Serious Gaming for Behaviour Change

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Contributor: RAMY HAMMADY

Serious games (SG) are defined as “interactive computer applications, with or without a significant hardware component, that have challenging goals, are fun to play and engaging, incorporate some scoring mechanism, and supply the user with skills, knowledge or attitudes useful in reality".

Keywords: behaviour change ; game design ; serious gaming ; gamification

1. Introduction

In the last four decades, games have been designed purposely for behavioural change [1][2]. This is due to their popularity in providing leisure activity and entertainment to players [3]. Researchers exploited the appeal of playing games to influence players’ behaviours after witnessing significant behaviour changes while playing [3][4][5]. Since then, specific games have been particularly created and developed to help transform and change certain behaviours in different fields such as health, psychology, education, marketing, and tourism, etc. [6][7]. New terms have emerged to define these types of games such as: serious gaming, gamification, persuasive games, etc. Designing a persuasive game for serious purposes requires a thorough understanding of the relevant behaviour change theories that can feed into the design process [5]. Games that have been employed to make an impact on players’ behaviours are often aided by well-known behavioural change theories and the engaging characteristics of game design elements and mechanics.

1.1. Serious Games & Gamification

Serious games (SG) are defined as “interactive computer applications, with or without a significant hardware component, that have challenging goals, are fun to play and engaging, incorporate some scoring mechanism, and supply the user with skills, knowledge or attitudes useful in reality” *p28* [8]. Another definition relevant to this research is “Games designed for educational, training or modification of behaviour” [9]. SG are also defined as games designed for purposes other than entertainment [3]. They can provide an ideal environment to stimulate players to make decisions in complex processes or change their attitudes or behaviours [10]. SG have applications in a wide spectrum of fields, such as health, the military, education, and government [11]. Researchers in education consider the content of the teaching material used by teachers as the “seriousness“ part of these games [12].

Gamification is a term coined in 2008 in the digital media industry [13]. Before the second half of 2010, parallel terms with the same concept have been widely adopted such as “behavioural games” [14], “playful design” [15], “surveillance entertainment” [16], “productivity games” [17], and “funware [18]”. Gamification is defined as follows: “Effective gamification is influencing human behaviour through engaging experiences, using game design principles in decision-making applications and services” [19]. Others have defined gamification as the adoption of the methods of game design and game technology outside of the games industry [20]. It is often associated with behavioural economics, where game elements can be used to promote certain behaviour. Its application has spread rapidly in technology and health domains.

Though both terms, gamification and serious games, have been frequently used together in many studies, they are different approaches in terms of the way they work. Gamification blends the game mechanics with traditional activities, e.g., learning, physical activity, etc. [21]. However, serious games follow the typical game structure but also aim to achieve the goal that the game is built for, such as changing attitudes or behaviours. Serious games are entertaining, fun, and interactive even after aligning these games with the mission of achieving the goal needed [22]. While gamification involves the structure of a gamified traditional method, serious games can exist independently [23]. A very comprehensive study concluded that the differences between the two terms are that serious games include all game elements but to varying degrees, while gamification can involve an extraction and the application of a particular game element to a non-game process [24]. Here also criticised considering both terms as complementary approaches, even if they yielded the same game elements, as they applied them differently.

1.2. Definition of Behaviour Change Games

Behaviour Change Games (BCG) form a subset of serious games, which were designed in order to support attitude and change behaviours, as stated by Boyle and Connolly [3]. BCG have the same nature as what are often called persuasive games [25]. Persuasive technology is defined as “an interactive product designed to change attitudes or behaviours by making desired outcomes easier to achieve” [26]. Naturally, video games are used to implement persuasive strategies by utilising the power of mechanics and elements of the game design; for instance, self-monitoring, which can allow people to monitor themselves; conditioning, which offers rewards based on the performance of particular behaviour; and tunnelling, which is about leading players through a prearranged sequence of actions to either encourage or discourage particular behaviour [27]. Persuasive games have applications in many fields, such as health games, political and social games, and advertising games aiming to change behaviour regarding certain issues, such as encouraging recycling, discouraging smoking, or increasing voting [25]. Considering the significance of these types of games, this focused on BCG that have been produced in different areas.

1.3. Game Design Elements and Behaviour Change

Werbach and Hunter [28] categorised game features into Mechanics and Components. Bharathi and Singh [29] listed game design features, which are relevant to Mechanics, e.g., challenges, feedback, and rewards; and Components, e.g., achievements, avatars, badges, leaderboards, levels, points, and social graphs, as well as latent game design features.

Alike entertainment games, serious games have generic components and game elements, which are replicated and used in different titles [30]. However, the usage of these elements is for scaffolding purposes, and not as they are normally used in entertainment games [31]. Generally, features and mechanics in SGs have not yet been characterised and defined due to their complex nature compared with entertainment games [30]. To be more focused on behaviour change games or persuasive games, game design elements and mechanics vary based on the type of gamified application and the desired outcome, i.e., whether they are built for learning purposes, health behaviours, or fitness purposes.

For instance, in health applications, the game design incorporates several strategies, such as monitoring, harmony, group opinion, and dis-establishing [32]. In fitness applications, game design has been used to encourage players’ long-term engagement through social interaction. Therefore, different elements and mechanics such as social play, micro goals, fair play, and marginal challenge are often employed [33].

1.4. Behaviour Change Theories and Effective Game Design

Various persuasive games or BCGs from different fields are informed by the theories of behaviour change in the process of game design, such as health games [5] and exergames [34]. There is a relationship between the theories of behaviour change and the choice of game elements that should be embedded in BCGs.

Behaviour change through games often relies on Social Cognitive Theory (SCT) and the Elaboration Likelihood Model (ELM), comprising four main steps that demonstrate information processing, i.e., attention, retention, production, and motivation [5]. The first two phases are relevant to the learning process, and the second two are relevant to performance [35].

The Theory of Planned Behaviour (TPB) is one of the most frequently cited theories for predicting human social behaviour [36][37]. It was adopted to design games to influence the public’s behavioural intention to play online games [38]. Social-participation theory relies on involving a large group of people in an activity, and it has been used to inspire persuasive technology and game design processes [39].

Flow theory [40] has been used to improve interactive experience and video game design [41]. When the difficulty level of a task is balanced with competency, individuals can be more focused on achieving goals and more immersed in an activity, with a feeling of pure pleasure and enjoyment, without the need for external rewards [42]. Flow theory has also been used to drive behavioural change in games, and it is considered a natural foundation of games, especially educational games [43].

2. Serious Gaming for Behaviour Change

2.1 Game Features

2.1.1 Health

'Challenges' was the most common game feature in health studies; this feature taps into players' tendency to accept challenges in order to onboard and engage, as this behaviour can motivate players to complete the game [44]. Various health studies employ games that apply challenge mechanics that influence players to do or stop certain habits when they play together [45]. Challenges are also essential in exergames to encourage players to improve their skills and not lose the momentum and flow of the activity [46].

The existence of *'Rewards'* is a natural result of the challenge element in health games. Therefore, the element of rewards was the second most common in health games, which is due to it being usually applied in a gamification strategy to encourage individuals to complete the required tasks [47]. Rewards also motivate players to progress and to achieve the objectives of medical games in multiple stages [48]. Ref. [49] found that using rewards produces a sense of achievement for players.

Outcomes from challenges are often visualised as feedback through *'Points/Scoring'*, which was the third most common feature in health studies. The adoption of points and scoring in medical applications allows for the identification of problematic areas based on the challenges and scenarios the children engage with within the game, which, subsequently, allows doctors to identify issues faced by children after cancer treatment [50]. Studies using this feature have also shown a positive impact on stopping unhealthy attitudes as an outcome of engaging with mobile games [51], as they can be accompanied by challenges mechanics in order to be used for different measures, e.g., they can be part of a feedback loop to inform players of where they are in the game.

Rani and Sarkar [52] proved through their framework that real-time feedback can maintain the optimum challenge in games. Therefore, *'Feedback'* is a significant feature, which was ranked fourth most common in health games/gamified systems. Feedback has been utilised in health games in the process of behaviour assessment for the sake of enhancing engagement and comprehension, leading to changes in players' behaviour [53].

'Levels' represents the continuity of the challenge concept in a game, with every new game level marking a new challenge [54]. Levels were noted to be the fifth most used feature in health studies. Levels have contributed to health game design to scaffold the development of mental health literacy in young people, where each player's skill level is shared with other players to boost the game's appeal by fostering a sense of competition [55].

The sharing of players' statistics often encourages *'Competition'*, which has been considered a key element that promotes an entertaining experience for players [56]. Being the seventh most used in health games, competition is not entirely important for encouraging engagement in health games. However, this element plays a role in maintaining players' interactions during the process towards nurturing and changing behaviours and attitudes. Competition in health games often takes the form of team competitions, which also promotes collaboration, where players cooperate to ensure their team is winning [57].

It is interesting to note that a sense of control through customisability is also important, such as the use of characters controlled by players, which can influence engagement in the game-playing experience [58]. So, considering engagement is a significant factor in changing behaviours [59], the 'Avatars' element was the sixth most popular in health studies. Avatars used in gamified health applications have played a significant role in helping children choose healthier food [60].

Generally, designing games/gamified systems for health studies requires a clear understanding of the aims and objectives of the impact needed. The BCG design for healthy purposes should be composed collectively from several game elements that have shown significant results in changing behaviours. The results, particularly for the health studies samples, showed the priority of involving the challenge element and several ways of rewarding either scores/points, or incentive feedback. Additionally, to engage players within the game for a greater impact, involving competitions between players and/or teams would be effective. Game levels, also part of the challenge concept, and the ability to control avatars, showed a greater influence on player engagement.

2.1.2. Psychology

In psychology studies that involve BCG, *'Rewards'* took the first place. Wang and Sun [61] articulated those rewards can deliver pleasure and satisfaction to players. Rewards also showed a positive influence on adding the enjoyable factor for the players [62], which consequently impacts the intrinsic motivation [63]. A psychological study found that rewards in gamification systems can increase customers' loyalty to their vendors [64].

'Challenges' was the second highest adopted game feature in this domain, shown to increase the progress of a player in a game [65]. It was also demonstrated to increase players' effectiveness in mastering a game, which accordingly reflects on the players' behaviour [66]. Studies show that challenges are usually implemented with other game features to identify the

nature of the players' behaviour [67]. Other psychology studies embed challenges in their games to investigate players' responses to different choices presented in the game [68].

'Points/Scoring' took third place in phycology studies. Scoring as a game mechanic was also shown to have a positive impact on attaining the athlete engagement goals [69], which is perhaps caused by the competitive nature and scoring provided the familiar feedback for the players. *'Competition'* took third place, as it demonstrated significant contribution to the understanding of a player's behaviour and to stimulate players for doing more efforts towards certain behaviours during play [70]. *'Avatars'* took third place as they were adopted for exploring the identity of players [71].

'Feedback' took fifth place. Psychological games prefer the use of feedback as it was found to motivate players to continue playing or to mitigate their poor performance [72].

Generally, the reviewed psychology BSG studies often prioritise rewards and incentives, as well as the use of challenges. Points/score and feedback are part of the challenge, feedback, and reward loop. This can be combined with the adoption of avatars and the sense of competition in the game mechanics in order to obtain effective outputs.

2.1.3. Education

'Rewards' took first place and was often demonstrated to influence intrinsic motivations when it comes to learning [73], such as increased or sustained engagement in educational games [74][75].

Education significantly relies on *'Feedback'* [76]; therefore, it took second place in BCG in education studies. Studies have shown that feedback has significant influences on learning effectiveness if learners regularly receive it [77], which perhaps links to the use of points/scoring and rewards as part of the informative feedback.

'Challenges', in third place, was revealed to be slightly less significant in education studies when compared with health and psychology, though this element is still one of the main features in BCG games or gamified education systems for achieving better learning and retention [78]. Challenges also help players stay in the flow towards mastering the game [79]. As mentioned earlier, challenges can stimulate motivation. For instance, Denis and Jouvelot [80] suggested that motivation during an educational process can strengthen students' attention. Furthermore, when challenges are presented in a game, the game provides a safe space for training and can meaningfully evaluate the student's learning performance [81]. The previous elements are often part and parcel of the challenge-feedback-reward loop.

'Competition' in an education context can motivate students to learn and change their attitudes drastically [82]. Therefore, this game element took fourth place in education, as it was shown to increase students' abilities to learn programming skills [83]. *'Points/Scoring'* took fifth place in education studies. Games that use this feature amongst others were also shown to motivate learners to focus on their performance to achieve goals, as they seek higher scores during play [84]. *'Levels'* was the fifth most used and mentioned in educational BSG studies. Game levels have been utilised for educational purposes as they support the levelling up approach where learners progress through the game from one level of difficulty to the next, which can enhance their engagement in learning [85]. *'Avatars'* were in ninth place in education studies. The adoption of avatars in BCG games was shown to help players achieve learning goals in education games [86].

Designing BCG for an education context emphasises the use of rewards (points/scores) due to its significance and perhaps familiarity in the common education process, followed by the integration of feedback mechanics. Challenges can be integrated into the game and the mechanics of competitions, especially if the game will be played by groups or through role-playing scenarios. Other game elements that would impact engagement in the game include avatars and levels.

2.2. Behaviour Change Theories

'Self-Determination Theory' was the most commonly used theory in '*Psychology*' and '*Education*' studies, and the second most common theory in '*Health*' studies. This theory was adopted to develop games with aspects that are used to respond to the motivational factors related to autonomy, relatedness, and competence [87]. It has been adopted for health games to provide and improve wellbeing services [88]. This theory has also been adopted in many education games, for instance in games that help students practice music education [80], promotes students' motivation, engagement, and problem solving competencies [89], and its efficiency in motivating students through the social adaptive e-learning was proved [90].

'Social Cognitive Theory' was the most commonly adopted theory in 'Health' studies, and the third in 'Psychology' and 'Education' studies. Integrating this theory with health serious games has demonstrated game design that has an impact in directing and guiding healthy behaviours [91]. In psychology studies, it has been adopted to explore the video games' effect on players [92]. Education integrated with entertainment aspects was introduced by digital games through the adoption of social cognitive theory in the game design phases [93].

'Theory of Planned Behaviour' was the third most adopted theory in 'Health' studies, and the second in 'Psychology' and 'Education' studies. In health studies, it helps to inform game design that influences positive healthy behaviours, and has also been used to help predict healthy behaviours that can be achieved through games [36]. The theory allows the exploration of people's intentions to play online games [38]. It has contributed to education studies, as a game informed by this theory has been shown to stimulate children to use exergames for learning physical lessons [94].

'Flow Theory' was the third most frequently adopted theory in '*Health*' and '*Psychology*' studies. Flow theory can be used to design serious games able to help treat cognitive disorders in the elderly [95]. It has also led psychological games to investigate the effects of gamification [96].

'Theory of Fun' was the fourth most frequently mentioned and adopted theory in '*Education*' studies; however, it did not appear in '*Health*' or '*Psychology*' studies. This theory has contributed to the design of games for education purposes [97].

'Motivational Theory' was ranked fourth in '*Health*' studies, fifth in '*Psychology*', and third in '*Education*' studies. It was adopted to improve the travel behaviour change [98]. It was also part of designing gamified systems for health and wellbeing purposes [80]. Moreover, it was integrated into games that helped to practice music for students [80].

'*Self-Participation Theory'* was ranked fourth in '*Health*' studies and third in '*Psychology*' studies. It was used to explore players' attitudes towards using wheelchairs as part of health game applications [99]. Moreover, it was adopted to change behaviours by promoting pro-environmental behaviours [100].

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