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The Opportunities and Challenges of Serious Games for People with an Intellectual Disability

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Abstract

Serious Games (SG) are increasingly used to deliver education and training to support well-being, social skills, independent living and online safety. This presents opportunities and challenges for users, developers and educational providers to ensure their benefits are available to all. People with intellectual disability (ID) experience high levels of digital exclusion. This article reviews and synthesises the literature on the use of SG with people with ID. Recent work indicates the importance of the psycho-social profile of the game player, mechanics, and game context. We consider how these factors influence the inclusivity of SG and how they could be addressed. We demonstrate how a psychological perspective illuminates the impact of the user's psychological profile on game use and effectiveness, and explore how culture, personalisation and learning analytics can increase inclusivity of SG. We conclude by identifying wider challenges such as the need for multi-disciplinary working and a more integrated, conceptual framework for games design which addresses diversity in learning needs.

Key Words: Serious Games, Intellectual Disability, Psychology, Game Mechanics, Games Design

1. Introduction

Serious Games (SG) are used across social, work, educational and healthcare contexts to deliver and support a rapidly expanding range of content. This expansion is generally attributable to the engaging nature of games and their ability to support self-paced learning and provide immediate feedback (Boyle et al., 2016). Developing SG is a complex interdisciplinary exercise, involving those with content knowledge, technological skills, and learning expertise. This complexity is illustrated by Kelley et al.'s (2017) analysis showing that game experts identified 76 different concepts relevant to designing games for health.

There are no agreed guidelines for SG design and evaluation, although there are several suggested frameworks. De Freitas & Oliver's (2006) four-dimensional framework (4DS) highlights the usefulness of considering the components of learner, pedagogy, context and representation (how the game represents the content and desired learning outcome), while Garris et al. (2002) suggested an approach that integrates game characteristics with instructional content to provide specified learning outcomes. More recently, Arnab et al. (2015) endorsed the need to integrate learning and games mechanics, with their Learning Mechanics-Game Mechanics (LM-GM) model. In this paper we build on this clear need for greater integration and highlight the benefits of adopting a detailed and explicit focus on the user, game and context of use.

Issues concerning design and understanding of how and why games function as effective vehicles for education and behaviour change are highly relevant in the context of games for health (Kelley et al., 2017), especially their use by disabled populations. However developing games for individuals with intellectual disability (ID) introduces an additional layer of complexity into the design process that requires in-depth understanding of their cognitive, social, emotional and behavioural needs.

ID is a significant life-long experience that has three components: (1) reduced ability to understand new or complex information or learn new skills (in global rather than specific areas); (2) reduced ability to cope independently; (3) onset before adulthood (before age 18) with a lasting effect on the individual's development. People with ID experience high levels of exclusion, including digital exclusion (Darcy et al., 2016), such that uptake of technology by people with intellectual disability is considered to be substantially less than within the

mainstream population (Sheehan & Hassiotis, 2017). Reasons for this are multiple, however accessibility is a fundamental one. As devices become more complex, the importance of accessibility in user interface and physical design become paramount. The Universal Design paradigm seeks to promote the broad accessibility of new artefacts, yet its realisation is partial, as exemplified in accessibility web standards which currently benefit those with sensory or physical disabilities more than those with ID (Waight & Oldreive, 2016).

In this context, the use of SG by people with ID further demonstrates the need to understand their abilities and needs. Recent reviews of the use of SG by people with ID, Autism Spectrum Disorders or other developmental disabilities identify various opportunities and challenges in using SG to deliver education and training to support health and well-being, social skills, emotional skills, independent living and online safety (Grossard et al, 2017; Tsikinas et al., 2016; Zakari et al., 2014; Noor et al., 2012). For example, Cano et al., (2016) classified games via learning outcomes with the aim of developing an evidence base to inform games design. The classification is built not only upon the explicit recognition of user needs and preferences, but also comprehensive user testing and longer term evaluation to assess the capacity of SG to build skills and support behaviour change over the longer term.

It is important to note that, while there can be overlaps between the populations of people with ID, and those with an Autism Spectrum Disorder, the two are not the same. Despite this, it is possible to identify common themes and challenges across the conditions, such as the difficulties of designing for such a heterogeneous population, the importance of personalisation, the relative lack of an evidence base to inform games design and limited understanding of how games support learning in general and of people with ID in particular.

1.1 Integrative approach

Recent work concerning SG in the general population indicates the benefits of applying the psychologically informed tripartite framework of Gamer, Game Mechanics and Context, both individually and in their complex interactions (Boyle et al., 2017; Ramsay et al., 2017). In this paper we adopt an integrative approach in considering how these three factors may influence the uptake of SG as an educational medium for individuals with ID, and how their consideration may allow some of the identified challenges to be addressed. Given the breadth of the literature relevant to this end, it is not our intention to provide detail of the studies

cited, beyond their main findings, but to focus more on promoting an integrative understanding.

2. Opportunities and Challenges: A Psychological Perspective

A major advantage of SG is that they provide a safe and pressure-free environment to experience activities and solve dilemmas. As Kwon and Lee (2016) summarise, SG provide an opportunity for acquiring skills through repetition, at the individual's own pace, without the consequences and risks that can arise from real world implementation, and in a way which accommodates potential issues around insecurity and anxiety (Tomé et al., 2014). Tomé et al (2014) also highlight attention issues that may be evident in individuals with disabilities, and which SG can accommodate through their potential for capturing and holding attention. Applying a psychologically-informed characterisation to such issues, based around consideration of the Gamer, Context, and Mechanics, can provide insight into both SG design generally and specifically for people with ID. The aim in this paper is not to specify the requisite user interface design solutions per se, but to persuade the SG development community, both technologists and educators, that there is an empirically-informed need to position individuals with ID at the heart of the development process

2.1 The Gamer: Psycho-social Profile

The existing evidence base in e-learning and games-based learning recognises the important influence of the user's psychological profile, such as limited attentional and memory resources, the distributed and contextual nature (Godden & Baddeley, 1975) and psychological context e.g. emotional state (Woike et al., 2009) of memory, and the importance of motivation, self-regulation and metacognition to help regulate learning (Terras & Ramsay, 2012; Ramsay et al., 2017). Many of these considerations are also reflected in the evidence base and design process of SG for people with ID (Tomé et al., 2014). However, the socio-emotional profile of people with ID is relatively neglected. Potentially, this represents a missed opportunity, as mainstream research in SG illustrates the ways in which gameplay can impact positively on motivation, excitement and emotion (Ryan et al., 2006). In addition, several theories have been widely used to explore the reasons for and benefits of games use, and thereby inform game design. These include Self-Determination theory which considers players' needs for autonomy, competence and relatedness as drivers for game playing (Deci & Ryan, 2000) and Uses and Gratifications Theory which identifies varied reasons for

playing games, including: to experience challenges, to compete against others, to socialise, for excitement, for fantasy and as a diversion activity (Sherry et al., 2006).

These approaches highlight the need for successful SG design to consider not only physical accessibility but also *psychological accessibility*, not only in terms of cognitive factors such as attention and memory but also psycho-social attributes such as motivation, personality, emotionality and social skills. To date, attention has generally been directed at physical accessibility which can be defined as the ‘degree to which a product, device, service, environment or facility is usable by as many people as possible, including by persons with disabilities’ (ISO, 2017). This definition is reassuringly wide: it includes, but goes beyond, disability, to design for all. When designing SG for people with a disability it is important to differentiate between usability in the main and accessibility, with accessibility being focused on the avoidance of technical barriers to access, and usability focusing on the user experience (Hersh & Leporini, 2012). Although both are essential for satisfactory design, accessibility tends to be associated specifically with disabled users and ignores the fact that both accessibility and usability issues can be experienced by all users regardless of disability. A psychological perspective with a focus on the skills and preferences of all users distinguishes itself by offering an inclusive framework to support user-centred design that considers influences upon both physical and psychological accessibility and how these interact.

Consideration of the psychological profile of the user/learner is central to effective user-centred design, especially when designing for people with ID, for whom literacy and communication issues are prevalent and careful consideration of how instructions are conveyed is required. Usoro et al. (2016) recommend providing instructions as both text and audio, while Terras et al. (2017) suggest that the use of accompanying symbols, photographs and illustrations can assist comprehension. However, their use also raises questions around interpretation of and familiarity with the images used (Chin, 2017), and the cognitive load they impose (Buell et al., 2016), and further highlights the importance of recognising individual abilities and preferences. Accommodating such diversity is challenging but necessary, as there is increased recognition of the impact of atypical cognition in a games context, e.g. first person shooter games are generally not effective for people with attentional and impulsivity disorders (Tomé et al., 2014).

Tailoring support in these ways is relevant for everyone but carries a number of design challenges when considering the heterogeneous ID population. As Tomé et al. state, “pathology is a mere indicator” (Tomé et al., 2014, pg 3), since no two people are alike even if they share the same diagnostic label. While personalisation is frequently advocated as a solution for accommodating user heterogeneity, it frequently overlooks socio-emotional factors. The mainstream concept of flow may have some utility in relation to this. Flow can be defined as “the experience of being absorbed in an activity to the extent that self-awareness disappears” (Csikszentmihalyi, 1993), its experience being a major determinant in engagement with games. To date this has been under-explored by research exploring games use by people with ID.

Furthermore, the evidence base is rather limited with respect to individual differences in gamers with ID, and tends to focus on characterising differences via broader categories, such as the well documented deficits in socio-emotional skills in individuals on the Autism Spectrum and memory and language deficits associated with Down’s Syndrome. Whilst SG are being developed to address these deficits (e.g. Grossard et al., 2017) there is a distinct lack of research exploring individual differences in the traditional psychological sense e.g. motivation, emotion and personality: factors that have been demonstrated to influence the efficiency, engagement and enjoyment of SG. The lack of a broad evidence base is a major restriction on the development of comprehensive design guidelines that are transparently underpinned by a pedagogical strategy. Our current understanding of the actual learning processes involved in game-based learning in the general population, although developing, is hampered by the lack of a pedagogical approach (Boyle et al., 2017). These issues are even more pronounced with respect to the design of SG for individuals with ID. Providing effective and accessible games with options for personalisation necessitates an understanding of game mechanics.

2.2 Game Mechanics

The dimensions of “enjoyability” and “playability” have been identified as typifying SG (Procci et al, 2012). Playability is described by Procci et al (2012) as a holistic, integrative quality. If these aspects are to be incorporated into games for people with ID, then a detailed consideration of how they can be delivered, i.e. the Game Mechanics, is required. Arnab et al (2015) defined Serious Game Mechanics as the “design decision that concretely realizes the

transition of a learning practice/goal into a mechanical element of gameplay” (Arnab et al, 2015, p. 393).

A number of design factors that make entertainment games appealing have been identified: games are visually compelling and have sensory appeal; they provide interesting and novel experiences; they are challenging and interactive; they provide feedback; allow player control; change time awareness; and are motivating (Prensky, 2001; McGonigal, 2011). The Input-Process-Outcome model described by Garris et al emphasised the need to clarify how game characteristics are integrated with the relevant instructional content to provide productive player experiences in an interactive loop of player behaviour, system feedback and player evaluation, that lead to the specified learning outcomes. Arnab et al. (2015) also described how game features support learning activities with their Learning Mechanics-Game Mechanics (LM-GM) model which identified 31 learning mechanics (such as explore, identify, analyse) and mapped these into appropriate game mechanics (such as game turns, movement, feedback), providing a useful model for game design. These models strongly suggest the need to be clear about the learning outcomes sought, and how these can be realized in gamified learning activities. In-depth consideration of these issues is currently lacking in games for health generally (Kelley et al., 2017) and especially in games for individuals with ID (Baranowski et al., 2016).

While several pedagogical theories are relevant to learning in games, game designers have been eclectic in utilising relevant constructs from a range of theories, such as constructivism and situated cognition (Dondlinger, 2007), as well as active learning, self-regulation, experiential learning, and scaffolding (Arnab et al., 2015). It is most useful to identify learning activities or tasks that are required and the game activities that can best support these as Arnab suggests.

Games offer the capacity for ongoing performance review through learning analytics, the capacity to (generally unobtrusively) collect and analyse interaction data gathered by learning management systems. These are likely to be especially useful to maximise the learning potential of games for individuals with ID. Whilst learning analytics have been applied in educational contexts to improve learning, it has also been pointed out that it may be useful to distinguish “activity analytics” from “learning analytics” (Wilson et al., 2017, p.997). Ultimately, such data potentially supports learning if it is tailored to the individual student,

and can promote the inclusivity of SG by providing personalised learning. By embedding learning analytic models within health-related games, it is possible to capture the learning requirements of individuals with disabilities, and how they change over the course of the learning journey. Cano et al. (2016) embedded a learning analytics model within the game *Downtown: A Subway Adventure*, designed for learners with ID. The learning analytics captured included total time spent playing, progression and time elapsed without attaining a goal, which were then translated into user requirements. The use of game learning analytics is particularly challenging due to the highly interactive nature of games coupled with the short interaction cycles typical of gameplay. Nevertheless, evidence such as Cano et al. demonstrates both the feasibility of capturing learning analytic data for SG, and its use in adapting games to each individual's psychosocial profile.

2.3 Context

The use of SG does not occur in isolation: it is essential to consider the context in which it takes place. Context can be conceptualised in 3 ways: (1) Internal (psychological) to the individual and dependent on their psycho-social profile; (2) Game context which is determined by game design and mechanics; and (3) External, this being the context in which the game is played, which will include not only spatio-temporal aspects but also attitudes, culture and available support. Although the physical ability and motor skills of the gamer are clearly influential, the following discussion will focus on the relatively neglected psychological profile, rather than physical abilities, and how these and game mechanics interact with the different aspects of context.

Existing research in the general population demonstrates the importance of internal factors such as motivation, self-regulation and emotional engagement to the effectiveness of SG (Ramsay et al., 2017). To date, these factors remain relatively neglected in the use of SG for people with ID, and in many instances game design features, such as the more competitive aspects that enhance players' emotional responses and motives for playing, tend to be reduced or removed to make games more accessible. However, doing so undermines some of the benefits of using games and highlights the importance of adopting a more integrated approach.

User-centred design and personalization are key to such an approach, and should be considered with respect to game context and its interaction with user characteristics, and how they may influence the game's psychological context. For example, whilst fast pace, multilevel goals and feedback are generally considered as engaging factors of games, it is essential to remember that they may cause issues for some, e.g. noise feedback may be disconcerting for those with Autism, and overly complex goals may pose memory issues for those with Down Syndrome (Hersh & Leporini, 2012).

The external context of gameplay for people with ID is even more complex as these users often require support for such activities, which will have implications for design and use. For example, games that can be played both online and offline allows the offline mode to be used for training (Martins et al., 2011). It is also important to consider the more general context of social interactions and empowerment opportunities that games may present. Staff and carers (formal and informal) play an influential role in supporting people with ID in many aspects of their lives, especially in relation to healthcare decision making (Ferguson, Jarret & Terras, 2011). As a result, it is essential to consider the attitudes of staff and carers, as this may influence the support given.

Staff and carers may also vary in the extent to which they support the application of learned skills in real world settings. Indeed, transfer of learning from a game context to a real world one presents a significant challenge for all users, but particularly for people with ID, for whom development of skills within the context in which they will be applied is often promoted. However, as Cano et al. note, delivering supported learning in situ carries with it the potential to remove risks which could be encountered were the individual acting by themselves (e.g. being approached by a stranger when using public transport, or getting lost). Incorporating real world aspects into virtual environments is one response to this; another is utilising the functions of mobile devices to provide discrete prompts within real world environments (Brown et al, 2013). Virtual reality (VR) may present a further route for increasing the real world relevance of tasks. In summarising the literature regarding video games and ID, Jiménez et al., (2015) note existing work describing the use of VR, in both leisure and skill acquisition contexts. While it is appropriate to note, as Politis et al. (2017) do, that the evidence base in relation to VR and ID is still accruing, it is not difficult to anticipate it having a far greater role in the near future.

The extent to which culture enables the application of games-based learning is an additional contextual issue. Recent evidence suggests the effectiveness of SG may be influenced by cultural factors: a sample of UK, Swedish and Israeli children used the *Emotiplay* SG for recognizing others' emotions (Fridenson-Hayo et al., 2017). Whilst improvements were witnessed for all, the specific improvements varied, with the UK sample improving their body language interpretation, and socialization, while in Sweden and Israel, participants improved on all measures when compared to a control sample. The multi-layered aspect of such findings is significant: in combination with the other context issues identified, they highlight the need for effective SG for people with ID to be informed by a sophisticated, and deeply contextualized consideration of the individual.

3. Conclusion:

3.1 Summarising Insights

A psychological perspective on the opportunities and challenges of SG use by people with ID highlights the complexity of these. However, the three-factor framework of Gamer, Game Mechanics, and Context provides a powerful framework for managing that complexity, and generates a number of insights:

- *The psychological profile of the user should be incorporated into games design*

Consideration of the psychological profile of the user/gamer facilitates better understanding of the heterogeneous nature of the ID population, highlighting the complexity of user-centred design and the importance of personalisation. For example, it emphasises the relative neglect of socio-emotional factors such as engagement and flow in the design of games for people with ID and highlights the challenge of designing SG that are sensitive to both cognitive constraints and motivational factors that promote engagement. It also highlights gaps in the existing evidence base, particularly regarding the consideration of motivation and emotion. This is a serious oversight as such factors have been shown to be a major factor in both the enjoyability and effectiveness of SG. Relevant insights can be gained from considering mainstream models of immersion and flow, while the use of learning analytics to provide personalised feedback may provide a mechanism for increasing motivation as well as performance.

- *An Integrated Approach: The Utility of the Three Factor Model*

The use of our three factor model with its focus on Gamer, Game Mechanics and Context helps situate our discussion of SG for people with ID within the wider framework of SG research. Doing so illustrates the importance of emotional and motivational traits and how such factors have been relatively overlooked when designing games for people with ID. Our reflection on the interaction between the individual and the mechanics of the game draws upon emerging theories of game mechanics, illustrating how the explicit consideration of the nature of the game provides a framework that supports consideration of user-centred design but also aims to understand the actual games-based learning process itself - we need to understand both *how* and *why* games support learning. It illustrates the need to adopt a more explicit pedagogical approach that emphasises not only the specification of the learning outcomes targeted by a game, but also how these will be realised via the game mechanics.

- *The Complexity of Context*

The contextual influences on game play are complex and dynamic and our exploration of these reflects this. Considering not only the external but also the psychological context highlights the need to consider both, individually and in combination, when designing and using SG. This is especially true for people with an ID, particularly if the external context involves the provision of additional support from carers or others, a factor which has been relatively neglected to date. The characterisation of the multi-faceted nature of context raises awareness of skill transferability issues, and also highlights the complex nature of the wider context including culture and attitudes, and the support of others. This approach offers a framework to help situate future research and practice aimed at understanding how different game and gamers characteristics interact with context in a transactional manner across time.

3.2 Future Directions

A number of areas for research emerge from these insights. Firstly, there is a need for more multi-disciplinary working, drawing upon a range of expertise to ensure all needs are met. Designing and developing SG is a complex interdisciplinary exercise, integrating the content knowledge of discipline experts, the technical skills of game designers, pedagogical expertise and psychologists' understanding of individual differences.

Secondly, integration is also required at a theoretical level to ensure that the latest understanding concerning games design and mechanics, pedagogical approaches to game-

based learning and psychologically-based theories of engagement and use are applied to the design of games for people with disability. Whilst guidelines for the pedagogically-informed development of SG do not currently exist, this can potentially be remedied by adopting a trans-disciplinary perspective on development (Arnab & Clarke, 2017).

Thirdly, Torrente et al. (2013) observe that the greater challenges for learners with ID using educational games is the “design, content and mechanics” (p. 375). Design, content and mechanics are sufficiently broad as an area of endeavour that a trans-disciplinary approach is arguably not only necessary but inevitable. We advocate further research into the socio-emotional aspects of SG use by people with ID as it is essential to ensure that consideration of disability in the context of user-centred design does not overshadow the importance of more general principles concerning games design.

Fourthly, the disempowerment of people with ID within society remains a significant issue. Incorporating the voice of people with ID into the design of SG is one avenue for addressing this, particularly as Harris (2010) highlights the relative absence of the voice of people with disabilities within design-oriented conversations. Politis et al (2017) identify two main reasons for involving people with ID in the design of software: (1) ensure usability and usefulness and (2) social and individual benefits e.g. ownership, empowerment and social inclusion. SG may well be an important element of supporting people with ID to achieve greater inclusion within society. They may also potentially provide a means for those without disabilities to better understand the wider role of society in creating exclusion. Benefits would undoubtedly arise from further enquiry into both aspects.

Fifthly, the move towards globalization has produced products and devices that transcend cultural differences. Nevertheless, people from different cultures and with different types of impairments still have *a range of different beliefs, values and expectations of these same products* (Jhangiani & Smith-Jackson, 2007). The design and development of SG for individuals with disabilities is no exception. A potential way to align individual requirements with enabling technologies that are culturally-sensitive is the use of Hofstede’s (1997) dimensional cultural model. The dimensions are Power distance (inequality between society members); Individualism vs Collectivism; Femininity vs Masculinity; Uncertainty Avoidance; and Long Term Orientation. Hofstede’s dimensions have served as a useful framework to steer design development, including the development of mobile devices for

visually-impaired users (Jhangiani & Smith-Jackson, 2007). These dimensions are relevant to all, but may be especially powerful for people with ID, where the identity and emotional life of the individual is all too often neglected in favour of a focus on a (medically and socially constructed) group identity.

In conclusion, SG offer a range of opportunities to promote inclusion and empower people with ID, if appropriately informed by the user's psychological profile, culture, context, and socio-emotional aspects. We anticipate that the insights offered by psychological informed characterisation will serve as a catalyst for debate, discussion and future research.

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