

Using Serious Games for Promoting Blended Learning for People with Intellectual Disabilities and Autism: Literature vs Reality

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Abstract. Educating people with intellectual disabilities (ID) or autism spectrum disorder (ASD) is a non-trivial process and differs from the learning methods of typically developed people. Recently, serious games (SGs) have been used to enhance the learning process of these groups and address different skills. On the other hand, blended learning (BL) is applied to formal and informal educational contexts and combines face-to-face and online learning. In this study, we examine if SGs can provide the necessary means for applying BL, especially for people with ID or ASD that could be benefited by personalized learning opportunities. In addition, we examine 43 existing SGs for people with ID or ASD, as well as the perceptions of 93 special education professionals (SEP) and teachers (SET) working in schools and institutions for people with ID or ASD regarding the role of technology and SGs in their education. We concluded that SGs could enhance the learning process of people with ID or ASD in many skills. In addition, the opinions of SEP and SET regarding the importance of technology in the learning process of people with ID or ASD and the familiarity with SGs, indicate that BL could be effectively promoted through SGs.

Keywords—accessible blended learning, serious games, intellectual disabilities and autism

1 Introduction

The learning methods of people with ID or ASD differ from the learning methods of typically developed people, or even of people with learning disabilities [53]. The most common learning methods for people with ID or ASD include role/mimic playing, educational cards, conversation, reading and creative work. However, these learning methods for people with ID or ASD might present issues in generalizing the learning objectives [31] and require enhancements [14]. On the other hand, researchers have indicated specific steps in order to include effectively new technologies in accessible learning [40]. Thus, new technological solutions, such as educational software and SGs have empowered the learning process for people with ID or ASD [27, 10].

SGs are digital games that aim to fulfill additional purposes apart from entertainment [43]. SGs have been used in various disciplines and scientific fields, such as education and health [43]. The use of SGs in the learning process adds motivation and engagement to the learner [23]. Lately, SGs have been used successfully in the learning process of more inclusive learners, i.e. people with ID or ASD [3, 18]. Due to the effectiveness of SGs, it is our belief that SGs can provide the necessary means for promoting BL for people with ID or ASD. Specifically, SGs can offer great opportunities for implementing all the unique features of BL and applying it effectively: SGs can be applied to informal and formal educational contexts; SGs can combine in-person and online learning; SGs can be designed so as to achieve an important feature of BL, which is to provide students control, to a certain extent, over time, place, path or pace [26]; SGs can incorporate combinations of different learning methods and may include multiple learning tools in order to promote effectively the learning process, exactly in the same manner as in BL [55]. In summary, SGs can be used both at the context of education, as well as tools for informal education at home encompassing various technologies (e.g. online, learning, learning analytics).

The goal of this study is to examine the landscape of SGs for people with ID and ASD, as well as the perceptions of SEP and SET working in schools and institutions for people with ID and ASD regarding the role of technology and SGs in their education. The rest of the paper is organized as follows. In section 2 the goals and the methodology of our study are presented. In section 3 the results are summarized and comparatively analyzed and in section 4 the conclusions of the study are presented.

2 Research Goal and Study Methodology

The main goal of this study is to examine whether SGs can be utilized as a means of promoting BL opportunities for people with ID or ASD, that is if SGs can be used by people with ID or ASD for learning not only in the context of school but at home as well on their own pace. In order to approach this goal, we have to:

- *Objective 1:* Study the landscape of SGs for people with ID or ASD based on: the category of targeted skill; platform (desktop-based, web-based or app-based); teaching approach used; evaluation results.
- *Objective 2:* Study the perceptions of SEP and SET in the field, regarding various factors that could make possible the usage of SGs for supporting BL. The factors studied are: the usage of technology (computers, smartphones, tablets) by people with ID or ASD; the current state regarding the usage of educational software and SGs in the learning process; how effective SGs would be and for which specific adaptive behavior or intellectual functioning skills; what typical teaching approaches should be incorporated in SGs.
- *Main Goal:* Synthesize the results of the state-of-the-art regarding existing SGs for people with ID or ASD along with the perceptions of SEP and SET.

In order to achieve the first objective, we refined a previous work of ours [60] that reviewed 43 SGs for people with ID or ASD. The SGs were grouped based on the

category of skill that they address according to the American Association on Intellectual and Developmental Disabilities (AAIDD) definition of ID [2]. In this study the SGs are organized in two main categories regarding the target group (ID or ASD) and are further grouped based on the targeted skill(s), the type/platform of the game, the teaching approach utilized (where defined) and the evaluation results. The evaluation results indicate if the SG was evaluated for its usability or effectiveness and if the results were positive (+), neutral (+/-) or negative (-).

In order to study the stakeholders' perceptions (objective 2) an online questionnaire was prepared and distributed to special schools and institutions for people with ID and ASD in Greece. Ninety-three SEP and SET responded and the data collected were analyzed using descriptive statistics.

Finally, in order to reach the main goal, we critically analyze the results of the literature review on SGs along with the results of the questionnaire survey. This analysis aims at investigating whether the SGs developed for people with ID or ASD: utilize the teaching methods proposed by the SEP and SET; address the adaptive behavior or intellectual functioning skills that the SEP and SET believe that such SGs would be more efficient; utilize the platform that better suits people with ID or ASD. This will allow us to draw significant conclusions regarding the inclusion of BL in the learning process of people with ID or ASD using SGs.

3 Results of Literature and Questionnaire

3.1 State-of-the-art

Tables 1 and 2 present SGs for people with ID and ASD respectively, providing the information described in section 2.

The 14 SGs presented in Table 1 aim to improve adaptive behavior or intellectual functioning skills for people with ID. Most of the SGs presented aim to improve conceptual skills (5) or intellectual functioning skills (6). Regarding the hosting platform, 7 SGs are desktop-based, 2 are app-based, 2 web-based and 2 run on game consoles. One SG [38] runs both on the web and as a desktop application. The majority of the SGs (9) have been positively evaluated for either their usability or their effectiveness. As far as the teaching approach is concerned, in 7 SGs the approach is not presented or defined. However, in most of the rest SGs, it is observed that role-playing (3) and conversation (2) methods are utilized, although other approaches are also identified, such as experimental learning and narration.

The 29 SGs presented in Table 2 aim to improve adaptive behavior or intellectual functioning skills for people with ASD. The majority of the SGs presented aim to improve the social skills of the users (17), addressing social interaction [24], emotion and facial recognition [1] and collaboration [54]. Most of the SGs for people with ASD are desktop-based (21) and fewer are app-based (5). It is observed that there are no web-based SGs. Also, there are studies where a custom hosting system is used [44, 54]. Although the majority of SGs is positively evaluated (18), negative evaluation results were reported for 4 SGs. The teaching approach utilized in most of the SGs for

people with ASD is not defined. The teaching approach used in the rest of the SGs is: conversation (4); role-playing (3); and narration (3). In particular, the SGs that aim to improve social skills use mainly social interaction approaches, between the user and an AI agent [4] or between users [54].

Table 1. SGs for people with ID.

| <i>Category of Skill</i> | <i>Num</i> | <i>Type/platform</i> | | | | <i>Teaching Approach (number of SGs)</i> | <i>Evaluation results</i> |
|---|------------|----------------------|------------|------------|----------------|--|---|
| | | <i>Desktop</i> | <i>Web</i> | <i>App</i> | <i>Console</i> | | |
| Adaptive behavior: Conceptual Skills | | | | | | | |
| <i>Money</i> [15, 16, 41] | 2 | 1 | | 1 | | Experimental Learning (1) | Effectiveness + (1) Usability + (1) |
| <i>Language, Literacy</i> [51] | 1 | | | | 1 | | |
| <i>Time</i> [49] | 1 | | 1 | | | Conversation Self-exploration | Effectiveness + |
| <i>Numbers</i> [6] | 1 | | 1 | | | Role-playing | |
| Adaptive behavior: Social Skills | | | | | | | |
| <i>Interpersonal</i> [37] | 1 | 1 | | | | Conversation | Usability + |
| <i>Social Responsibility</i> [10] | 1 | 1 | | | | | Effectiveness + |
| Adaptive behavior: Practical Skills | | | | | | | |
| <i>Daily Living</i> [9] | 1 | 1 | | | | Narration | Effectiveness - |
| <i>Work-Related</i> [38, 39, 57, 58] | 2 | 2 | 1 | | | Role-Playing (1) | Usability + (1) Usability +/- (1) |
| <i>Healthcare</i> [36, 50] | 2 | 1 | | | 1 | | Effectiveness + (1) Usability/Effect.+ (1) |
| <i>Travel, Transportation</i> [7, 8] | 1 | | | 1 | | | Usability + |
| Intellectual Functioning | | | | | | | |
| <i>Cognitive Skills</i> [33, 34] | 1 | 1 | | | | Role-Playing | |

In general, it is observed that the existing literature on SGs addresses the importance of using SGs as supplementary tools, in combination with existing typical teaching methods or practices [27]. Therefore, using a SG in combination with the appropriate established learning methods can be considered as BL, because BL encourages combinations of different learning methods [55] utilizing technology.

Table 2. SGs for people with ASD.

| <i>Category of Skill</i> | <i>Num</i> | <i>Type/platform</i> | | | | <i>Teaching Approach (number of SGs)</i> | <i>Evaluation results</i> |
|---|------------|----------------------|------------|------------|----------------|---|---|
| | | <i>Desktop</i> | <i>Web</i> | <i>App</i> | <i>Console</i> | | |
| Adaptive behavior: Conceptual Skills | | | | | | | |
| <i>Language, Literacy [46]</i> | 1 | 1 | | | | | Effectiveness + (1) |
| Adaptive behavior: Conceptual Skills | | | | | | | |
| <i>Interpersonal [1, 4, 12, 19, 21, 24, 25, 27, 28, 29, 30, 35, 42, 44, 45, 54, 56, 59, 63]</i> | 18 | 13 | | 3 | 2 | Conversation (4) Role-Playing (2) Narration (2) | Usability + (4) Usability – (2) Effectiveness + (4) Effectiveness – (1) Effectiveness +/- (1) Effectiveness N/A (1) Usability/Effect. + (1) |
| Adaptive behavior: Practical Skills | | | | | | | |
| <i>Daily Living [5]</i> | 1 | | | | 1 | | Effectiveness + |
| <i>Safety [62]</i> | 1 | 1 | | | | | Usability + |
| <i>Healthcare [13, 22]</i> | 2 | 2 | | | | | Usability + (1) |
| <i>Schedules, Routines [64]</i> | 1 | | | 1 | | Narration | Usability - |
| <i>Use of Telephone, Internet [52]</i> | 1 | 1 | | | | Role-Playing | Usability + |
| Intellectual Functioning | | | | | | | |
| <i>Cognitive Skills [11, 17, 32, 48]</i> | 4 | 3 | | 1 | | | Usability + (2) Effectiveness + (2) |

3.2 Questionnaire

The respondents comprised of 64 female and 29 male SEP (9) and SET (84) working in different institutions, such as special primary school, special secondary high school, Special Education and Training Workshop, etc. The participants have on average 9.8 years of experience in special education.

Table 3 presents the participants' usage of technology in the learning process. As presented, PC is mainly used in the learning process compared to smartphones or tablets. Furthermore, the use of smartphones and tablets is quite similar, indicating that mobile devices are used equally in the learning process.

Table 3. Usage of technology in the learning process (1=never, 5=very much).

| | Mean | SD | 1 | 2 | 3 | 4 | 5 |
|------------|------|------|---------------|---------------|---------------|---------------|---------------|
| PC | 3.58 | 1.15 | 3.2% (3) | 18.3% (17) | 20.4% (19) | 33.3% (31) | 24.7% (23) |
| Smartphone | 2.06 | 1.22 | 46.2% (43) | 22.6% (21) | 12.9% (12) | 15.1% (14) | 3.2% (3) |
| Tablet | 2 | 1.26 | 50.5% (47) | 21.5% (20) | 12.9% (12) | 8.6% (8) | 6.5% (6) |

The results presented in Table 4, show the use of educational software or SGs in the learning process. It is clear that SEP and SET have preference in using educational software compared to SGs. However, the number of participants that use SGs is encouraging and indicates that SEP and SET are familiar with SGs. The results also indicate that SGs could be included in the learning process of people with ID or ASD and provides further room for exploration.

Table 4. Use of educational software and SGs (1=minimum degree, 5=maximum degree).

| | Mean | SD | 1 | 2 | 3 | 4 | 5 |
|----------------------|------|------|---------------|---------------|---------------|---------------|---------------|
| Educational Software | 3.1 | 1.23 | 9.7% (9) | 25.8% (24) | 24.7% (23) | 24.7% (23) | 15.1% (14) |
| Serious Games | 2.44 | 1.35 | 35.5% (33) | 17.2% (16) | 24.7% (23) | 12.9% (12) | 9.7% (9) |

Table 5 presents the perceptions of SEP and SET regarding the role of technology in the learning process of people with ID or ASD (1=very negative, 5=very positive) and the familiarization of people with ID or ASD with technology (1=very low, 5=very high). The results indicate that there is not a significant difference regarding the role of technology between people with ID and people with ASD, which is considered much or very much important. However, SEP and SET believe that people with ASD are more familiar with technology. Therefore, both groups are more or less familiar with technological means and technology is important for their education, and this encourages us to believe that BL could be used successfully.

Table 5. Role of technology in the learning process and familiarization with technology.

| Technology | Mean | SD | 1 | 2 | 3 | 4 | 5 |
|-----------------------|------|------|-------------|---------------|---------------|---------------|---------------|
| ID – Role | 4.46 | .60 | 0 | 0 | 5.4% (5) | 43% (40) | 51.6% (48) |
| ASD – Role | 4.37 | .69 | 0 | 0 | 11.8% (11) | 39.8% (37) | 48.4% (45) |
| ID – Familiarization | 3.03 | .88 | 1.1% (1) | 28% (26) | 43% (40) | 22.6% (21) | 5.4% (5) |
| ASD – Familiarization | 3.55 | 1.04 | 2.2% (2) | 16.1% (15) | 24.7% (23) | 38.7% (36) | 18.3% (17) |

Figure 1 presents the opinion of SEP and SET on the effectiveness of SGs for people with ID or ASD in specific adaptive behavior and intellectual functioning skills. The participants believe that SGs could effectively improve all the skills presented in the questionnaire for people with ID or ASD. Also, they believe that SGs for people with ID or ASD would be more effective for children or young adults (16-24), apart from work-related skills, where adults (<35) should be the target group. However, as observed in Table 4, the use of SGs in the learning process is limited, so we have to be reserved towards the opinion of the SEP and SET that SGs could be effective.

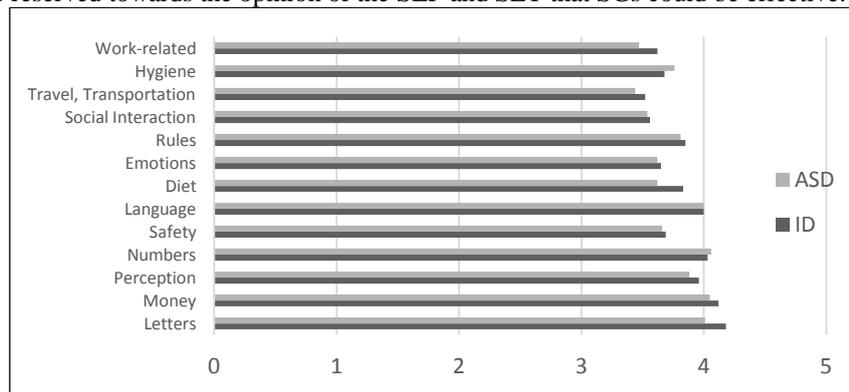


Fig. 1. Effectiveness of SGs on various skills (1=not effective, 5=very effective).

Figure 2 presents the importance of incorporating typical teaching approaches in SGs in order for them to be effective. The results indicate that incorporating role-playing is considered important for the effectiveness of SGs for both groups.

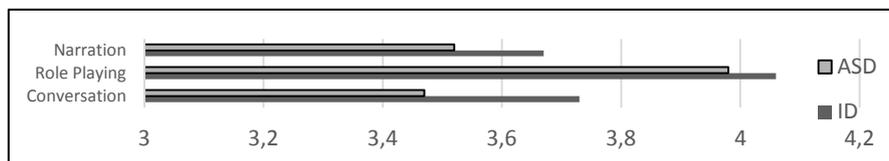


Fig. 2. Importance of teaching approaches in SGs (1=not at all, 5=very much).

3.3 Literature vs Reality

The next step of this study is to compare the results of the existing SGs with the perceptions of SEP and SET. Firstly, the most suited electronic device for developing an educational solution for people with ID or ASD is the PC, since it is the main hosting system for the existing SGs (65%) and the most common device that SEP and SET use in their work (58% uses PCs, 18.3% uses smartphones and 15.1% uses tables much or very much).

The results from the literature review indicate that the majority of SGs developed for people with ID address conceptual and cognitive skills. In addition, the SEP and SET believe that SGs addressing conceptual skills would be more effective. In partic-

ular, developing SGs for improving the concepts of money, letters and numbers, would be more effective. However, it is observed that SGs for improving social skills (social interaction and emotion control) would not be such effective.

As observed in Figure 1, SGs for people with ASD would be more effective for conceptual skills. However, the studies of the existing SGs address mainly social skills, such as social interaction, emotion control, facial recognition and collaboration. People with ASD, on the other hand, have significant limitations in social, communicational and emotional skills [65]. We believe that special education professionals' and teachers' opinion on the effectiveness of SGs concerning social skills rely on the fact that common learning methods are sufficient.

The results of the questionnaire presented in Figure 2 and the existing SGs for people with ID indicate that role-playing is the most important and commonly used teaching approach that could effectively improve the learning process of people with ID. However, for people with ASD the existing SGs use mainly conversational teaching approaches, whereas the results of the questionnaire indicated that role-playing is the most important teaching approach to incorporate in a SG.

4 Conclusions

In the present study, we examined the state-of-the-art of SGs for people with ID or ASD and the results of a close-ended questionnaire. We conducted an analysis of the literature compared to the opinions of SEP and SET. In addition, we aimed to identify whether promoting BL through SGs for people with ID or ASD is possible. Based on the literature and the questionnaire, it is concluded that SGs could effectively enhance the existing learning methods. The implementation of personalized learning models is an effective way for educating people with ID or ASD. In this sense, SGs that are adjusted to the user's profile can be effectively used in the learning process. In addition, such games can be used for the daily evaluation of students' progress and help SEP and SET in the teaching process. Thus, adding a game performance-tracking tool, which exists in SGs examined in our previous study, could promote BL, since in this way the SEP and SET could adjust the path and pace of the game that can be used both at school and home.

Furthermore, the comparison of existing SGs with the results of the questionnaire indicated that SGs for people with ID could be effectively used for promoting conceptual skills, whereas for people with ASD the results are conflicted. Although the existing SGs address social skills, SEP and SET believe that developing SGs to improve conceptual skills would be more effective. In addition, based on the questionnaire, SGs for people with ID that apply a role-playing approach are preferred and considered effective. We have to note, however, that in several SGs the teaching approach utilized is not defined, so the conclusion considering the inclusion of specific teaching approaches cannot be generalized and further research is required.

5 References

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