

# A Literature Review of Serious Games for Intellectual Disabilities

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**Abstract.** Our review examines the literature on Serious Games used as learning tools for people with intellectual disabilities. Although intellectual disabilities are a very broad field where each individual has very specific characteristics, it would be beneficial to have general evidence-based recommendations about how to design videogames adapted to their cognitive requirements. Thus, the first step of our investigation is to identify and review the available literature on Serious Games for intellectual disabilities classifying them according to the learning outcomes associated. Search terms identified 43 papers covering this topic and our review presents the initial results. A second aim is to understand the mechanics designed, the methods used in the investigation and the data obtained. The final goal is to identify what is working in this kind of games and how this can be generalized into a methodology to simplify the creation of more effective games for people with intellectual disabilities.

**Keywords:** Serious games · Intellectual disabilities · Cognitive disabilities · Educational games · Autism spectrum disorder · Down syndrome

## 1 Introduction

The use of educational or therapeutic videogames for people with intellectual disabilities is still a relatively unexplored field. Even though intellectual disabilities are a very broad and diverse field where each individual has very specific characteristics, it would be beneficial to have general evidence-based recommendations about how to design videogames adapted to their cognitive features. To pursue this goal, the purpose of this paper is to identify and review the available literature on Serious Games for intellectual disabilities and classify the research found according to the learning outcomes associated to them. A second aim would be to understand the mechanics designed, the methods used in the investigation and the data obtained.

## 2 Serious Games for Intellectual Disabilities

Even though the different intellectual disabilities have similarities, it is not possible to standardize common requirements of all impairments and reflect them in the design of a videogame's mechanics. The result is that not all Serious Games are suitable as learning tools for all disabled game players [1, 2] so we are interested in identifying those articles referred to two concrete disabilities: ASD (Autistic Spectrum Disorder) and DS (Down Syndrome) for three reasons:

1. Down Syndrome is the most common genetic disorder found in newborns and the most common intellectual disability associated with mental impairments. The prevalence of Down syndrome has been reported to occur in about 1 out of every 600 live births [3].
2. ASD comprises a group of conditions within the category of developmental disorders. Due to its heterogeneity of symptoms, ASD is the disorder with the largest number of scientific investigations among the intellectual disabilities [4].
3. There are a large number of associations in Spain and US dedicated to ASD and DS (separately) that can provide us advice about the characteristics, skills, attitudes and behavior of each group and provide users for the actual game testing.

## 3 Method

To examine the available literature in Serious Games we applied a similar approach to the used by Connolly et al. [5]. First, we selected the databases that are relevant in the topic of this article: Computer Science, Psychology, Medicine and Science in general. All of them were accessed in their electronic format.

Secondly, we identified three groups of search terms that combined helps us to perform an accurate search in databases referred to the technology, the subject and our particular interest in game design and development methodologies. The final query used in the databases included terms like "videogame", "intellectual disability", "down syndrome" or "autism"<sup>1</sup>

As a result of the search we obtained 498 studies but not all of them were relevant for the purpose of our investigation so we applied the following selection criteria in order to choose which articles include in our review:

1. The purpose of the study is to test the acquisition of knowledge through videogames designed or adapted considering specific needs of a particular intellectual disability or a common feature in people with intellectual disabilities in general.
2. The purpose of the study is to identify patterns and behaviors in the use of videogames in people with intellectual disabilities.
3. The purpose of the study is to apply a methodology in the design or development of videogames for a particular intellectual disability or intellectual disabilities in general.

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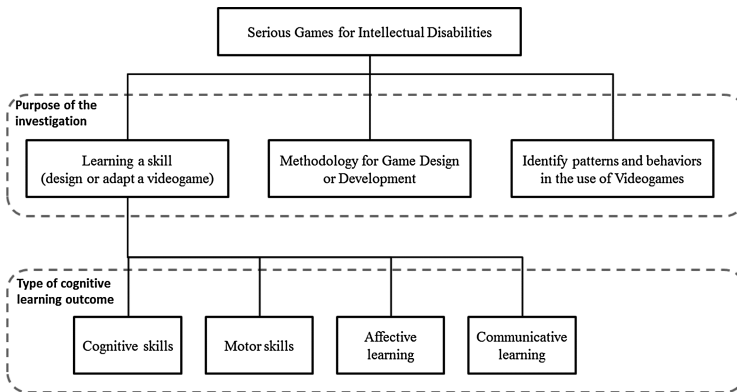
<sup>1</sup> Note that each database has its own nomenclature. We adapted the query to each database's search requirements without removing any search term.

In addition, we discarded the studies that do not appear in scientific publications and those published before 2005. Those papers that do not report an empirical evidence of the results has been included only when the results show relevant behaviors of the users or when best practices are identified.

We obtained 43 papers to include in our review following the method previously described.

#### 4 Classification of the Studies and Future Work

The studies included in our review are classified as follows: First, we determined the purpose of the investigation in accordance to one of our three inclusion criteria. Second, we applied the taxonomy described by Wouters [6] to those studies which purpose is to learn a skill (Fig. 1).



**Fig. 1.** Classification scheme of the studies included in the review

We provide an outline of the research available on Serious Games for intellectual disabilities by reviewing and classifying these 43 studies according to the purpose of the investigation and the learning outcomes associated to them. We think that the literature available is still insufficient because the majority of the studies do not provide empirical results that can be collected in a best-practice guide for developing Serious Games for intellectual-disabled people.

Our review is only a first step to obtain guidelines for creating more effective games for users with intellectual disabilities. Next step would be the identification, compilation, implementation and test of the best practices using a proof of concept. These best practices will be a mix of lessons learned identified in the review and our own assumptions.

Once we test the mock-up with our design assumptions, our final goal consists on describing a methodology that can be generalized to simplify the development of more effective Serious Games for people with intellectual disabilities.

**Acknowledgments.** The e-UCM research group has been partially funded by Regional Government of Madrid (eMadrid S2013/ICE-2715), by the Complutense University of Madrid (GR3/14-921340), by the Ministry of Education (TIN2013-46149-C2-1-R), by the RIURE Network (CYTED 513RT0471) and by the European Commission (RAGE H2020-ICT-2014-1-644187).

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