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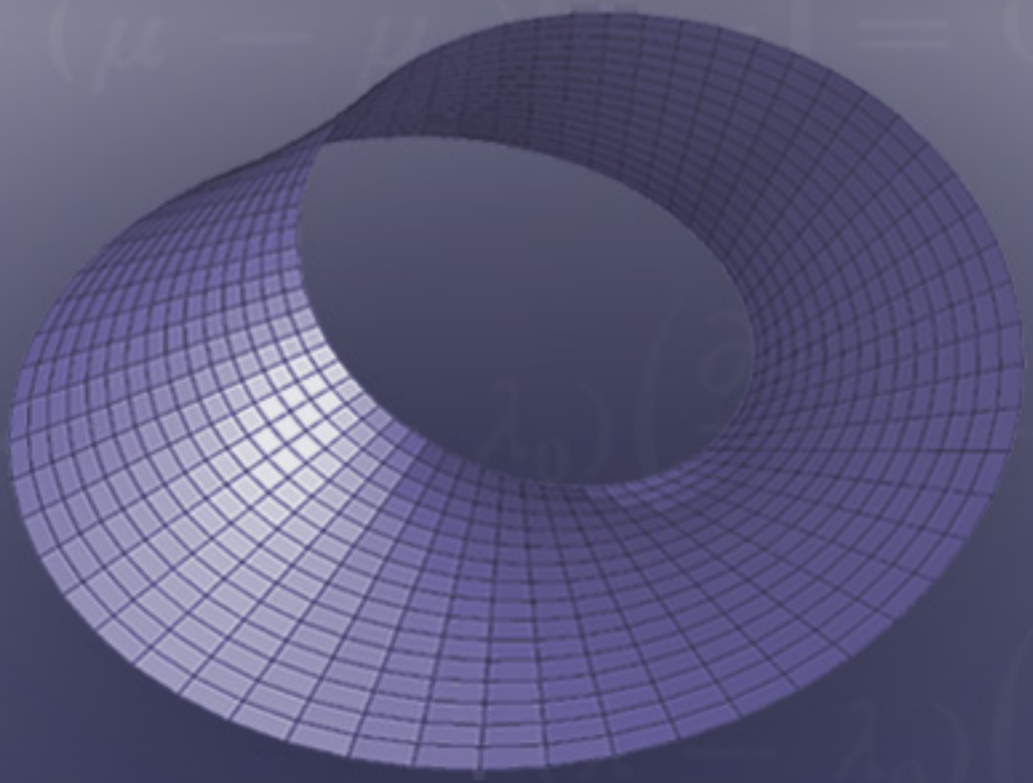

Digital Games-Based Learning for Students with Intellectual Disability

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ABSTRACT

Students with Intellectual Disability (ID) are often described as "slow learners" and cannot easily integrate to the normal curriculum. Still, the needs of a person with ID for accomplishment, enjoyment and perception of high quality multimedia content are augmented. In general education settings digital games for learning seem to work successfully with students, regardless of their developmental state or academic achievements. However, can such an approach work in a suitable and effective way for students with ID? If the answer to this question is positive, under which conditions and limitations can digital games be integrated into the ID instructional process?

The purpose of this chapter is to investigate the common grounds between methodologies for Special Education Needs/ Intellectual Disability (SEN/ID) pedagogy on the one hand and Digital Games-Based Learning (DGBL) on the other, as well as to explore the potential of using digital games for SEN/ID students. To this end, the usage of digital games in the learning experience of students with Intellectual Disability is discussed, the ways in which commercial and educational games support various SEN methodologies and theories regarding Intellectual Disability pedagogy are examined and findings from the education literature as well as experimental observations and case studies are presented in order to investigate how and to what extent learning-purposed as well as entertainment-purposed games are able to constitute a powerful educational medium for SEN education and its inclusive objectives.

1. OBJECTIVES OF THIS CHAPTER AND QUESTIONS ADDRESSED

Intellectual Disability (ID) is a term employed to refer to certain limitations of children and adults in mental development, communication and social skills. These limitations will cause a child to learn and develop more slowly than typical. In addition children with intellectual disability may take longer to learn to speak, walk and take care of their personal needs such as dressing or eating.

It should be noted that a number of wordings and definitions has been employed for the limitations and difficulties that Intellectual Disability refers to. Terms such as "Developmental Delay(s)", "Mental Retardation", "Learning Disability" and "Special Learning Difficulties" have been used over the past years. The term "Mental Retardation" has prevailed for some time but has received a number of criticisms lately. Following a 2002 survey by the American Association on Intellectual and Developmental Disabilities (AAIDD, formerly the AAMR[1]) which has shown the general consensus among parents, educators and other professionals to be that this term has a negative connotation, the term "Intellectual Disability" is currently used in British Commonwealth countries and by the International Association for the Scientific Study of Intellectual Disabilities (IASSID).

Intellectual Disability represents a widespread and heterogeneous condition, characterized principally by cognitive deficits in relation to the normal population (Zeaman & House, 1963; Ellis, 1963). According to the authoritative definition of the AAIDD[2] which undertakes a functional perspective, as well as the statements of researchers such as (Schalock et al, 2007) who states that "*Intellectual Disability is characterized by significant limitations both in intellectual functioning and in adaptive behavior as expressed in conceptual, social, and practical adaptive skills*", one of the basic characteristics of ID is the lack of adaptivity in everyday situations. Persons with Intellectual Disability might be delayed or lacking some of the so called Adaptive Behavior Skills such as reading, writing, expressive and receptive language, money concepts, self directions, responsibility, self-esteem, gullibility, understanding and following rules, daily living activities and occupational skills (AAIDD, 2008).

Within a formal educational context students with Intellectual Disability are often described as "slow learners" and cannot easily integrate to the normal curriculum, as a result of the aforementioned lack of adaptive skills and other low IQ-related difficulties, often coupled with additional handicaps and special needs. It is exactly these conditions, however, that result in an augmented need for persons with ID to draw a sense of enjoyment and personal accomplishment

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[1] It should be mentioned that the American Association on Mental Retardation (AAMR) continued to use this term until 2006. In June 2006, under the leadership of editor Steven J. Taylor, AAMR members voted to change the name of this association to "American Association on Intellectual and Developmental Disabilities" (AAIDD). As Taylor himself explains, however, "anyone who believes that we have finally arrived at the perfect terminology will be proven wrong by history. I am sure that at some future point we will find the phrase *intellectual and developmental disabilities* to be inadequate and demeaning" (Prabhala, 2007)

[2] "Intellectual disability is defined as significantly sub-average general intellectual functioning existing concurrently with deficits in adaptive behavior and manifested during the developmental period (Grossman, 1983 p.11) that adversely affects a child's educational performance. Based on the former American Association on Mental Retardation (Grossman, 1983) and the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 1994) and using intelligence (IQ) test scores, intellectual disability occurs on the four levels of mild (score 50 through 55 to approximately 70), moderate (score 35 through 40 to 50 through 55), severe (score 20 through 25 to 35 through 40), and profound (20 through 25)".

from the educational process. The aim of this chapter is to investigate to what extent pre-adult learners (children and adolescents) with Intellectual Disability are able to use digital games in order to test their abilities in a trial-and-error fashion within a formal – but nonetheless friendlier – learning process while at the same time having fun.

This objective calls for highlighting the common grounds between Intellectual Disability pedagogy on the one hand and Digital Games-Based Learning (DGBL) on the other, with a view to shedding light on the capabilities and limitations of applying digital games as instructional tools in the ID classroom. To this end a review of the relevant literature is provided, coupled with observations from a number of case studies using digital games as an instructional tool for students with ID. It must be noted that the term "digital games" is used in this chapter to refer to a broad spectrum of games running on standalone computers or on-line and implemented at various degrees of sophistication, ranging from browser-based applications to fully developed commercial-off-the-shelf (COTS) products, and also including a number of edutainment software applications.

The following questions are addressed in this chapter:

1. Can DGBL meet the instructional requirements of ID pedagogy?
2. Are there specific types of digital games that seem to meet these requirements in a particularly effectively way?
3. What are the critical success factors for applying DGBL to the ID classroom?
4. What are the limitations of such an effort?

The rest of the chapter is organized as follows:

- Section 2 sets out a correspondence between requirements for the instructional process and curriculum for students with intellectual disability, on the one hand, and the capabilities of digital gaming and digital games-based learning, on the other.
- Section 3 reports on a number of case studies on DGBL applications in the special and ID classroom, taken from a review of the associated literature as well as from the authors' own research.
- Section 4 discusses findings, recommendations, limitations and critical success factors associated to the application of DGBL as an instructional tool for students with ID.
- Finally, Section 5 concludes the chapter.

2. ID INSTRUCTIONAL REQUIREMENTS AND DIGITAL GAMEPLAY

2.1 ID Instructional Requirements

The aim of Special Education is to design and implement an alternative learning framework, in order to overcome the learning difficulties of special students and at the same time enable their social integration at the highest possible level of autonomy and self-determination. To this end, special education is offered through different structures and services, ranging from special schools, inclusion practices, pull-out classrooms and support classes to SEN bases or units, outreach services as well as residential care centers.

Adoption of a number of instructional principles is instrumental to the achievement of the objectives of Special Education in a systematic and effective way. The relevant literature discusses a number of such principles, whose applicability may depend or not on specific types of special needs such as ID and others. Table 1 below, lists requirements applicable to the planning

of instructional processes and curricula for learners with Intellectual Disability, as adapted from (Kalantzis, 1985) and (Christakis, 2002).

Monitoring and immediacy (Christakis, 2002)	Individuals with moderate or severe intellectual disability have difficulties in the understanding of meanings, ideas and objects that are not situated in their "here and now" experience. Monitoring and immediacy are essential components of the instructional process.
Entrenchment and practice (Christakis, 2002)	Repetition and constant practice are indispensable for the development of knowledge, experience and skills that will have application in everyday situations.
Therapeutic intervention and assistance (Kalantzis, 1985)	Background demands need to be in harmony with learner needs and able to lead to positive interaction.
Child-centered/individual adaptation (Christakis, 2002), Adaptive curriculum (Kalantzis, 1985)	A prerequisite to the success of an instructional plan is adaptation to the abilities and educational needs of the learner, as these are combined with the instructional goals and individual objectives of the instructor involved.
Curriculum localization in the direct natural and cultural environment (Kalantzis, 1985)	The ultimate goal of Special Education is to prepare every student for adult life at the highest possible level of autonomy. To this end, the special curriculum needs to be localised on what is needed to cope with the learner's natural and cultural environment.
Proximity to real-life situations (Christakis, 2002)	Every teaching unit should satisfy the real current and future needs of the learner, in order to make efficient use of instructional time.

Table 1. Requirements affecting how an ID instructional curriculum and process needs to be planned

2.2 Digital Gaming Capabilities and Digital Game Types

It is interesting to see how the requirements for planning instructional processes and curricula for learners with Intellectual Disability listed in Table 1 correspond to some established capabilities of digital gaming, especially when specific game types are selected which are more appropriate for a particular ID instructional requirement. Table 2 presents such a correspondence between ID requirements and digital gaming capabilities while Table 3 presents a correspondence between ID requirements and specific digital game types. It should be noted that the term "digital gaming" refers here to engaging in general-purpose gameplay, and in many cases the digital gaming capabilities and game types mentioned are not specific to educational games. The resulting correspondence, therefore, indicates that even *pure* (i.e. entertainment-only) digital gameplay can still be of value to the ID instructional process.

The strict conclusion that can be drawn from the correspondence shown below is that, *in principle*, digital gaming is *not excluded* from serving as an instructional tool for ID. This somewhat weak argument of non-exclusion, however, will be complemented in the following by concrete examples of digital games for learning that provide thematic coverage of the ID educational curriculum, as well as by additional findings from actual cases of successfully applying DGBL with SEN and ID learners.

ID instructional requirements	**digital gaming capabilities**
Monitoring and immediacy (Christakis, 2002)	Digital games can include software agents that not only monitor and log player behavior during gameplay, but are also able to offer help in case of a difficult situation, hint at the solution and highlight the next step. Therefore the player can be constantly monitored and supported, with the game itself operating as a patient and omnipresent tutor.
Entrenchment and practice (Christakis, 2002)	Most games (ranging from simple applications like Dora the Explorer to much more complex games as The Sims) are based on mechanisms of trial-and-error and repetition of steps in order for player to learn the essential skills and continue the game. New tasks integrate with the repetitive process of acquired skills and form a complete instructional goal. In a popular educational title, for example, the user has to pick letters throughout his/her journey in various cities and form words and sentences. Acquired letters are used again and again and the process itself has to be repeated in order for the player to travel to the next city. As (Brooks, 1997) notes, an important value of digital games for learning is that they motivate players to focus, test their skills, use trial-and-error and learn while having fun.
Therapeutic intervention and assistance (Kalantzis, 1985)	This principle ensures that the co-existence of student's skills along with background demands will be harmonized and lead to positive interaction. Educational games such as "Dominic Interactive" are able to have a therapeutic result in cases of anxiety, racism, violence, and raise awareness. Additionally, digital games with popular animated heroes can have a therapeutic value in issues of self-esteem or loneliness.
Child-centered/individual adaptation (Christakis, 2002), Adaptive curriculum (Kalantzis, 1985)	A digital game could cover one or more educational needs, specialized on the mental and physical age of the player and reflecting his/her interests and necessities. By adjusting the level of difficulty and the pattern of navigation, both content and design can be adapted accordingly. Digital games allow the possibility of repetition and practice, allowing the player to practice

	and learn within his/her own cognitive capabilities and timeframe (Rooms, 2000). What is more, adaptivity and personalization are characteristics that many digital games share and therefore can be modified and used accordingly by the educator, meeting instructional goals adapted to each student's particular skills.
Curriculum localization in the direct natural and cultural environment (Kalantzis, 1985)	Digital games, through their immersive logic and cinema-style narrative, can be used as an effective medium for teaching attitudes and social behavior according to the cultural environment of the student. Brigadoon, for example, is a small virtual island within the Second Life massively multiplayer online game, created for individuals with autism and Asperger's syndrome in order to give them the possibility to explore the social interactions that are so hard for them in the real world (Lester, 2006).
Proximity to real-life situations (Christakis, 2002)	A large category of digital games simulates real-life situations and allows players to easily assimilate patterns and solutions (e.g. *The Sims*, *Roller Coaster Tycoon*, simulation games regarding money/shopping, dressing up etc). The second category of digital games which can be characterized as fictional, can still have adequate proximity to real-life situations since, by means of dramatization and engagement, the player not only identifies to the game hero, but is able to make connections between the fantasy and real worlds. While using a fictional character (such as a cartoon hero or a fictional creature, e.g. a dragon), children are able to equal fantasy to real life emotions and situations and find practical usefulness in a fictional scenario.

Table 2. Correspondence between ID instructional requirements and digital gaming capabilities

ID instructional requirements	**types of digital games**
Monitoring and immediacy (Christakis, 2002)	Every type of games can embed the principle of player monitoring. Especially adventure, simulation and role-playing games are particularly suited to this requirement as they define game progress according to player decisions and gameplay efficiency.
Entrenchment and practice (Christakis, 2002)	All game genres give the possibility to repeat an action till it is successful and to learn through practice. Especially drill and practice games as well as arcade/platform games are based on these characteristics, at times to an undesirable extent known as tread-milling.

Therapeutic intervention and assistance (Kalantzis, 1985)	Interactive digital storytelling for audience with intellectual disability needs to be used with caution. Depending on the scenario, graphics and sound effects, a complex adventure, simulation or role-playing game can cause stress to a player with ID. Simple platform or drill and practice games with soothing music and graphics, on the other hand, might prove relaxing.
Child-centered/individual adaptation (Christakis, 2002), Adaptive curriculum (Kalantzis, 1985)	Role-playing games are based on adaptivity and user-centered gameplay, whereas many simulation games offer various possibilities of personalization. Additionally, many drill and practice games offer player-adjustable difficulty and speed, font size and color density, as well as guided or free-style gameplay. Drill and practice games are often preferred for classroom usage due to their simple scenario and obvious learning outcomes. However simulation games with rich scenario options may equally well be adapted to fit instructional goals, whereas arcade/platform games with simple scenarios can also be created by the instructors themselves using simple game development tools.
Curriculum localization in the direct natural and cultural environment (Kalantzis, 1985)	Simulation and high-quality role-playing games are the game genres that are able to respond better in the principle of localization. The educator is able to choose the most suitable game according to the direct needs of the student in order to prepare the student for the social and practical necessities of adult life. According to researchers such as Elaine Raybourn and Annika Waern, games have long provided a structured environment for quickly learning complex behaviors, especially role playing games can help gamers explore skills, methods and concepts rapidly within an engaging non threatening environment (Raybourn and Waern, 2004).
Proximity to real-life situations (Christakis, 2002)	Simulation and role-playing games are the most efficient game types when it comes to this principle. Successful games of these genres are able to embed real-life situations in their scenarios and allow the player to take decisions. Previous work (Standen, Cromby & Brown, 1997) suggests that virtual environments are effective in facilitating the acquisition of everyday living skills, as for example shopping.

Table 3. Correspondence between ID instructional requirements and types of digital games

2.3 Digital Games-Based Learning for SEN

The proposed correspondence between instructional requirements for learners with ID and digital game capabilities and types presented in the tables above should not really come as a surprise. As early as 1981, Malone was one of the first to recognize that digital games engage students' interest through mechanisms of balanced challenge, curiosity and imagination, while at the same time lending themselves to personalization and adaptivity according to the learners' capabilities and needs (Malone, 1981). Nowadays, computer games-based learning has taken its place in homes and national curricula in the form of educational and edutainment software, while game researchers such as Becker and Verenikina have connected existing game design with scholarly and widely accepted pedagogy (Becker, 2005a; Verenikina, Harris and Lysaght, 2003).

Becker, in particular, has demonstrated how games, even purely commercial ones, already embody the fundamental elements of learning and instructional theories. Learning theories such as Gagné's Five Categories of Learning and Nine Events of Instruction (Gagné, Briggs and Wager, 1992) or Gardner's Theory of Multiple Intelligences closely correspond to game design principles (Becker, 2005b). Design of an entertainment or education-oriented game can incorporate support for various learning styles (Becker, 2005a), including the different types or levels of learning mentioned in the analysis of Gagné:

- "verbal information" is provided by digital games both verbally and textually;
- "intellectual skills", such as the use of concepts and rules to solve problems, form the basis of most strategy games;
- "cognitive strategies" are essential in order to accomplish game tasks;
- "attitudes" are of cardinal importance to role-playing games; and
- most games require the use of some sort of controller or keypad, thereby helping to develop "fine motor skills" (Becker, 2005a).

All these five categories of learning come to life in Gagné's Nine Events of Instruction, a theory that provides the essential conditions for effective learning. Becker has shown that there are types of games (according to the author's terminology, "good games") that meet practically all of the above criteria (Becker, 2005b).

All over the world today researchers, educators and game designers are increasingly becoming interested in the potential use of computer and video games to support the learning experience of young people. There are still questions and open issues, however, as to whether proprietary games developed for educational purposes can deliver a more effective DGBL experience, in comparison to COTS games designed for entertainment rather than instruction (de Freitas, 2006). COTS might fail in supporting defined learning objectives, but their game design and levels of immersiveness, are superior to their educationally driven rivals. The research into how games can support learning both in and out of school by engaging students has led to a recent interest in developing state of the art personalized educational games. Therefore, efforts are made to develop educational games that will exhibit the same levels of quality, playability and immersiveness of the bestselling mainstream games (Sandford and Williamson, 2005, p. 23).

Regarding special learners, researchers as Langer, Pronger and Lester have stressed the importance of technology in the facilitation of social interaction for people with cognitive and physical disabilities and the fact that advances in computer and communication technology present a great opportunity for people with disabilities to gain equal access to a number of social opportunities (Langer, 1985; Pronger, 1995; Lester, 2006).

Apart from conventional non-digital gameplay students with cognitive disabilities can use educational software and digital games in order to experience everyday situations and curriculum

learning subjects such as mathematics, reading and vocabulary, promote problem solving skills and prepare themselves virtually for social integration, vocational training and safety (Fitros, 2005). According to the literature, besides the enjoyment that students experience thanks to digital gaming, concentration is also being supported and students are able to prove their skills and knowledge (Detheridge, 1996).

An additional argument in this line of thought in favor of the introduction of DGBL as an instructional tool for Special Education in general, and Intellectual Disability in particular, comes from the observation that there is currently available a number of educational games which can clearly cover subject matter of the ID instructional curriculum, as detailed in the following section.

2.4 ID Curriculum and Digital Games

Although every single digital game can operate as a tool for skill acquisition, not all games can have the same instructional effectiveness within the general or SEN/ID classroom. Generalizing the connection between digital gameplay and learning outcomes without paying attention to the different qualities of each game leads to misunderstandings and fruitless debates on the barriers of DGBL, rather than on its potential.

Therefore, it is essential to discuss different games and their corresponding educational potential with respect to the instructional curriculum at hand, and in particular to the SEN/ID curriculum of interest here. Table 4 shows some examples of digital games which are now freely or commercially available and address major topics of the SEN/ID curriculum such as literacy and numeracy skills, social and communicational skills, personal safety and hygiene, physical and psychological health as well as specific cases of vocational training.

ID curriculum subject matter	**digital games available**
literacy and numeracy skills (writing and verbal skills, arithmetic skills, logic, counting, significance of time and date etc)	In games such as *Sebran*[3] and *All About Numbers*[4] students visualize grammatical, vocabulary and mathematical concepts with colorful pictures and animations. *Alphabet Track*[5] allows players to move through eight fun activities at their own pace. By learning to recognize and locate letters of the alphabet quickly and consistently, students at all levels acquire more spelling independence and remain on track for developing vocabulary and other vital literacy skills.
social and communicational skills	*Toward Independence*[6] is a well-rounded collection of five life-skill programs that covers functional vocabulary and community outings, money skills, shopping and social behavior, presented in a step-by-step fashion.

[3] http://www.wartoft.nu/software/sebran/
[4] http://www.virtualimage.co.uk/html/all_about_numbers.html
[5] http://www.onestopeducation.co.uk/icat/1844410595main&bklist=icat
[6] http://www.attainmentcompany.com/xcart/product.php?productid=16279&cat=0&page=1

personal safety and hygiene	*Body Explorer*[7] and *Bodywise*[8] are able to enliven health and life science curriculums via animations and graphics and allow students to investigate body systems, health education topics, and frequently asked questions about the human body. *Out and About*[9], on the other hand, includes activities such as cooking, shopping, use-by dates and others.
physical and psychological health	*Dominic Interactive*[10] is a computer game that helps children to reveal their anxiety, including depression tendencies and strengths. *Smart Alex*[11] is a cartoon character that can undertake over a hundred faces, expressing different emotions. At a higher level, users can hold a simple conversation with Alex and talk about their likes and dislikes.
vocational training (selected topics)	*Happenings*[12] and *Restaurant Game*[13] help students increase awareness of the descriptions and responsibilities of everyday professions, while through *The Sims - Open for Business*[14] they can better apprehend the notions of responsibility, punctuality and duty.

Table 4. Indicative digital games available for subjects of the ID curriculum

As can be seen from Table 4, when referring to students with ID educators are not necessarily more constrained in their options; on the contrary, in some cases they can have more flexibility on the usage of different game types and genres.

3. USING DGBL FOR LEARNERS WITH ID/SEN: CASE STUDIES

3.1 Review of Cases Reported in the Literature

Studies and cases have gradually started to appear in favor of the introduction of digital games in Special Education. At Becta's Computer Games in Education project, SimCity 3000 and The Sims were used with key stage 3 and 4 students with special needs. According to the Becta report *"the primary learning aims were for the pupils to build simple models (a city or house) within a microworld, to understand the rules governing the model, and to vary the parameters for different effects. SimCity was used to enable pupils to develop some technical ICT skills such as using menus and viewpoints, and to be able to read and understand data in various forms*

[7] http://www.amazon.co.uk/Become-A-Human-Body-Explorer/dp/B00004UCNT
[8] http://shop.sherston.com/products/details.aspx?p=1&prodId=93
[9] http://www.inclusive.co.uk/catalogue/acatalog/out_and_about1.html
[10] http://www.dominicinteractive.com/
[11] http://www.autismcoach.com/Smart%20Alex.htm
[12] http://www.inclusive.co.uk/catalogue/acatalog/happenings.html
[13] http://web.media.mit.edu/~jorkin/restaurant/
[14] http://thesims2.ea.com/about/ep3_index.php

(databases, graph, etc). The Sims was used to encourage understanding of the importance of budgeting, and gave support to discussions and exploration of emotional and relationship issues. Other unintended benefits included use of the Internet for focused reasons (information, new items)" (Becta, 2001).

Research on autism and multimedia games has revealed increased interest and sense of personal accomplishment on behalf of the players, on top of very positive results in educational objectives such as reading and concept learning (Williams et al, 2001).

Lynne Padgett and Dorothy Strickland (2006), have used a specifically designed computer game, in order to teach fire safety skills to children diagnosed with Fetal Alcohol Syndrome[15]. Children participated in this study by using a multiple baseline, multiple probe design. Before the game, no child could correctly describe the proper actions that should be taken during a home fire. A computerized game allowed them to learn the recommended safety steps in a virtual world. Skill learning and real-world generalization were tested immediately after the intervention and at an 1-week post-test. As a result of this study, all children reached 100% accuracy on the computer intervention, defined as successfully completing each of the safety steps. At the 1-week follow-up, all the children were able to perform the steps correctly in a real world simulation (Padgett and Strickland, 2006).

Another case study conducted by Demarest brings to light persuasive results. As mentioned in Griffiths' work regarding the educational benefits of videogames: *"Demarest's report of her own autistic 7-year old son reported that although he had serious deficiencies in language and understanding, and social and emotional difficulties, videogame playing was one activity he was able to excel. This was ego-boosting for him and also had a self-calming effect. Videogames provided the visual patterns, speed and storyline that help children's basic skills development. Some of the therapeutic benefits Demarest outlined were language skills, mathematics and reading skills, and social skills."* (Griffiths, 2002)

Moreover, according to a research which used a fully interactive virtual school, with playful activities, specifically designed for students with Down Syndrome "combining learning with a positive and comfortable experience, provided by playful environments should be critical in edutainment', with desktop devices being indispensable for obtaining this." The application was design and applied in order to make it possible for the students, to learn about the physical and social world (Vera, Herrera and Vived, 2005).

3.2 Contributed Case Study A: Athens-based ID/SEN Rehabilitation Center

3.2.1 Description of the Case

In order to better identify the potential and limitations of applying digital games-based learning solutions at the service of learners with intellectual disability a series of pilot observations has been organized by the authors, in collaboration with an Athens-based rehabilitation and education center for children with intellectual and other developmental disabilities. These observations have took in two periods of a total duration of 9 months during school years 2006-2007 (April 2007 – June 2007) and 2007-2008 (November 2007 – April 2008).

[15] According to traits among clinically referred preschool children symptoms include (a) problems in learning and preacademic skills, (b) arousal dysregulation (impulsivity and hyperactivity), (c) poor adaptive skills, (d) unresponsiveness to verbal danger cautions, (e) difficulty in generalization from one learning setting to another, and (f) behavior and discipline problems (Padgett and Strickland, 2006).

During these observations, 12 individuals with intellectual disability (ages 10-17 years old) collaborated as players of educational interactive applications and digital games. These students were exposed to open source digital games, COTS titles and educational software, with both academic as well as social skills content in sessions of 40 minutes per student pair.

Each gaming session of this pilot observation was designed beforehand in terms of educational goals, abilities of each student involved and results from previous sessions. During the session information was recorded on the cognitive and emotional condition of each player, duration of playtime, games played and reactions, achievement of objectives with or without help, preferences, communication amongst peers, difficulty and success playing the games as well as any general observations that seemed to be significance. In the end of the session, participant players would filled in a simple questionnaire regarding their likes, dislikes and difficulties.

The sessions of the first period (April 2007 – June 2007) involved small tutorials regarding IT skills and participant observation, while in the second period of the pilot (November 2007 – April 2008) participants were followed-up through informal interviews, direct observation, collective discussions and the aforementioned questionnaires. All-in-all, this 9-month pilot observation revealed important facts and findings regarding the use of DGBL within a classroom of SEN and ID learners. With the use of commercial entertainment as well as proprietary educational games such as *The Sims*[16], *Body Explorer*, *World Explorer*[17] and educational open source and online solutions such as *Travel Trainer*, *Sebran*, *Mini Sebran*[18], *Poisson Rouge*[19] and others, participating students were able to practice:

- language skills
- basic math skills
- basic reading skills
- social skills.

3.2.2 Findings from the Pilot Observation

1. From the usage of various online and commercial-off-the-shelf games as well as educational games and simulations in the context of this DGBL pilot with students of different emotional and cognitive maturity and ability it has been observed that all five central fields of knowledge are supported by various game types.
2. More specifically, it was observed that children have proven high IT literacy and were able to use the personal computer efficiently. By using gaming and multimedia software such as drill-and-practice educational software (e.g. Sebran ABC) and on-line edutainment games (e.g. Poisson Rouge), students were able to acquire the practical knowledge needed in order to use a personal computer.
3. In various cases, moreover, it has been observed that following a number of gaming sessions students were able to recognize the letters on the keyboard and their typing speed improved. In some cases it was observed that even though a student held a negative attitude towards classroom-based reading and writing activities, this was not the case during the gaming sessions, where the student's accuracy on recognizing and typing letters was improved. It is worth mentioning at this point that, during gaming sessions,

[16] http://thesims.ea.com/
[17] http://www.amazon.co.uk/DK-Become-A-World-Explorer/dp/B00004UCNQ
[18] http://www.wartoft.nu/software/minisebran/
[19] http://www.poissonrouge.com/

those students who were not able to read tended to encourage their fellow students to read out loud in order to help them understand, participate and enjoy the game.

4. Through the usage of traditional games such as hangman in digital animated form, as well as drill-and-practice applications such as picture-meaning and counting identifications, high participation and cooperation was observed even by children with various communication limitations. Reaction speed and accuracy was increased, while the interest seemed elevated no matter the repetition of the drill.
5. Additionally, exploiting the need for collaboration between fellow players, the educators became able to use digital games as a communication medium as well and promote a common communication code among students, thus acquiring an important ally in order to counterbalance diversities in the educational process
6. The educators observed that games, especially simulations and adventures, not only lent themselves to repetition and practice, but could also be employed as innovative introductions to various curriculum topics and social activities. Students became able to identify terms and meanings such as the human body, organs, daily routine, fatigue, traveling, distance, direction and map reading through the usage of adventure games and simulations. Terms that might seem complicated to be included in a single class hour were introduced in a fascinating matter through commercial and edutainment games.
7. Due to the shared use of personal computers, children were willing to express themselves during gameplay, give instructions, offer possible solutions and cooperate with their peers. Students proved themselves able to cooperate responsibly, helping one another, in order to have fun.
8. It was very important that the selected videogames were able to facilitate, discussing and sharing, following and giving directions, answering questions, and therefore they provided a discussion topic to share with others. Especially regarding following and giving directions we should mention that students with problems in verbal communication were more than happy to participate and demonstrate to their fellow students their ability to control the game hero successfully. It was observed that they didn't hesitate to follow directions by their co-students, taking initiatives and organizing spontaneously a new game amongst their peers.
9. During the second period of observation the team was able to self-manage gameplay, taking turns smoothly. As a result the need for instructors' intervention regarding the time of each players' gameplay was limited. Special teachers taking part in the study found that use of the games could not only provide motivation among students with intellectual disability, but at the same time help them develop skills and encourage collaboration. The motivating power of games and their ability to encourage co-operation were felt to support the work of schools in developing independent, yet socialized individuals.
10. There have been cases of students who, without any further mention or dramatization from the educator, were able to make the correlation between in-game situations and real-life practices on their own. In one of those cases, a 14 year old student would proudly mention that *"last Saturday we went with our family to the restaurant and I washed my hands and used the forks as it was shown by the Restaurant Game"*; in another case, and without any prior motivation, a 12 year old claimed: *"I think I am older now and I should not be afraid of the dark just like Victor; (the game hero) I will try not to keep the light on when I go to bed"*. For every educator and specialist working with children, especially those having difficulties in emotional communication, such statements are clearly encouraging.

All-in-all, this 9 months' pilot has shown that the games-based learning process in the ID/SEN classroom indeed seems to become more engaging and enjoyable; students have actually enjoyed playing digital games and, although most of their teachers were not familiar with new technologies and especially digital gameplay, children have shown the need to carry on with the gaming sessions.

3.3 Contributed Case Study B: ID/SEN Class of Provincial Public Special School

3.3.1 Description of the Case

A second pilot observation was organized during academic year 2007-2008 in the SEN Class of a Greek provincial public special school. The pilot was implemented under supervision of the authors by two public education teachers as part of their postgraduate assignments within the MSc Program "ICT in Education", jointly organized by the Faculty of Communication and Media Studies and the Faculty of Early Childhood Education of the University of Athens.

The special school where the pilot was conducted is located in the same premises with the local public primary school. It accommodates 12 children with serious mental disabilities aged between 4.5 and 14 years old and is run by 4 teachers. Most of the students were familiar with using computers since their school curriculum includes a computer-based activity, whereas two of them had their own personal computers at home. In the context of this pilot, DGBL material was presented to 11 out of the school's 12 children.

The objective of this pilot was to investigate whether digital games can provide a pleasant and effective means of learning for children with special needs such as severe learning difficulties, mental health problems, as well as some physical and/or developmental disabilities. Besides using on-line freeware games and commercial edutainment software selected in accordance to the formal SEN curriculum, the intervening educators also created their own flash games with academic curriculum and social/emotional skills content using Macromedia Flash and Microsoft PowerPoint.

The two intervening educators planned the DGBL pilot in accordance with the educational objectives of the official SEN curriculum. The whole process, however, was intentionally left informal, in order to allow students to feel free to participate and have fun playing without any pressure or the fear of evaluation from their teachers.

The educators' role was planned as that of an animator and instructor who would help students during gameplay. Considering possible negative reactions of the students towards persons that they were not familiar with, and in order not to disturb the daily school program, the educators opted to implement the DGBL pilot in hours separate from the daily timetable. Therefore, this pilot took place as an activity parallel to the daily school program with a total duration of 10 hours in 5 school days.

During the application, the intervening educators recorded for every student, information such as age, cognitive and emotional condition, duration of playtime, games played and reactions, achievement of objective with or without help, preferences, difficulty or facility playing the games and general observations that seemed to be significance. 9 out of 12 students of the school were finally able to participate in the trial application; 6 of them played all the games, while the 3 remaining students played only games for learning colours.

As far as the cognitive objectives of the trial are concerned, games were chosen that would help students learn to:

- add and subtract
- recognize primary colours
- measure and calculate money
- put pictures in order /time sequence
- group and distinguish objects in categories.

The socialization objectives of the trial mainly had to do with enabling students to express themselves as well as communicate and collaborate with each other during gameplay.

3.3.2 Findings from the Pilot Observation

Overall, this pilot has highlighted a number of interesting practical issues for DGBL attempts such as game usability, student cooperation and the critical role of the educator. Digital games have again proven to offer a pleasant and effective way of learning for children with intellectual disability. Learning scenarios of both academic and social content were specifically designed by the educators and students felt free to participate, cooperate with one another and have fun without any pressure or the fear of judgement from their peers and teachers.

Detailed findings of the pilot are as follows:

1. The most impressive observation during the entire trial was the eagerness of the children; they waited their turn to play without causing any trouble in order not to lose the opportunity to play. The teachers stated that they had not seen the students so calm before.
2. Generally the students showed a big interest and a strong will to participate no matter the errors they made. Students did not react negatively to failure during gameplay and despite problems they might face during this experience, they still wanted to be “exposed" in playing. Most students needed help but they were able to finish the gaming sessions successfully, getting better and better after each session.
3. As for the school teachers, the application confirmed in certain cases their estimates of the knowledge and the capabilities of their students. However it seemed that in some cases, even though they were friendly to the whole idea of these gameplay sessions, they did not have an interest in the actual experience of their students. Sadly it seemed that the trial application constituted a rather good excuse for their absence from the classroom.
4. In this particular case, the use of digital games in the education of students with SEN has seemed to confirm some initial expectations, concerning both the benefits and the problems of this attempt:
    - the training process became enjoyable
    - digital games functioned as a challenge, activated the children but simultaneously highlighted capacities and issues that the local teachers had not perceived
    - some school teachers showed ignorance and lack of interest in using ICT tools as an instrumental part of the educational process.
5. Even though the special school provided a warm reception for the project and the students showed great appreciation, the intervening educators faced certain problems concerning:
    - technical equipment (malfunction of one of the four computers in the school laboratory, special keyboards with Latin characters that could not be recognized by the children, lack of utility of special levers installed)
    - cooperation with school educators (teacher refusal to allow 3 students to participate saying they were not capable, teachers’ minimal knowledge of computers’ use, existence of only one teacher eager and available to help the intervening educators, frequent absences of children due to illness and other problems).

4. TOWARDS USING DGBL IN THE ID CLASSROOM

4.1 Game Types Suited to the ID Instructional Process

Many researchers and educators seem to believe that special games are needed for people with special needs, especially when the intention is to use them as educational tools. This line of thought tends not to consider that the sheer act of gameplay itself has its own potential and exhibits the essential characteristics of a successful educational framework adaptable to the capabilities of individual students. As various studies for students with disabilities have highlighted, children and young adults with disabilities prefer COTS computer games which provide the player *"with an environment not only to learn within, but also a world when experiences can affect emotional and social development"* (Kearney, 2005).

Nonetheless, the digital game as an interactive medium still has to transform its educational potential into real instructional assets. Various research efforts have identified characteristics of successful educational games or, to be more exact, characteristics of *games that can be successfully used as educational tools*. *The Sims, Civilization, Rollercoaster Tycoon, Second Life, SimCity* and others are some good examples.

Throughout the discussion so far, based on the correspondence between ID instructional requirements, curriculum and digital gameplay, as well as the literature review and our own reports for DGBL cases for ID learners, adventure and drill-and-practice educational games seem to be quite effective instructional games for students with ID. However it is of cardinal importance that every single game type can be of high educational and entertainment value, when designed and introduced in the classroom as appropriate.

Regarding the question between preferring COTS games over educational software or vice versa, it has been observed that COTS solutions can be used not only as an appealing kick-start for the entire DGBL process, but also as effective instructional tools themselves. In that case, however, the educators' needs to facilitate the process properly so as to ensure quality of gameplay and accomplishment of the educational objectives sought. Educational games, on the other hand, should be selected in order to be just as amusing as they are instructional. In the bottom line, the educator will be the one to set the goals and choose the products appropriate for his/her classroom.

The following table sums up some literature- and research-based observations as to the degree that usual types of digital games seem appropriate tools for the ID instructional process.

digital game types	**appropriateness for the ID instructional process**
drill-and-practice games	Traditionally games intended for educational purposes have been designed according to the drill-and-practice paradigm. These types of games involve problems or multiple-choice questions about the subject area of interest; in general they have simple goals, providing the player with practice in a certain subject area and thus helping to improve some basic skills. While such an approach can be beneficial, drill-and-practice games are often not as engaging for the learner as many commercial games (Prensky, 2005). Games that are not designed with education in mind, on the other hand, are almost never developed in a

	drill-and-practice format.
adventure games	Some of the most successful commercial games represent a mixture of gameplay types, the one most commonly used being adventure games and simulations. Both of these types can be easily adapted to educational goals and are often used in an instructional context. Adventure games generally ask the player to assume the role of a character and solve problems within a world by collecting objects and information and applying it to the situation at hand. Our own research shows that adventure games can practically incorporate any kind of educational content while remaining highly enjoyable. Moreover, adventure games encourage cooperation between students and engagement in brainstorming. In some cases, however, adventure games offer more information than students can handle and provide textual instructions that make the game difficult to play without an educator's assistance.
simulation games	Simulation games enable the player to manipulate a number of variables determining the outcome of the situation at hand. In this type of games the player is generally given control of some sort of entity, ranging from a country, to an amusement park, to a shopping mall. In our own research we have used *Sims 2*, some on-line cooking and serving simulations as well as DK *Body Explorer*[20] asking students to make decisions with respect to everyday activities and well-being. A key aspect of these games is the provision of immediate feedback to the players about their decisions as well as the collaborative style of learning that they call for, especially among peer students with varying abilities of verbal communication.
role-playing games	Technically speaking, role-playing games (RPGs) can be characterized as offering to the players an opportunity to immerse themselves in the player characters' situation. RPGs continue the rich history of storytelling by embracing innovative approaches to digital narration. Characters tend to be rich in features, gameplay has a long duration whereas character management is quite technical in nature in RPGs such as *Baldur's Gate*[21], *Fable*[22], *Might and Magic*[23], *Neverwinter Nights*[24], *Ultima*[25] and *World of Warcraft*[26]. Multiplayer RPGs seem to promote collaboration and decrease tensions between fellow students, while at the same time augmenting their interest and self-involvement in the learning process. At the same time, however, even a single-player game can have the same benefits under appropriate instructor guidance. As already mentioned, in vast gaming environments students may have

[20] http://www.avanquest.com/UK/kids/learning/key-stage-2/Become_a_Human_Body_Explorer.html
[21] http://www.planetbaldursgate.com/
[22] http://fable.lionhead.com/
[23] http://www.mightandmagic.com/
[24] http://www.neverwinternights.com/
[25] http://www.uoherald.com/
[26] http://www.worldofwarcraft.com/

	the tendency to experiment and walk about the game's virtual world, rather than follow a specific goal; this should be carefully considered before deciding to use a role-playing game in the classroom.
arcade/platform games	Students seem to enjoy even the simplest of arcade games. Moreover, this type of games can be easily coupled with educational content. A game of Space Invaders, for instance, can be easily transformed into a simple maths or grammar game. It has been observed, however, that when arcade games without educational content are used in the classroom students do not find it easy to stop playing, while at the same time they may have difficulty in concentrating because of the simplicity and repeatability of these games.

Table 5. Appropriateness of digital game types for the ID instructional process

4.2 Animation of DGBL Activities in the ID Classroom

According to the mentioned case studies, effective usage of DGBL in a classroom of students with intellectual disability is based not only in the choice of suitable games but on proper preparation and intervention of the educator as well, he/she being the one who will choose the games, introduce them to the class and guide students through a successful gaming and learning experience.

Educators planning DGBL processes should be aware of the instructional capabilities and limitations of selected games in order to facilitate exploration or resolve possible issues during gameplay. A basic issue raised by educators is the fact that each student might react differently to the game introduced. Therefore, the intervening educator needs to set the limits and rules of in-class gaming including time of gameplay, sharing of computers with fellow players and other provisions.

Educators should remain in the background, as guides or fellow players for the students, facilitating their gaming experience and infusing trust to the DGBL activity. According to educators who participated in the case studies reported above, gameplay time gave them the chance to observe abilities and potentials regarding academic, communicational, problem solving and art skills that had gone unnoticed during normal class hours.

As these case studies have shown, the more controlling an educator appears the less fun the DGBL experience turns out for the students, which is only to be expected since gaming is all about exploring, making mistakes and having fun while learning. An interesting analogy can be drawn here with case studies on the introduction of students with ID to virtual environments where it was observed that teachers contributed significantly less as sessions progressed, selectively dropping the more didactic and controlling behaviors from their repertoire (Standen & Low, 1996). During the DGBL pilot interventions reported above it has been made clear that the point where the educator stops controlling the DGBL process in a didactic way and allows the game to take over is exactly the point where students start to feel comfortable and express themselves while playing. The DGBL educator should always be aware of the process but in a manner of non-explicit control.

An extremely important part of effective GBL activities in the special classroom seems to rely on the connections that can be established with real-life situations. Yes, digital gaming is

definitely able to provide photorealistic graphics and direct references to the "real" experience, especially considering simulations and MMOGs. For children with ID, however, photorealism cannot make much of a difference for the connection to real-life situations if gameplay is not accompanied by the educator's assistance for that purpose. As we have observed during our pilot research, digital games seem to offer a privileged occasion for educators to introduce topics of communication and socialization, on the condition that they are present and prepared to do so.

One more point that should be noted is that digital games, much like any other artifact, can be of high quality or not. Educators are inevitably responsible not only for the right usage of the game, but also for the selection of a game of suitable quality from the options that the gaming industry offers. As acknowledged in the relevant literature, *"In addition, the games development industry needs to understand the constraints on schools, teachers, parents and above all children of time, resources, and the requirements of curriculum and examination if games with more direct educational value are to emerge"* (Kirriemuir and McFarlane, 2004).

The studies of Kirriemuir and McFarlane for applying commercial games in the classroom, as well as the work reported by Sandford and Williamson (2005), both show that using COTS games in the classroom is not only a matter of technological literacy and adequate game design. It has to do with the educator's views as well. Our own findings from the application of DGBL pilots in the ID classroom do not differ. How will a special teacher be able to assimilate a "foreign body" into his/her lesson plan, and so much so in a way that fits well to the students' capabilities and instructional needs? According to our experience, gaming literacy and proper preparation seems to be the answer. In the case of students with intellectual disability the educator has to be certain that the game will be suitable for every one of his/her students and that she/he will be able to integrate the game well with the rest of the classroom activities. As mentioned by one of the educators: *"especially regarding children with intellectual disability, the connection between gaming experience and real-life settings is mandatory"*. Since in most cases the educators will not be able to design and create the games themselves, they need to be prepared to highlight the qualities of each game and identify content which may not be appropriate according to their own educational agenda and their students' profiles.

4.3 Limitations and Critical Success Factors for DGBL Activities in the ID Classroom

The instructional potential of DGBL activities in the ID classroom may be limited due to a number of reasons.

First of all, digital games are not necessarily accessible on an equal basis to all players. Players with disabilities may encounter a number of accessibility problems, the most important of which are summarized in a relevant IGDA report (Bierre et al, 2005).

Secondly, one of the most common problems is the difficulty in following a storyline in cases where no subtext is available, storytelling advances by cut scenes and/or the story is very complex to follow. Lack of a tutorial mode, poor documentation and lack of guidance are common shortcomings often mentioned by both students and educators.

Thirdly, students may be unable to complete a game task because they simply cannot understand the game goal, or because they find it hard to determine the game mechanics since clues are given in textual format, not catering for players with reading problems.

Other common issues among special players have to do with the inability to use adaptive hardware and/or to adapt game speed according to the players' cognitive and memory

capabilities. Related problems are also found in games that require precise timing or accurate cursor positioning.

Apart from these issues, our findings regarding students with intellectual disability and severe educational problems show that there are also some general problems with game design that may possibly be circumvented through the help of an educator.

One such risk is that students who succeed in accomplishing the game goal may bypass and in the end ignore the educational scope of the game. This is something extremely vivid with gamers, especially when the amusement that gameplay offers is much stronger than its educational intention. As a result, a gamer may be able to play without any learning implications, or in any case without implications relevant to the learning objectives that he/she was originally supposed to meet. In the end of the day, understanding the game logic rather than acquiring bits of knowledge through gameplay seems to be an equally tempting gaming experience.

This situation may also appear in more complex games such as adventures and simulations played by ID students. In most cases of children with mild ID, when a game is particularly fun students may eventually tend to comprehend the pattern they need to use in order to avoid the educational strains of the game, getting only pure fun. In this case the assistive role of the educator is of cardinal importance in order for the players to be able not only to enjoy gameplay, but at the same time achieve their instructional goals.

On the opposite side, there is a great number of edutainment titles where the educational agenda is so obvious that students, especially students with digital native and avid gamer profiles, will show signs of boredom. A student experienced in gaming may soon reveal the educational intentions of such a game and, at the best case, start trying to play “correctly”, thus converting the educational game into poor educational software and losing all the qualities of games-based learning. At this point, however, it is worth mentioning a difference observed during our own research in ID classrooms. Even though students made quite soon the connection between the in-game situation and the instructional goals, mentioning clearly most of the times the true goal of the game, they still did not abandon the game and in some cases they even tried hard to achieve the educational part of it while having fun. As it was observed, even for applications with poor animations and recurrent sounds, provision of an interactive interface with a gaming essence and combination with teachers’ assistance were able to raise interest and create fun for the students. In some cases of avid gamers with a preference for popular COTS games and mild ID, it was surprising to observe that even an absent storyline, poor animation and strong educational content were not enough to make them lose their interest in gameplay and the challenge to succeed. What is more, for games lacking sufficient instructions or somewhat dis-orientating for the students, more advanced players would still try to help their less experienced peers, in some cases operating more like mentors rather than as fellow players.

Last but not least, considerations for introducing DGBL to players with disabilities must also incorporate some important issues raised by the educators. Lack of appropriate technology training in teacher education programs is the most commonly cited barrier to the use of games in the classroom, in general and special education alike. Moreover, individual schools are often hesitant to provide the necessary technology because they need to fund these purchases on their own budget, rather than being able to rely on the school district’s resources (Hasselbring and Glaser, 2000).

5. CONCLUDING REMARKS

As it has been discussed in this chapter, digital games have a rich potential to incorporate the instructional content and methodologies required for students with intellectual disability. A number of considerations for the applicability of digital games and DGBL to the ID classroom are still valid, but the overall idea seems nevertheless to be grounded in theory and justified by the pilot research findings available thus far.

At the bottom line, it seems that the integration of digital games in the classroom, general and special classroom alike, is more of a matter of attitude rather than a question of appropriate game design. What happened some decades ago with the integration of play in the classroom is necessary to happen today as well. Educators need to rebuild their faith in gaming, become familiar with digital gaming and assimilate a medium that promises to reveal the hidden potential of their students.

In addition, game researchers and the game industry need to understand the possibilities of DGBL and create games that are able to unleash learning. The limits of time, resources as well as the requirements of curriculum and individual instructional needs should clearly be taken into consideration, especially with respect to students with intellectual or other disabilities.

The educational sector, the game industry and the public need to better understand the potential and diversity of digital games before this new medium can take up a meaningful role in formal or informal education. Different game genres need to be studied more thoroughly in order to provide educators with clear guidelines which they will be able to apply with confidence.

Acknowledgements

The authors would like to acknowledge the contribution of Ms. Mandy Argyropoulou and Ms. Vayia Manoli, postgraduate students of the MSc Program “ICT in Education” jointly organized by the Faculty of Communication and Mass Media Studies and the Faculty of Early Childhood Education of the University of Athens, for running one of the DGBL pilots whose findings are reported in this paper.

REFERENCES

AAIDD (2008). Frequently Asked Questions on Intellectual Disability and the AAIDD Definition, [online], Available URL: http://www.aaidd.org/Policies/faq_intellectual_disability.shtml (last accessed Jul 7, 2008).

American Psychiatric Association. (1994). *Diagnostic and Statistical Manual of Mental Disorders. American Psychiatric Publications,* Inc. ISBN 0890420254.

Becker, K. (2005a). Games and Learning Styles. *ICET 2005 Education and Technology. 7/4/2005 - 7/6/2005*, Calgary, Alberta, Canada.

Becker, K. (2005b). How Are Games Educational? Learning Theories Embodied in Games *DiGRA 2005 2nd International Conference, "Changing Views: Worlds in Play"* Vancouver, B.C. June 16-20, 2005.

Becta (2001). Computer Games in Education project. [online], Available: URL http://partners.becta.org.uk/index.php?section=rh&rid=13595 (last accessed Jul 7, 2008).

Bierre, K., Chetwynd , J., Bierre, E., Hinn, M., Ludi, S., Westin, T. (2005). Game Not Over: Accessibility Issues in Video Games. In *Proc. of the 3rd International Conference on Universal Access in Human-Computer Interaction,* March 2005.

Brooks, R. (1997) *Special Educational Needs and Information Technology: Effective Strategies for Mainstream Schools*. Berkshire: National Foundation for Educational Research.

Christakis, K. (2002). *Educational approach of children and young people with mild and sever learning difficulties. Atrapos, Athens*. (in Greek)

De Freitas, S. (2006). Using games and simulations for supporting learning. (eds). *C. Martin and L. Murray. Learning, Media and Technology. Special Issue on Gaming.*

Detheridge, T. (1996). Information Technology. In Carpenter, B., Ashdow, R. and Bovair, K. (eds) *Enabling Access: Effective teaching and Learning for Pupils with Learning Difficulties.* London:David Fulton.

Ellis NR (1963). The stimulus trace and behavioral inadequacy. In: *Handbook of Mental Deficiency,* N.R. Ellis (ed.), pp.134-58. McGraw-Hill, New York, NY.

Fitros, K. (2005). The importance of Informatics in Special Education.[online], Available: URL http://www.specialeducation.gr/files/fytros_cor1.pdf (last accessed Jul 7, 2008).

Gagné, R., M., Briggs, L., J. and Wager, W., W. (1992) *Principles of instructional design, 4th ed.* Fort Worth, Tex.: Harcourt Brace Jovanovich College Publishers.

Griffiths, M. (2002). The educational benefits of videogames. *Journal of Education and Health,* Vol. 20 No.3, p. 47, 2002.

Grossman, H. J. (Ed.). (1983*). Classification in mental retardation* (Rev. ed.). Washington, DC: American Association on Mental Deficiency.

Hasselbring, T. S., Glaser, C. W. (2000). Use of Computer Technology to Help Students with Special Needs. *Children and Computer Technology* vol. 10, no. 2 – fall/winter 2000.

Kalantzis, K. (1985). *Didactics of Special Educational Schools, for mentally retarded children.* Karavias. Athens. (in Greek)

Kearney, P., R. (2005). Playing in the Sandbox: Developing games for children with disabilities. *Proceedings of DiGRA 2005 conference: Changing Views – Worlds in Play*, June 16th - 20th, 2005

Kirriemuir, J. and McFarlane, A. (2004). Literature Review in Games and Learning Report 8 – A report for *NESTA Futurelab*.[online], Futurlab Series, 2004., Available URL: http://www.futurelab.org.uk/resources/documents/lit_reviews/Games_Review.pdf (last accessed Jul 7, 2008).

Langer, A. (1985). Personal computers and people with disabilities. *Australian Disability Review, 15 (4), 28-33*.

Lester, J (2006). Brigadoon, An innovative online community for people dealing with Asperger's Syndrome and Autism. Project Brigadoon, *BrainTalk Communities, Inc*. Available: URL http://braintalk.blogs.com/brigadoon/2005/01/about_brigadoon.html (last accessed Jul 7, 2008).

Malone, T. W. (1981). Toward a theory of intrinsically motivating instruction, *Cognitive Science,* (4), 333-369, 1981.

Padgett, L. S., Strickland, D. (2006). Case Study: Using a Virtual Reality Computer Game to Teach Fire Safety Skills to Children Diagnosed with Fetal Alcohol Syndrome. *Journal of Pediatric Psychology* 31(1) pp. 65–70, 2006.

Prabhala, A. (2007). Mental Retardation Is No More—New Name Is Intellectual and Developmental Disabilities. *American Association on Intellectual and Developmental Disabilities.* Available URL: http://www.aamr.org/About_AAIDD/MR_name_change.htm (last accessed Jul 7, 2008).

Prensky, M. (2005). Computer games and learning: Digital game based learning. In *Handbook of Computer Game Studies,* Raessens and Goldstein, Eds. MIT Press.

Pronger, N. (1995). Micro-technology. In J, Hogg & J, Cavet (Ed.). *Making leisure provision for people with profound learning and multiple disabilities* (197-209). USA: Chapman & Hall Publishers.

Raybourn, E. M., Waern, A. (2004). Social Learning through Gaming. *Conference on Human Factors in Computing Systems. CHI '04 extended abstracts on Human factors in computing systems,* Vienna, Austria , Workshops,Pages: 1733 – 1734.

Rooms, M. (2000) Information and Communication Technology and Dyslexia in Townend, J. and Turner, M. (editors) *Dyslexia in Practice: A Guide for Teachers.* New York: Kluwer Academic/Plenum Publishers.

Sandford, R., Williamson, B. (2005). Games and learning. *NESTA Futurelab*. [online], Available URL: http://www.nestafuturelab.org/download/pdfs/research/handbooks/games_and_learning.pdf (last accessed Jul 7, 2008).

Schalock R. L., Luckasson, E. A. and Shogren K. A. (2007). The Renaming of Mental Retardation: Understanding the Change to the Term Intellectual Disability. *Intellectual and Developmental Disabilities, Volume 45*, April 2007, Number 2: 116–124.

Standen and H L Low (1996), Do virtual environments promote self-directed activity? A study of students with severe learning difficulties learning Makaton sign language, In: *Proceedings of the First European Conference on Disability, Virtual Reality and Associated Technologies.* Ed: Paul M Sharkey, Maidenhead, UK pp. 123-127.

Standen, P. J., Cromby J. J. and Brown, D. J. (1997). Evaluation of the use of virtual environments with students with severe learning difficulties. Proceedings of the *British Psychological Society*, 10, 8, pp. 139.

Vera L, Herrera G, Vived E. (2005). Virtual reality school for children with learning difficulties. *ACM SIGCHI ACE05*, June 2005.

Verenikina, I., Harris, P., Lysaght, P. (2003). Child's play: computer games, theories of play and children's development. *Proceedings of the international federation for information processing working group 3.5 open conference on Young children and learning technologies*, Sydney, Australia, Pages: 99 – 106.

Williams, C., Wright, B, Callaghan, G., Couglan, B. (2001). Do Children with Autism Learn to Read more Readily by Computer Assisted Instruction or Traditional Book Methods? *Autism 2002;* 6 p. 71-91. The National Autistic Society, SAGE Publications.

Zeaman D. & House B. (1963) The role of attention in retarded discrimination learning. In: *Handbook of Mental Deficiency,* N.R. Ellis (Ed.), pp. 159-223. McGraw-Hill, New York, N.Y.