ranked "Not Sure" in first place. Cooperative play (overall: 9%, f: 14%, m: 6%), player vs. player (overall: 8%, f: 6%, m: 10%), multilateral competition (overall: 6%, f: 0%, m: 10%) and unilateral competition (overall: 4%, f: 3%, m: 4%) were less frequently ranked in first place, with multilateral competition receiving no female votes at all.

Participants reported the length of their gaming sessions as follows: among mobile gamers ($n = 63$), the most frequent duration for one session is up to 15 min (37%). About a third (30%) play 15–30 min and 27% report playing 30 min–1 h. Only a small margin of participants (3%) play more than an hour per session. This might be related to the most commonly reported situations, which we summarized into following categories: when waiting or during breaks ($n = 14$), in public transport or during commute ($n = 14$), before going to sleep ($n = 6$), at school ($n = 5$), when they're bored ($n = 4$) or while in the bathroom ($n = 3$).

Gamification User Types. Based on the data from the HEXAD questionnaire items, *Philantropist* received the highest score among user types. It was closely followed by *Socialiser*, *Free Spirit* and *Player* types. *Achiever* received a rather

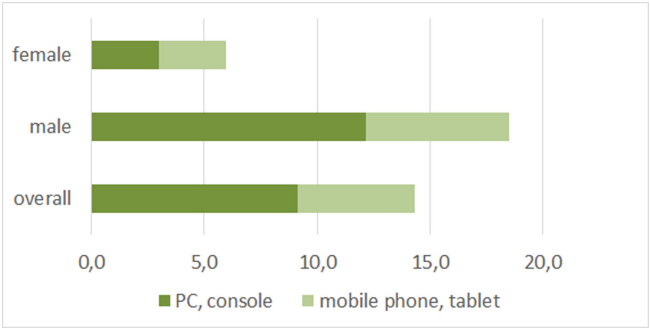

Fig. 2. Weekly video game play time (in hours)

Table 2. Gamification user types

User type	Mean score	S.D.
Philantropist	21,07	4,50
Socialiser	20,84	5,19
Free spirit	20,70	3,77
Player	20,14	4,22
Achiever	19,78	4,61
Disruptor	14,31	4,51

similar mean score of 19.78, with *Disruptor* being the only notably lower mean score of 14.31 (see Table 2).

3.2 Workshops

The 5 groups in the workshop consisted of 2 all-male teams, each having 5 members, while one team was mixed ($f = 2, m = 2$) and 2 teams were all-female, consisting of 4 and 5 members, respectively. All teams created a player character and a companion character. A large majority of player characters was designed as humans, with the exception of one all-female team, who designed an animal player character. Companions, on the other hand, where more diverse: 2 human characters (both stemming from all-male teams), 2 animal characters (all-female teams) and companion with a more abstract appearance (a fireball), designed by the mixed team. Two teams included customization of the player character in the beginning of the game, while all 3 teams changed the companion's looks according to the progress of the game, considering the required in-game development of the companion. Only one team also included the improvement of abilities of the companion character, who learned new forms of movements and attacks to fight against enemies in later stages of the game. One team portrayed player character progress by providing new and stronger weapons. While several teams included hostile non-player characters (NPC) in the presentations of their game, none specified their appearance in more detail. They were, quite contrary to the player and companion character, mostly closely related to the game's setting inside a digital world: 2 teams presented viruses, one team referred to a Trojan (horse) and one included "Twitter birds" as enemies.

4 Serious Game Design for Adolescents

The following sections will discuss possible future directions for serious game design, considering several crucial aspects: 1) characteristics of prospective players, 2) play environments, i.e. the setting in which the game will be played, 3) player resources, referring to both available hardware and a player's skill (physical or cognitive), and lastly, 4) the game's characteristic goal, which refers

to the defining, non-entertainment goal of the game [7]. Based on our empirical data, we compiled a list of recommendations that help to tailor serious games for adolescents and address RQ 1 and RQ 2 as posed above.

4.1 Considerations for Serious Game Design for Adolescents

Technical Considerations. Intended deployment platforms and their specifications should be closely considered as design choices might limit the possibilities of prospective players to participate. Especially outside of formal education settings, in cases where no hardware is typically provided, both hardware availability and skills of our prospective players may present constraints. Mobile platforms are by far the most widespread among the examined demographic [10]. Additionally, while adolescents are savvy smartphone users [13], research reports that they experience difficulties using desktop computers and related software [4]. The latter has also been indicated by our own research [19]. However, consoles, desktop computers and other platforms are a suitable option when availability, training and support are provided or when the characteristic goal, e.g. for exergames involving physical movement, calls for it. In other cases, the mobile platform appears as the most suitable and also necessary choice.

User Interface (UI) and Controls. General guidelines in user interface design call for the use of simple and common UI elements [36]. The latter refers to familiarity, which, again brings up the issue of inclusive design considering non-gamers and their knowledge, or lack thereof, regarding common game interaction elements. Research has shown that natural user interfaces may engage users more in comparison to conventional approaches [27,39]. The advent of messaging platforms, especially among our prospective players [28], for example, suggests natural language interaction as a promising solution.

Session Design. Several smartphone practices indicate a strongly habitualized use of the device and installed apps, be it triggered at certain times of the day or by certain situations, e.g. traveling to school, or feelings like boredom [17, 19]. While many app designers make use of these persuasive techniques [11,18], serious game designers should consider the use of these triggers from an ethical standpoint. Since heavy smartphone use can potentially lead to stress among adolescents [29], building habit-forming products, might not always be advisable in a serious game setting. While progress-indicators are certainly important from a learning perspective, and also a popular feature among adolescents [14,18], measures should be taken to ensure that these games do not foster addictive tendencies - by e.g. limiting play time [25]. Providing statistics about play time or implementing warnings when a certain threshold of play time is reached would also help to create transparency in these matters. Beside ethical considerations, prospective player's practices should be taken into account, such as average duration of game sessions. This is relevant for the design of some game elements, for example: subgoals (e.g. time to complete a level or challenges) or check points

in order to save a game's progress. More than a third of our participants report an average length of up to 15 min for their mobile gaming sessions, another 30% play between 15 and 30 min. This would be mitigated by splitting the game into sections with less than 15 min duration, using short puzzles, levels, or checkpoints for appropriate segmentation.

Gaming Motivations and Player Interaction. Previous work identified challenge and, even more so, competition as major motivators for teenage gamers [16,33]. These findings are only partly mirrored in our survey's data: *Achievers*, which are drawn to a game because of its challenging aspects, have not been represented prominently in our sample, ranking 5th out of 6. Also, the *Philantropist* user type scored highest among our participants, characterized by people motivated by cooperation and helping others. This is in line with our findings about adolescent workshop participants, who readily opened up about their social media usage when considered experts, as in our game design workshops [14]. *Socializers* scored second highest, a category which includes those enjoying competition. This is also supported by team competition as the highest ranked interaction mode. Nevertheless, multiplayer scenarios might restrict playability by e.g. asking for a minimum amount of active players or internet connection. In some situations, it might also be inappropriate for the learning goals, e.g. in psychotherapeutical settings [32]. Single player mode is an appropriate player interaction in such cases, especially considering that it was among the favorite play modes, thus also catering to player preferences.

Story and Character Design. Story and character design can be addressed by a more creative and exploratory approach, supported by participatory and co-design methods [9,20,31]. Especially when designer and intended user groups differ in main characteristics, e.g. age, gender or cultural background, participatory design can support suitable design choices [7]. Insights can be gained on familiar metaphors, graphical styles or storylines in the context of the game's characteristic goal. Results presented above suggest that adolescent players might prefer human avatars for player characters but are more open towards animal or abstract companion characters. Prototypes, developed in the aforementioned workshop, also suggest that the design of NPCs is preferably closely related to the game's learning goals and game setting: in our case, the player encounters Twitter birds, viruses and Trojans in a digital world set in a smartphone.

The 4 above mentioned criteria can of course not be viewed separately but always interact with each other: e.g. the play environment might determine what hardware is available and what kinds of interfaces are the most appropriate. In the following sections we will provide an example of how these factors can interact and how they can be taken into consideration for the design of a serious game.

4.2 Case Study

The following section presents the design of a serious game project supporting social media literacy among adolescents. Participatory methods accompanied the

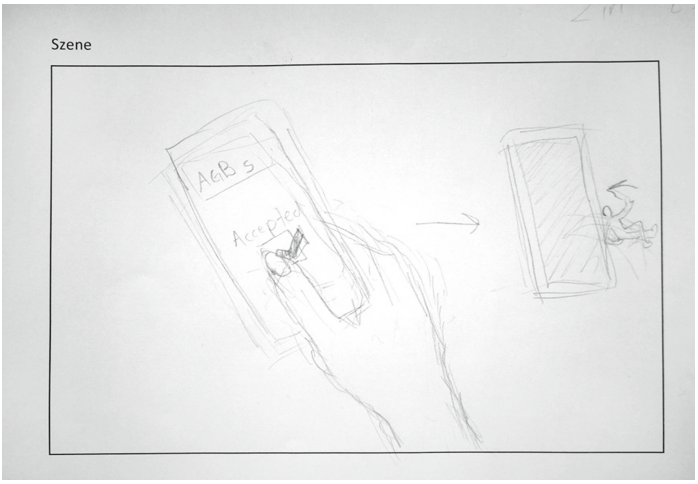

Fig. 3. Storyboard displaying the player's companion agreeing to questionable terms of use

development process and are the foundation for story and character design [14]. In terms of the above mentioned criteria, the prospective players are adolescents aged 14–19. As the game is intended for non-formal education purposes, the play environment is not specified. Evaluation of technical resources and player's relevant skillsets are based on previous research [4,10,19] and on the survey presented above. The game aims to provide transparency about attention economy and related gamification practices as well as data privacy. This characteristic goal is another determining factor for game design decisions.

The story of the game, developed in previous workshops [14], revolves around the player character and their animal companion, a caterpillar. After agreeing to dubious Terms of Service (see Fig. 3), they get sucked into a digital world representing the insides of a smartphone. The player is introduced to the game's map, consisting of several little villages the duo has to visit to reach the final level before being able to exit the smartphone. Each village represents one level, which covers a topic from the field of social media and related practices. By completing the levels, the player will gain both knowledge and related in-game items necessary to access and play through the final level. Based on adolescents' prototypes [14], it will be a jump 'n' run game intercepted with puzzles and quizzes. The characteristic goal of the game was introduced in the design sessions beforehand to facilitate the development of relevant stories and prototypes.

Considering available technical resources among our game's audience, the game is developed for a mobile platform, given that 97% of adolescents aged 12–19 own a smartphone, according to studies in the region [10]. As several of our research participants reported to not have regular access to the internet [19], the game, once installed, does not rely on an internet connection to ensure playability, especially in many of the gaming situations mentioned in our

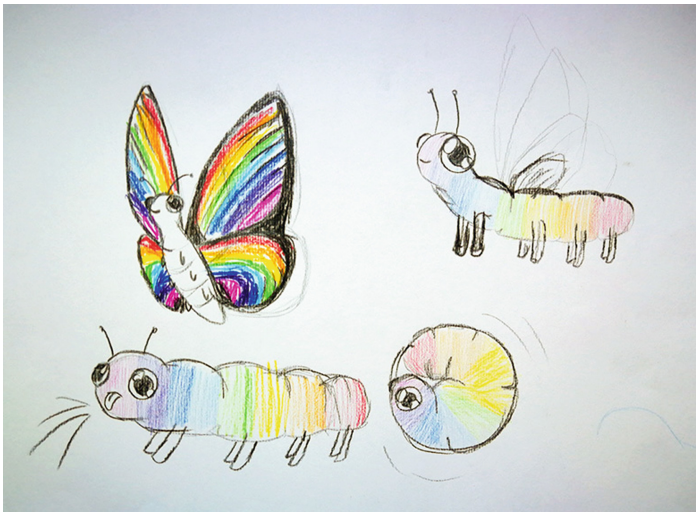

Fig. 4. Companion's optical development as designed in a participatory session

questionnaire. Despite suggestions from participants to include e.g. motion sensors, controls are based solely on touch input to accommodate a larger variety of smartphones, including older models.

The interaction with the companion (Fig. 4) will be supported by a text-based dialogue system, or chatbot, for various reasons: it is one of the most-familiar interaction methods for adolescents on a mobile phone [28] and it holds a great potential for reflective learning [21], e.g. by asking questions and allowing free text input. Spoken language interfaces will not be implemented, since most reported situations for mobile gameplay do not allow for uninterrupted interaction. While multiplayer settings would accommodate findings regarding team competition as popular interaction mode, single player game mode was selected due to the need for offline play.

The large number of *Philanthropists* among our users will be addressed by establishing a teacher-student relationship between the player and their companion. Based on the protégé pattern [3], the player will learn by discussing their knowledge with their game companion and answering their questions.

5 Discussion

The presented findings lay out current issues in serious game design for adolescents, based on empirical data. While there is a large body of research discussing the various motivational factors of gaming, we address some of the issues that come into play when drawing on these findings. Serious games need to include the characteristics of non-gamers as well, a group that has been largely neglected so far in these studies. According to our results, participants with parents with

no higher education degree play less mobile games than others, as do female participants. This underlines the necessity for a more inclusive approach, to ensure that serious games accommodate the needs and preferences of their diverse audience members. Nevertheless, due to the non-representative sample of our survey, further investigation will be necessary to address this issue and consider further implications for inclusive game design.

Furthermore, we are aware that the criteria presented as guidelines for game design decisions and requirements do not represent an exhaustive list. Serious game projects are often subject to additional restrictions. For example, available resources, in terms of time, staff or budget oftentimes do not allow the free pursuit of all possible options. Also, while we strongly recommend participatory methods in order to appropriately include prospective players and stakeholders, the generalization of results is limited. Ultimately, specifics of participatory design depend on the setting, the participant group's characteristics and previous gaming experience [22], among other factors. In addition, the materials used during prototyping sessions, might have, in our case, strengthened a focus on development of characters' appearances instead of their abilities.

6 Conclusion and Outlook

Our survey as well as qualitative data gathering indicate several further directions for research. While this paper focuses on adolescents, presented methodology can be applied among other age groups to shed further light on the intricacies of serious game design. Our team intends to conduct additional workshops in order to discuss and further develop our serious game prototype in an interactive process, thus evaluating requirements presented in this paper. As our results point to the differences in gaming practice, based on gender and socioeconomic variables, we conclude with a call for further serious games research seeking to understand and involve diverse audiences.

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