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Effects of enhancing education for students with intellectual disability through game-based learning: A meta-analysis

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ABSTRACT: Recent researchers have explored the effects of digital games on the academic performance of students with intellectual disabilities (ID), particularly through the lens of game-based learning (GBL). GBL has emerged as an innovative approach that integrates communication and teaching activities, making the process of information transmission more vivid. However, one significant critique within this research field is the limited attention given to the impact of different variables within GBL on learners with ID. This meta-analysis aims to fill this gap by investigating certain moderating variables, including control group treatment, game type, game platform, and intervention duration, to explore their potential impact on academic outcomes. The results of analyzing the effect sizes of 24 studies published between 2013 and 2023 showed that GBL has a moderate effect on the learning of students with ID compared to instructional activities without game-based instructional interventions. It is evident that students with ID can achieve better learning outcomes in an environment that is motivating and enjoyable.

Keywords: Intellectual disabilities, Game-based learning, Meta-analysis, Moderating variables

1. Introduction

Intellectual disabilities (ID), also known as intellectual developmental disorder, are characterized by major limitations in cognitive functioning, learning abilities, and adaptive behavior. These limitations are usually assessed through IQ tests, with an IQ score of below 70 being the threshold for diagnosis (Harris & Greenspan, 2016). The educational priorities of learners with ID are different from those without ID. Educational initiatives for learners with ID are often inspired by medical paradigms, such as the tendency to concentrate on the student's physical training, daily hygiene, and perceptual training, including the recognition of colors, shapes, and sounds (Elfakki et al., 2023; Tian et al., 2024). Meanwhile, as public education initiatives have begun to emerge, the research focusing on ID education has shifted from theoretical knowledge to cognitive academic skills enhancement (Tlili et al., 2022). However, one of the most criticized aspects of this research domain is that insufficient attention has been devoted to the new needs of these students, such as interaction with technology in the learning process (Van den Beemt et al., 2020).

Due to learners' predisposition for games, digital games have been employed by educators across K-12 and higher education. Over the past two decades, supported by computer and mobile technologies, game-based learning (GBL) has been introduced to cater to the needs of students with ID (Lan, 2018). In using GBL, teachers integrate game elements, mindsets, and mechanisms in non-game situations to engage students in learning activities (Fernández-Raga et al., 2023). In special education, GBL has also started to gain scholarly attention as a pedagogical approach for communication with learners with ID during teaching activities, making the process of information transmission more diverse and engaging. GBL has the potential to break through the traditional one-way didactic mode, introducing interactive, creative elements in the communication links (Zou et al., 2021). It also has the potential to support students with ID to learn in a more relaxing, enjoyable, and positive environment, and to cultivate multiple aspects of intelligence among students with ID (Derks et al., 2022).

As GBL for learners with ID is a relatively novel area of research, there have only been a small number of reviews. Shapoval et al. (2022) conducted a qualitative review of 10 studies from 2015, suggesting that there was a very limited number of papers that focus on GBL for learners with ID and most were conducted in the USA. Koh's (2022) qualitative review of 25 studies from 2008 to 2017, found that GBL had not been widely applied in relation to learners with ID and most of the reviewed studies were "focused on therapy and rehabilitation rather than academic, vocational or leisure-oriented" (p. 941). However, while these reviews have produced valuable findings, they are limited in terms of the number of the studies that they assess, and they lack insights into the development of appropriate games and guidelines for game design. Moreover, these reviews have mainly

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adopted a qualitative approach. Thus, although they provide some useful information about existing studies, they fail to offer a holistic overview of this research area. As pointed out by Saleh et al. (2020), there is a need for a more detailed analysis of how different GBL elements influence this group. This further emphasizes the strong necessity for specific research on moderating variables for ID learners in game-based learning. Against this backdrop, the present study aims to provide an in-depth understanding of GBL for learners with ID by examining the existing research findings. Specifically, there are five research questions:

- RQ 1: What are the main findings of the current GBL studies in ID education?
- RQ 2: What is the overall effectiveness of using GBL to teach learners with ID?
- RQ 3: Do multimedia methods provide greater learning gains for those with ID compared to traditional methods?
- RQ 4: Do the types of games or platforms used for playing affect how well students learn in a game-based setting?
- RQ 5: Does the duration of intervention influence students' learning outcomes in GBL settings?

2. Methods

A systematic review methodically gathers, filters, assesses, and summarizes a body of prior research to producing definitive and trustworthy findings (Basenach et al., 2023). Fundamentally, it is predicated on an exacting technique and methodical approach to classify and amalgamate hundreds or thousands of pieces of literature for a certain study subject or issue, assisting researchers in deriving the most exhaustive, trustworthy, and realistic instructional results (Helbach et al., 2023).

To ensure the trustworthiness of the design, operationalization, and presentation of a systematic review, we have adopted a standardized PRISMA process of reviewing the literature and synthesizing the data (Cacciamani et al., 2023). The PRISMA model has been argued to be conducive to controlling and reducing the irreproducibility of studies and researcher bias. Thus, it has been applied extensively in educational studies (Cacciamani et al., 2023). Therefore, this paper follows the PRISMA guidelines and analyzes the published literature by focusing on publications containing primary data sources, aiming to improve the scientific validity and comparability of the results of this study.

Meta-analysis is a powerful research design that combines existing studies based on a systematic review to pool the effects of interventions on experimental outcomes. Generally meta-analyses require a solid systematic review methodology. The neglect of one or more systematic review steps diminishes the quality of the meta-analysis. Therefore, in this study, the screened articles were analyzed on the basis of a systematic review.

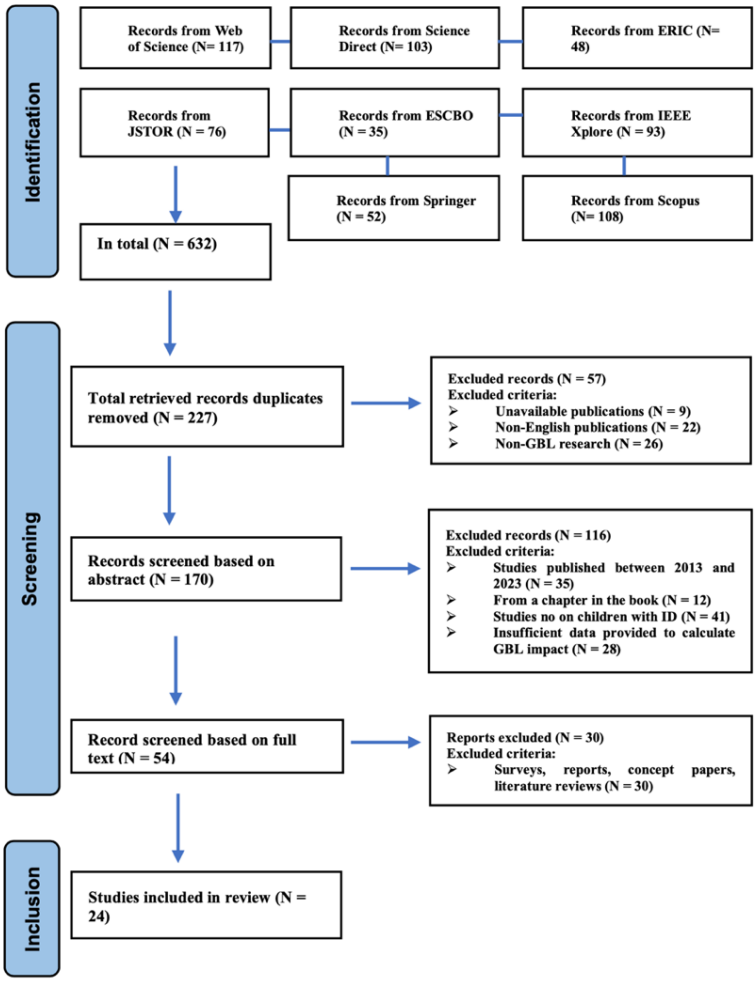
Furthermore, systematic reviews and meta-analyses provide insights for researchers and policymakers about the effects of interventions. The strength of available information on these effects and information on the potential harms associated with these interventions are well represented. Evaluating the use of gamified learning in special education using these two methods, as well as using these findings to develop practical guidelines, contributes to advancing GBL research.

2.1. Manuscript selection process

In this review, we selected articles from eight mainstream databases, such as Web of Science, IEEE Xplore, and Scopus (Appendix A). As an example, when searching Web of Science, using the advanced search function, we entered the search terms (Title: (((“special education school” OR “disability students” OR “intellectual disability”)) AND ((“game-based learning”) OR (“digital game-based learning”) OR (“educational game”) OR (“game-oriented class”)) AND ((“smartphone”) OR (“laptop”) OR (“desktop”)) AND ((“education”) OR (“learning”) OR (“game”))) OR Abstract: (((“special education school” OR “disability students” OR “intellectual disability)) AND ((“effects”) OR (“outcomes”) OR (“impacts”)) AND ((“game-based learning”) OR (“digital game-based learning”) OR (“educational game”) OR (“game-oriented class”))) OR Keyword: (((“special education school” OR “disability students” OR “intellectual disability)) AND ((“effects”) OR (“outcomes”) OR (“impacts”)) AND ((“game-based learning”) OR (“digital game-based learning”) OR (“educational game”) OR (“game-oriented class”))). The language of “English”, document type “article”, and time span “2013-2023” were selected as parameters (Wang et al., 2022). In total, 632 articles were retrieved from the 8 databases (Appendix A).

Figure 1 presents the article selection process. A total of 405 duplicates were removed and the remaining 227 documents were independently manually reviewed based on the inclusion and exclusion criteria. First, 57 articles were excluded because of the 3 criteria: non-English language literature, non-GBL research, and unavailable publications. Secondly, 116 articles were excluded for reasons such as the publication year was not during 2013-2023, articles were a book chapter, studies were not on children with ID, and insufficient data were provided to calculate GBL impacts. Thirdly, after reading the full article, another 30 articles were excluded because of the type of article, such as survey, conceptual paper, or literature review. Finally, after filtering and removing duplicate content through keyword searches as well as independent and manual review based on the inclusion and exclusion criteria, 24 articles were selected (Figure 1).

Figure 1. Article selection flowchart



2.2. Data coding and analysis processes

To conduct rigorous analysis of the literature in this meta-analysis, we created a coding scheme based on our research questions to code for moderator variables. Table 1 presents details of the moderator variables for all included studies. Moderator variables are study characteristics that are associated with study outcomes. Potentially varying effect sizes might result from different moderator variables. The most common moderating variables were game type, game platform, intervention duration, and control treatment. These moderating variables are measures that effectively analyze the causes of heterogeneity in differences in effect sizes. The reasons are as follows: First, the variables were selected based on the gaps identified in previous research and their potential impact on the learning outcomes of students with ID. For example, the type of control group significantly influences the effect size, as demonstrated in early meta-analyses such as that by Cheung and Slavin (2016). Similarly, different game types may have varying effects on ID learners, as noted by Ke and Abras (2013), while Swart (2023) emphasize that platform selection may influence accessibility and engagement. Additionally, intervention duration is a critical factor, as longer exposure times may lead to better retention

effects, a finding supported by Couper et al. (2010). Moreover, Proulx et al. (2017) linked motivation to game mechanics and platform selection in their research on self-determination theory.

Table 1. Meta-analysis material characteristics (N = 24)

Authors (Year)	Disorder	N	CT	GT	GP	Intervention Duration
Amiry & Azizi (2022)	ID	14	T	BG	Computer	Not specified
Batz et al. (2022)	ID	22	T	TG	Computer	< 1week
Benyakorn et al. (2018)	ID/ASD	26	T	IG	Mobile	1 month-3 months
Brown et al. (2013)	ID	8	M	TG	Mobile	≥ 3 months
Cheung et al. (2022)	ID	145	T	TG	Mobile	1 week-1 month
Constantin et al. (2017)	ID/ASD	15	M	IG	Mobile	< 1week
Dandashi et al. (2015)	ID	77	M	TG	Computer	< 1week
Delavarian et al. (2015)	ID	24	M	IG	Mobile	1 week-1 month
Demir (2022)	ID	34	M	BG	Computer	1 month-3 months
Guarnieri et al. (2019)	ID	88	M	BG	Computer	1 week-1 month
Hsu (2016)	ID	24	M	IG	Mobile	1 month-3 months
Kang & Chang (2019)	ID	4	T	TG	Computer	1 week-1 month
Kang & Chang (2020)	ID	3	T	TG	Mobile	1 week-1 month
Kim & Lee (2021)	ID	60	M	TG	Computer	≥ 3 months
Kirk et al. (2016)	ID	76	T	BG	Computer	≥ 3 months
Lau et al. (2020)	ID	203	M	IG	Mobile	≥ 3 months
Lopez et al. (2014)	ID	12	M	TG	Computer	1 month-3 months
Pashapoor et al. (2018)	ID	20	M	TG	Computer	1 month-3 months
Saleh et al. (2020)	ID	25	M	TG	Computer	1 week-1 month
Santórum et al. (2023)	ID	47	T	IG	Computer	1 month-3 months
Siberski et al. (2015)	ID	32	T	IG	Computer	≥ 3 months
Vorkapic & Christiansson (2022)	ID	7	T	IG	Mobile	1 week-1 month
Wajiuhullah et al. (2018)	ID	30	M	TG	Computer	1 week-1 month
Wang et al. (2021)	ID	30	T	TG	Mobile	≥ 3 months

Note. Abbreviations: ASD: autism spectrum disorder; ID: intellectual disability; N: sample size; CT: control treatment; EL: education level; GT: game type; GP: gaming platform; T: traditional; M: multimedia; PE: primary education; SE: secondary education; HE: higher education; IG: immersive games; TG: tutorial games; BG: board games.

2.2.1. Game type

Different researchers in the area of GBL have different ways of defining game types. For instance, according on the role-playing processes used, Li and Tsai (2013) distinguished between two categories of games: games without role-playing and games with role-playing. Offering a broader classification, Hung et al. (2018) identified eight game types from the perspective of game participation: musical games, immersive games, simulation games, tutorial games, alternative reality games, episodic games, adventure games, and board games. In this study, we have reviewed the games used in the selected papers and categorized them according to Hung et al. (2018). Thus, the game types examined in this study were immersive games, board games, and tutorial games. The board games category in this study also includes digital adaptations running on computers or other digital platforms. Notably, only three out of the eight game types were included: the primary reason lies in the scarcity of empirical research on diverse GBL methods tailored for ID learners. Although Hung et al. (2018) developed a classification system designed for broader educational contexts, research on ID groups often focuses on narrower game design parameters, such as simulation games, narrative games, or alternate reality games, which require abstract thinking, multitasking, or complex narrative comprehension—skills that may pose challenges for ID learners. Therefore, researchers and developers tend to adopt simpler, more structured formats such as tutorial games or board games to better align with the needs of ID learners (Kagohara et al., 2013). Additionally, designing and implementing immersive virtual reality games for ID learners typically involves higher costs, technical expertise, and accessibility adaptations, leading to limited research in this area (Lancioni et al., 2019). Second, the widespread presence of tutorial, board, and immersive games in the sample reflects a pragmatic preference in the field: Tutorial games: These games are widely adopted due to their provision of repetitive, step-by-step practice—a critical component for skill mastery in ID education (Bouck et al., 2014). Board games: Physical, low-tech options are favoured for their familiarity, ease of use, and ability to adapt to individual needs (Ramdoss et al., 2012). Immersive games: Although less common, narrative-driven digital games (such as social skills simulations) have drawn research attention for their potential engagement, but their complexity limits

broader application (Mazurek et al., 2015). While our analysis is constrained by the existing literature's focus on a subset of game types, this limitation highlights the need for broader exploration of GBL solutions designed for ID learners.

2.2.2. Game platform

In this study, we follow the framework established by Thompson and Gillern (2020) to systematically classify gaming platforms into two major categories—computers and mobile devices—while taking into account the special needs of learners with ID. Computer-based platforms include traditional desktop/laptop computers (using keyboard and mouse interfaces) and dedicated gaming consoles, as these devices share similar interaction patterns and are often grouped together in educational technology research. This category includes web applications accessed via browsers and custom-installed software programs (Hasan et al., 2023; Huang et al., 2016). The mobile device category primarily consists of tablets and smartphones with touchscreen interfaces, as well as hybrid portable devices when used primarily in tablet mode, as these devices feature direct touch interaction—a fundamental characteristic particularly important for ID learners (Webster & Williams, 2018). We intentionally excluded certain categories from our classification: while some board games incorporate technological integration, they are retained as independent non-digital categories. Our classification method prioritizes hardware characteristics and input methods over software functionality, as research indicates that physical interfaces significantly impact ID learners' accessibility and usability, particularly regarding fine motor skill requirements (Starcic et al., 2013). This hardware-centric classification method aligns with existing literature while addressing the specific needs of the target population. To ensure transparency and reproducibility, we documented each classification decision and provided clear examples from the included studies, such as classifying web-based math games accessed via PC as computer-based and touchscreen social skills apps on iPad as mobile devices (Farhan & Razmak, 2022). This systematic platform classification enables us to analyze how different hardware interfaces influence the learning outcomes of students with intellectual disabilities in game-based learning environments.

2.2.3. Intervention duration

Based on the framework established in previous meta-analysis studies (Bai et al., 2020; Chen et al., 2018), the duration of interventions was categorized, ensuring that the classification scheme sensitively reflects the unique characteristics of GBL interventions targeting individuals with ID. Our five-level classification system aims to capture substantial differences in dose-response effects while aligning with existing literature: (a) very short-term interventions (less than one week), typically representing intensive but brief exposure, often used in pilot studies or to measure immediate effects; (b) short-term interventions (one week to one month), representing the typical duration for studies focused on skill acquisition; (c) medium-term interventions (one to three months), reflecting more comprehensive programs, allowing for skill consolidation; (d) long-term interventions (three months or longer), capturing sustained educational programs that may lead to more enduring learning outcomes; and (e) unspecified duration, for studies that did not explicitly report the intervention duration (Bai et al., 2020). The classification results were independently verified by two researchers, with any discrepancies resolved through discussion and, if necessary, consultation with a third researcher. This rigorous approach to duration coding enabled us to conduct meaningful subgroup analyses while maintaining methodological consistency with previous meta-analyses in this field.

2.2.4. Control treatment

In this study, we operationalized the control group interventions using a binary classification system that distinguishes between "traditional teaching" and "multimedia teaching," based on the conceptual framework established by Wang et al. (2022). The traditional teaching category encompasses traditional teaching methods, where knowledge transmission occurs through teacher-led direct instruction in a physical classroom environment, utilizing standard educational materials such as printed textbooks, blackboard/whiteboard displays, and hands-on laboratory activities (Dawson et al., 2014). This category represents the baseline teaching model for comparison with game-based learning interventions, characterized by reliance on verbal explanations, static visual aids, and synchronous face-to-face interaction. In contrast, the multimedia teaching category is more broadly defined as any technology-enhanced teaching method incorporating digital or interactive elements, specifically including: (1) game-based learning tools (including digital and physical educational games), (2) video-based teaching materials (including recorded lectures and educational animations), and (3) computer-assisted instruction delivered through various technological platforms (such as dedicated educational software,

mobile learning applications, or web-based learning management systems). This classification system aims to address the trend toward increasingly heterogeneous control conditions in educational technology research while ensuring sufficient distinction between fundamentally different teaching methods. It is worth noting that our operational definition excludes the simple digitization of traditional materials (such as PDF textbooks or PowerPoint slides without interactive elements) from the multimedia category to maintain a substantive distinction between the two modalities (DiNapoli, 2023).

2.2.5. Data analysis

Comprehensive Meta-Analysis 4.0 software was used to synthesize the effect sizes and moderating variables in this study. Meanwhile, to better assess the effect size of different control treatments, *ES* was articulated as standardized mean differences. The homogeneity of the studies was assessed using the *Q* statistic and I^2 values. A significant *Q* statistic refuted the null hypothesis of homogeneity, signifying the existence of heterogeneity (Lipsey & Wilson, 2001). Consequently, a random-effects model is more suitable (Borenstein et al., 2010) and indicates the necessity to examine moderating variables. The *ES(d)* was computed utilizing the subsequent formula (Hedges, 1982):

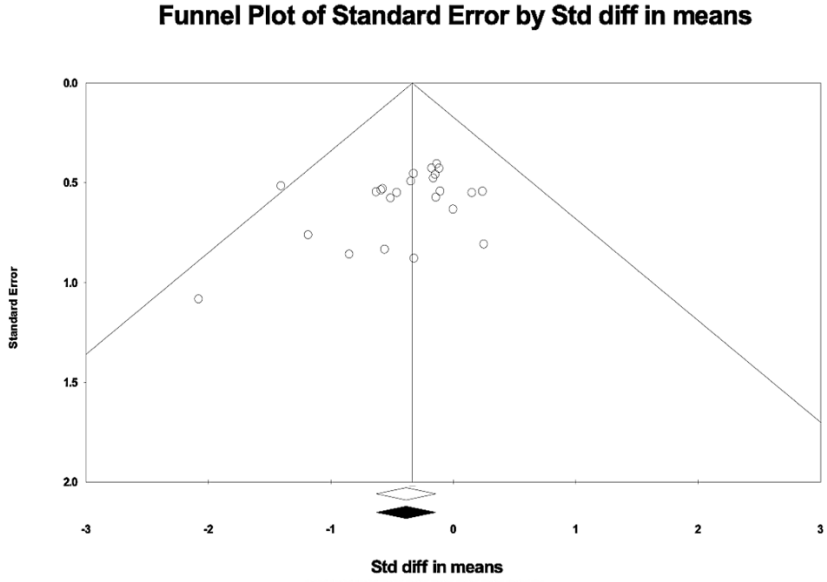
$$ES = \frac{ME - MC}{\sqrt{\frac{(NE-1)S_E^2 + (NC-1)S_C^2}{(NE+NC-2)}}},$$

ME represents the estimated mean of the experimental group, *MC* is the estimated mean of the control group, *NE* and *NC* are the sample sizes of the two groups, and S_E^2 and S_C^2 are their respective standard deviations (Wang et al., 2022).

3. Findings and discussion

3.1. Publication bias and heterogeneity

Figure 2. Effect size funnel plot with 95% CI



Results of meta-analysis studies can be affected by publication bias (Egger et al., 1997). Publication bias is assessed on the basis of funnel plots, and visualization of the funnel plots generated by meta-analysis may also be useful in assessing the validity of a meta-analysis. If the funnel plot produced by the meta-analysis is an asymmetric funnel when only positive findings are published, then it can be concluded that publication bias exists in the analysis. Conversely, it suggests the absence of publication bias. The studies in Figure 2 are mainly symmetrically distributed and most of them are located in the middle and upper part of the funnel plot, from which it can be determined that publication bias is absent. For further validation, the Begg and Mazumdar rank

correlation (Kendall's Tau with continuity correction) showed results ($Z = 1.328 < 1.96$, $p = .184 > .05$) that demonstrated no significant publication bias (Begg & Mazumdar, 1994). Meanwhile, the classic fail-safe N test indicated that the fail-safe value for this meta-analysis was 2771, exceeding 5 (*24*) + 10. The absence of publication bias was shown if the fail-safe value exceeded Rosenthal's (1979) formula: $5k + 10$, with k denoting the number of effect sizes in this study. Accordingly, the overall findings indicated that the likelihood of publication bias was very weak.

Moreover, the Q-test and the I^2 value test were used to test for heterogeneity. It is worth emphasizing that the I^2 test is complementary to the Q-test. A result in the range 0% - 25% indicates low heterogeneity, moderate when it falls between 25% and 75%, and substantial when it falls between 75% and 100% (Higgins et al., 2003). Consequently, if the I^2 value is larger, it denotes greater heterogeneity. The statistical results ($Q = 224.185$, $I^2 = 89.741$, $p < .001$) showed the existence of statistical heterogeneity. In the presence of substantial heterogeneity, it is advisable for researchers to employ a random-effects model. One advantage of a random-effects model is that it can better handle the variation between study effect sizes (Wang et al., 2019). Therefore, this study employed a random-effects model for statistical analysis.

3.2. RQ 1: What are the main findings of the current GBL studies in ID education?

Appendix B provides a comprehensive overview of the 24 studies related to GBL and their application to individuals with ID and other related conditions. Below we provide a categorized summary of the key themes and findings from these studies:
(1) *Educational Impact and Learning Enhancement*: GBL has been shown to improve mathematical understanding, academic achievement, and cognitive skills in individuals with ID. Studies like Amiry and Azizi (2022) show that educational games can enhance the understanding of mathematical and chemical concepts in individuals with ID. Meanwhile, regarding attention and cognitive skills, the research by Kirk et al. (2016) and Siberski et al. (2015) indicates that serious games and computerized attention training programs can improve selective attention and other cognitive skills in children with ID and developmental disabilities. In addition, for emotion recognition and social skills, Wajiuhullah et al. (2018) demonstrated that incorporating digital games into instruction effectively aids students with ID in developing number concepts, specifically enhancing their abilities in number recognition, counting, and basic operations. Santórum et al. (2023) developed a serious game platform designed to promote process learning among individuals with intellectual disabilities through simulated workflows, thereby strengthening their social skills in workplace settings. Kim and Lee (2021) also found that a game-based cognitive training program (Neuro-World) outperformed traditional training in improving cognitive learning ability.

(2) *Technological Interventions and Tools*: Cheung et al. (2022) and Kang and Chang (2020) highlight the effectiveness of Virtual Reality (VR) and Augmented Reality (AR) in improving memory span, daily living skills, and specific tasks like ATM usage. Delavarian et al. (2015) employed a targeted computerized working memory training program specifically designed to train working memory. The program dynamically adjusts difficulty based on the performance of individuals with ID to achieve adaptive training. Regarding the interactivity of games, Lau et al. (2020) employed "Active Video Games" (AVGs). The core of this technological intervention lies in transforming sedentary screen time into moderate-intensity physical activity. Hsu (2016) utilized Nintendo's Wii Fit game. This study employed it for balance game training, providing students with ID with immediate, visual feedback and training on their balance abilities. In addition, Guarnieri et al. (2019) emphasize that the AR game MoviLetrando was reliable for teaching alphabet and motor control skills to children with ID.

(3) *Design and Development of Educational Games*: Santórum et al. (2023) detailed the design and development process of a serious game platform, placing particular emphasis on accessibility design. This includes simplified user interfaces, clear visual elements, tactile feedback, and the avoidance of distracting stimuli to ensure the platform meets the needs of users with ID. Constantin et al. (2017) conducted research emphasizing the importance of involving target users in the design process itself to ensure the final product aligns with the preferences and motivations of individuals with ID.

(4) *Behavioral and Psychological Outcomes*: Benyakorn et al. (2018) emphasized feasibility and reported high participant satisfaction with computerized cognitive training, an indicator of positive psychological experience. In terms of the motivation and engagement of students with ID, Batz et al. (2022), Dandashi et al. (2015), Demir (2022), and Pashapoor et al. (2018) report increased motivation and engagement levels among participants who used learning applications and games.

(5) *Inclusive Education and Accessibility:* Batz et al. (2022) discussed the lack of a comprehensive framework for inclusive education and the need for interdisciplinary collaboration to address digital exclusion and learning requirements. Regarding improving the life skills and independence of students with ID: Kang and Chang (2019) and Lopez et al. (2014) highlighted the importance of games in teaching essential life skills like money management and routine tasks, which promote greater independence. Meanwhile, Brown et al. (2013) developed an Android route learning system for individuals with poor spatial skills to help them train in spatial functioning in a safe environment.

(6) *Challenges and Future Directions*: Vorkapic and Christiansson (2022) argued that digital GBL does not improve emotion recognition. Meanwhile, Saleh et al. (2020) discussed the challenges in creating games that are both engaging and appropriately challenging for individuals with ID. Moreover, Wang et al. (2021) also noted that high-quality randomized controlled physical intervention studies for individuals with ID face implementation challenges such as participant recruitment, retention, and ensuring program fidelity.

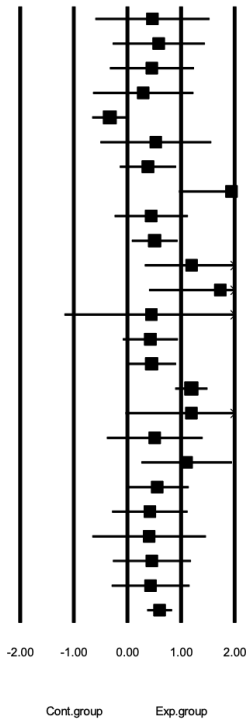
To summarize, the selected studies collectively underscore the potential of GBL and digital technologies in enhancing educational outcomes, cognitive skills, and life skills for individuals with ID and related conditions. However, they also highlight the need for tailored design, inclusive frameworks, and further research to fully realize the benefits of these interventions.

3.3. RQ 2: What is the overall effectiveness of using GBL to teach learners with ID?

Based on the data reported in the study, GBL is an effective method for enhancing learning in children with ID. The application of a random effects model to the data produced a considerable positive effect size (*ES* = 0.600, 95% *CI* [0.370-0.831], $p < .001$). As indicated by Cohen (1988), when the *ES* < 0.2, it indicates a small effect; when $0.2 \leq ES < 0.8$, this indicates a moderate effect; and $ES \geq 0.8$ indicates a large effect. Through in-depth interpretation, it can be concluded that game-based instructional content design has a moderate effect on the learning of students with ID compared to instructional activities without game-based instructional interventions. This phenomenon can also be described by the observation that in the design of instructional activities for children with ID, the game-based instructional model has a facilitating effect on students with special needs (Krath et al., 2021). Figure 3 shows random-effect model forest plots of all effect sizes.

Figure 3. Random-effect model forest plots of all effect sizes

Study name	Std diff in means	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Amiry & Azizi (2022)	0.466	0.542	0.293	-0.595	1.528	0.861	0.389
Batz et al. (2022)	0.584	0.437	0.191	-0.273	1.441	1.335	0.182
Benyakorn et al. (2018)	0.456	0.398	0.159	-0.325	1.237	1.144	0.253
Brown et al. (2013)	0.296	0.477	0.227	-0.639	1.230	0.620	0.535
Cheung et al. (2022)	-0.327	0.167	0.028	-0.655	0.001	-1.953	0.051
Constantin et al. (2017)	0.530	0.527	0.277	-0.502	1.562	1.006	0.314
Dandashi et al. (2015)	0.383	0.267	0.071	-0.141	0.907	1.433	0.152
Delavarian et al. (2015)	1.942	0.500	0.250	0.962	2.922	3.884	0.000
Demir (2022)	0.444	0.348	0.121	-0.238	1.125	1.275	0.202
Guarnieri et al. (2019)	0.509	0.217	0.047	0.084	0.933	2.348	0.019
Hsu (2016)	1.198	0.445	0.198	0.326	2.069	2.693	0.007
Kang & Chang (2019)	1.733	0.677	0.458	0.406	3.060	2.559	0.010
Kang & Chang (2020)	0.448	0.827	0.683	-1.173	2.068	0.542	0.588
Kim & Lee (2021)	0.428	0.261	0.068	-0.083	0.940	1.641	0.101
Kirk et al. (2016)	0.451	0.232	0.054	-0.004	0.906	1.941	0.052
Lau et al. (2020)	1.192	0.152	0.023	0.894	1.491	7.827	0.000
Lopez et al. (2014)	1.195	0.627	0.393	-0.034	2.423	1.906	0.057
Pashapoor et al. (2018)	0.510	0.454	0.206	-0.381	1.400	1.122	0.262
Saleh et al.(2020)	1.103	0.430	0.185	0.261	1.945	2.567	0.010
Santorum et al. (2023)	0.558	0.297	0.088	-0.025	1.141	1.875	0.061
Siberski et al. (2015)	0.418	0.358	0.128	-0.284	1.120	1.168	0.243
Vorkapic & Christiansson (2022)	0.405	0.540	0.292	-0.653	1.464	0.751	0.453
Wajiuhullah et al. (2018)	0.456	0.370	0.137	-0.269	1.181	1.233	0.218
Wang et al. (2021)	0.432	0.369	0.136	-0.292	1.156	1.169	0.243
	0.600	0.117	0.014	0.370	0.831	5.112	0.000



After comparing GBL with traditional learning, this study found that there is a noticeable relationship between game-based and students' engagement and motivation to learn. The moderate positive effect suggests that GBL can be more constructive in teaching children with ID (Bado, 2022). Because students with ID tend to lack sophisticated cognitive resources and exhibit behavioral issues, they need extra support in sustaining their attention and interest in learning. GBL enables them to learn in an enjoyable atmosphere, which helps reduce rejection of the course tasks; in particular, the game-based approach focuses more on training cognitive, affective, and social skills of children with ID in the early stages of the teaching activities (Bado, 2022). However, educators should be very careful when practicing GBL. For instance, the excessive use of GBL may lead to students becoming addicted to games, thereby affecting regular teaching activities. Moreover, the effective integration of GBL into special education courses may pose challenges, potentially resulting in students' lack of interest in learning or even resistance to learning; and students' ability to concentrate may be hindered by over-stimulation during gameplay (Martín-Hernández et al., 2021). Hence, educators should carefully assess the specific needs of learners with ID and tailor the integration of GBL into lessons based on diverse learning objectives. This approach, as highlighted by (Zou et al., 2021), can help optimize the use of game elements to enhance students' learning experiences.

The main contribution of this study lies in discovering moderating variables that may influence the effectiveness of instruction, as well as exploring the impact of game-based and non-game-based learning on the teaching of intellectually disabled children. We have found that GBL interventions exert a moderately positive effect on the overall learning of students with ID. In the preceding section, we noted that intervention duration, game type, and game platform may affect effect sizes. Therefore, under the random effects model, the effects of GBL on the learning outcomes of children with ID were interpreted based on the moderating variables of game type, game platform, intervention duration, and education level. Subgroup descriptive analyses have helped to answer this study's research questions. The findings and discussion of the study are presented below in RQ 3.

3.4. RQ 3: Do multimedia methods provide greater learning gains for those with ID compared to traditional methods?

The research data for the control group treatment variables are analyzed in Table 2. The results of the study showed that there was no statistically significant difference between the treatment of the traditional teaching program and the control group in the multimedia-intervention classroom (Qb = 0.248, p = .624). In contrast, the effect size of GBL with multimedia as the medium of information transfer was 0.530 (p < .001). The effect size of GBL in traditional teaching mode was 0.480 (p < .001). Therefore, these results reveal that GBL is more effective compared to other instructional strategies, and that employing GBL can improve the learning outcomes of students with ID. Additionally, the effect sizes found in this study were compared to other articles that were meta-analyzed in order to examine the effectiveness of GBL in various educational settings. Having analyzed the potential moderators of the effectiveness of GBL in special education, Tlili et al. (2022) found that students learned more effectively with GBL instruction than with non-GBL instruction. Manti et al.'s (2013) study of GBL for academic skills training for students with special needs found significant differences between GBL groups and non-game-based classroom groups. The effect size of GBL groups was reported to be higher than the non-game-based classroom groups. Furthermore, Saridaki and Mourlas (2013) also emphasized the potential of GBL to promote students' language proficiency based on the effectiveness of GBL in language education. To summarize, the results of this study's meta-analysis are consistent with other related research that has concluded GBL has a positive impact on the education of children with ID compared to traditional teaching methods.

Table 2. Control treatment affects random-effect model effect size

Moderator variables	*N*	*ES*	*SE*	*95%CI*		Q_b
				Lower	Upper	
Control treatment						0.248
Multimedia	13	0.530***	0.090	0.350	0.710	
Traditional	11	0.480***	0.100	0.280	0.689	

Note. Abbreviations: N, number of effect sizes; ES, effect size; SE, standard error; Q_b: Q value of the heterogeneity test between the subgroups; CI, confidence interval; ***p < .001.

3.5. RQ 4: Do the types of games or platforms used for playing affect how well students learn in a game-based setting?

Table 3 indicates that there is no significant difference in the effect sizes of various game genres on the learning outcomes of children with ID (Qb = 3.080, p = .214). Notably, the two game types in this study, immersive

games (*ES* = 0.718, $p < .001$) and tutorial games (*ES* = 0.459, $p < .001$), also demonstrated significantly impactful results. Previous studies have found that the different game types of effect on various aspects of students' learning including achievement, cognition, and emotion. The relationship between immersive games and students' interest in learning was noted in a study by Wu et al. (2023), which showed that immersive games help instructors to achieve different pedagogical goals and ultimately increase students' enthusiasm for learning. In addition, a study involving GBL for children with autism by Lu et al. (2023) showed that tutorial games allowed children with autism to improve their affective cognitive abilities. Furthermore, the multiple intelligences theory proposed by Gardner (1993) also largely recognizes the compensatory effect of GBL on different intellectual populations. Gardner highlighted that each individual's intelligence has a unique way of expression, and each kind of intelligence has multiple ways of expression. Given this, it is difficult to find a universal standard to evaluate whether a person is intelligent or not. Therefore, different types of games effectively help each individual to develop and strengthen any kind of intelligence he or she has (Gu et al., 2011). The traditional concept of intelligence and the concepts of teaching and evaluation that favor the development of verbal, mathematical and logical intelligence have greatly inhibited the cultivation of diversified talents with different forms of intellectual expression. As they have undermined the development of many special talents, they must be urgently changed (Dinh et al., 2014).

Table 3. Game type and platform affect random-effect model effect size

Moderator variables	*N*	*ES*	*SE*	*95%CI*		Q_b
				Lower	Upper	
Game type						3.080
Immersive games	8	0.718***	0.130	0.466	0.979	
Tutorial games	12	0.459***	0.110	0.228	0.671	
Board games	4	0.410*	0.190	0.004	0.780	
Gaming platform						0.893
Computer	14	0.460***	0.110	0.280	0.639	
Mobile	10	0.590***	0.086	0.367	0.810	

Note. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

The subgroups of gaming platforms consisted of computers (*ES* = 0.460, $p < .001$) and mobile devices (*ES* = 0.590, $p < .001$), and the results of the data analysis of both subgroups demonstrated a facilitating effect on the learning of children with ID (Table 3). Notably, there was no significant difference in effect size between the two subgroups (*Qb* = 0.893, $p = .345$). This situation suggests that both computers and mobile devices have the same facilitating effect on the learning of students with special needs. Other researchers have investigated how gaming platforms influence learners' interactions with games. Lei et al. (2022) examined the unique attributes and constraints of computers and mobile devices, asserting that the principles governing the use of diverse digital tools by families and educators must be taken into account. Soflano et al.'s (2015) study notes that gaming platforms provide a virtual world in which players can interact with each other, thus creating the social aspect of gaming. In terms of development and early learning for children with ID, interaction with different gaming platforms can make a large difference in how they categorize and use technology later in their learning journeys.

However, some researchers have also found that the addictive characteristics of social media and gaming platforms may adversely impact students' mental health (Andreassen et al., 2017; Hawi et al., 2019). The reasons for this include the fact that the reward mechanism in games satisfies the sense of achievement and self-worth for game players, and that the socialization mechanism allows them to feel the thrill of teamwork and group identity, thus satisfying the need for socialization (Hawi et al., 2019). In summary, although the benefits of game-based instruction have been overshadowed by concerns about potential harms, it is important to consider how different gaming platforms can provide unique experiences and give children with ID appropriate technological assistance (Brailovskaia & Teichert, 2020). Therefore, as technology, including gaming platforms, becomes more prevalent in the field of special education, it is critical that restrictions and guidelines are established to ensure that the behaviors of students who have special needs are positive and do not negatively impact their development (Hwang et al., 2014).

3.6. RQ 5: Does the duration of intervention influence students' learning outcomes in GBL settings?

The calculated effect sizes of intervention durations (Table 4) were found to be significantly different (*Qb* = 15.420, $p < .01$). This implies that GBL does not have the same effect on different intervention durations. The unspecified (*ES* = -0.008, $p = .876$) sample is too small to be included in the discussion. The data supports that intervention duration of ≥ 3 months had the greatest effect (*ES* = 0.946, $p < .001$). This was followed by 1 month to 3 moths (*ES* = 0.750, $p < .001$), then 1 week to 1 month (*ES* = 0.389, $p < .01$), and < 1 week (*ES* = 0.180, *p*

= .392). Consistent with previous research findings, long-term interventions have demonstrated greater efficacy in GBL compared to short-term interventions (Chen & Liu, 2023). Extensive research has found that the effects of many interventions require time to accumulate before becoming apparent (Dandashi et al., 2015). In long-term interventions, children with ID tend to show heightened enthusiasm about the use of games in the classroom (Dandashi et al., 2015). However, as time progresses, students developed trust in the new learning model, leading to a gradual increase in their motivation and enthusiasm for learning.

Table 4. Duration of intervention affects random-effect model effect size

Moderator variables	*N*	*ES*	*SE*	*95%CI*		Q_b
				Lower	Upper	
Intervention duration						15.420**
< 1 week	3	0.180	0.215	-0.230	0.599	
1 weak- 1 month	8	0.389**	0.149	0.118	0.650	
1 month- 3 months	6	0.750***	0.167	0.443	1.060	
≥ 3 months	6	0.946***	0.153	0.650	1.227	
Not specified	1	-0.008	0.510	-1.080	0.920	

Note. $^{**}p < .01$; $^{***}p < .001$.

4. Conclusion

This review has revealed that GBL has a moderate effect on the learning of students with ID compared to instructional activities without game-based instructional interventions. It is evident that students with ID are able to learn in an enjoyable environment. As a result, they are less likely to resist the learning tasks. Specifically, GBL is focused on enhancing the cognitive, affective, and social skills of children with ID during the initial stages of learning activities. Although no substantial differences were observed in effect sizes concerning multimedia mode, game type, and game platform, the effect size of multimedia mode was larger than traditional mode, with immersive games and tutorial games showing significant effect results. Furthermore, computers and mobile devices demonstrated a facilitating effect on the learning of children with ID. The effect sizes of intervention durations exhibited large differences, with data indicating that an intervention time of three months or longer had the most substantial effect. To summarize, the aforementioned data affirm, in different ways, the positive role of GBL in the education of children with ID. In addition, the data effectively demonstrate that the length of the intervention duration has a significant effect on the students' academic performance.

Based on the findings, the study yields several important implications. First, with the emergence of immersive technologies such as extended reality (XR), educators must consider carefully their effective adoption of GBL in ID education (Wu et al., 2023, 2025). Our analysis suggests that immersive games can effectively assist learners with ID; however, it is crucial to evaluate the technological attributes of XR to ensure they correspond with the learners' requirements. For example, the heavy headset and reported dizziness associated with XR can impede the use of such technologies by children with and without ID. Furthermore, the physical comfort of children with ID should be taken into account, raising questions about the acceptance of immersive games (Wu et al., 2023). Second, considering the attention span of children with ID, it is also crucial to carefully consider the duration for which the pedagogical use of GBL can be sustained. The novelty effect of GBL is particularly prevalent in children with ID. Third, it appears that young children with ID derive greater benefits from GBL than children above the primary school level. This suggests that primary school ID teachers should maximize the integration of GBL into their teaching practices.

Although the study offers new insights into GBL and ID education, the review has certain limitations. For instance, it solely focuses on English-language publications. Scholarly work written in other languages from under-represented contexts should also be included in future work to provide a more comprehensive overview of the landscape of GBL-enhanced ID education.

Conflict of interest disclosure

The authors declare no conflicts of interest related to this study.

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Appendix A. The selected articles from the mainstream databases

Database	Search string	Additional information
Web of Science	**Title**: (((“special education school” OR “disability students” OR “intellectual disability” OR)) AND ((“game-based leaning”) OR (“digital game-based learning”) OR (“educational game”) OR (“game-oriented class”)) AND ((“smartphone”) OR (“laptop”) OR (“desktop”)) AND ((“education”) OR (“learning”) OR (“game”))) OR **Abstract**: (((“special education school” OR “disability students” OR “intellectual disability”)) AND ((“effects”) OR (“outcomes”) OR (“impacts”)) AND ((“game-based learning”) OR (“digital game-based learning”) OR (“educational game”) OR (“game-oriented class”))) OR **Keyword**: (((“special education school” OR “disability students” OR “intellectual disability)) AND ((“effects”) OR (“outcomes”) OR (“impacts”)) AND ((“game-based leaning”) OR (“digital game-based learning”) OR (“educational game”) OR (“game-oriented class”))) AND **IDOM**:(English) AND **TYPE OF DOCUMENT**: (Article) **Period** 2013-2023	● Searched in the Web of Science Full-Text Collection ● Searched in the field “Abstract.” ● 117 initial results
Science Direct	**Title**: (((“special education school” OR “disability students” OR “intellectual disability)) AND ((“game-based leaning”) OR (“digital game-based learning”) OR (“educational game”) OR (“game-oriented class”)) AND ((“smartphone”) OR (“laptop”) OR (“desktop”)) AND ((“education”) OR (“learning”) OR (“game”))) OR **Abstract**: (((“special education school” OR “disability students” OR “intellectual disability)) AND ((“effects”) OR (“outcomes”) OR (“impacts”)) AND ((“game-based leaning”) OR (“digital game-based learning”) OR (“educational game”) OR (“game-oriented class”))) **Filters Applied**: Journals and Conferences 2013-2023	● Searched in the Science Direct Full-Text collection. ● Searched in the field “Abstract.” ● 103 initial results
ERIC	**Title**: (((“special education school” OR “disability students” OR “intellectual disability)) AND ((“game-based leaning”) OR (“digital game-based learning”) OR (“educational game”) OR (“game-oriented class”)) AND ((“smartphone”) OR (“laptop”) OR (“desktop”)) AND ((“education”) OR (“learning”) OR (“game”))) AND **IDOM**:(English) AND **TYPE OF DOCUMENT**: (Article) **Period** 2013-2023	● Searched in the ERIC Full-Text Collection. ● 48 initial results
JSTOR	**Title, abstract, keywords**: (((“special education school” OR “disability students” OR “intellectual disability)) AND ((“game-based leaning”) OR (“digital game-based learning”) OR (“educational game”) OR (“game-oriented class”)) AND ((“education”) OR (“learning”) OR (“game”))) AND **Filters**: 2013-2023 **Research Articles**	● Searched in all fields. ● 76 initial results
EBSCO	**Title, abstract, keywords**: (((“special education school” OR “disability students” OR “intellectual disability)) AND ((“game-based leaning”) OR (“digital game-based learning”) OR (“educational game”) OR (“game-oriented class”)) AND ((“education”) OR (“learning”) OR (“game”)))	● Searched in all fields. ● 35 initial results
IEEE Xplore	**Title**: (((“special education school” OR “disability students” OR “intellectual disability)) AND ((“game-based leaning”) OR (“digital game-based learning”) OR (“educational game”) OR (“game-oriented class”))) OR **Abstract**: (((“special education school” OR “disability students” OR “intellectual disability)) AND ((“effects”) OR (“outcomes”) OR	● Searched in the fields “Title”, “Abstract”. ● 93 initial results

	("impacts")) AND (("game-based leaning") OR ("digital game-based learning") OR ("educational game") OR ("game-oriented class"))) **Filters Applied**: Journals and Conferences 2013-2023		
Springer	**Title, abstract, keywords**: ((("special education school" OR "disability students" OR "intellectual disability)) AND (("game-based leaning") OR ("digital game-based learning") OR ("educational game") OR ("game-oriented class")) AND (("education") OR ("learning") OR ("game"))) **Filters Applied**: Journals and Conferences 2013-2023	● Searched in the fields "Title." ● 52 initial results	
Scopus	**Title, abstract, keywords**: ((("special education school" OR "disability students" OR "intellectual disability)) AND (("game-based leaning") OR ("digital game-based learning") OR ("educational game") OR ("game-oriented class")) AND (("education") OR ("learning") OR ("game")))	● Full-Text available ● 108 initial results	

Appendix B. General overview of selected studies (N = 24)

Research Purpose	Study results and observations	References
Exploring how educational games affect the rate that those who have ID who have been able to study are capable to acquire mathematical ideas.	The experimental group's average rating on understanding mathematical and chemical concepts has increased.	Amiry & Azizi (2022)
The necessary framework for an inclusive educational system and degrees that are recognized is lacking.	Motivation increased as a result of the learning application, and all target groups performed well on the knowledge assessment.	Batz et al. (2022)
This study explored the feasibility of supervised computerized cognitive training for children with autism and intellectual disabilities. It assessed adherence, satisfaction, and practicality, while preliminarily investigating potential cognitive and behavioral benefits to inform future research.	The training proved highly feasible and satisfactory with excellent adherence. Exploratory findings showed promising improvements in attention, working memory, and behavior. These positive results support the intervention's practicality and justify larger future trials.	Benyakorn et al. (2018)
The RECALL Project details the creation and assessment of an innovative Android OS route learning system for individuals with disabilities.	Systems that promote route learning rather than advice are needed for a target population that is defined as having "poor spatial skills," as route guide systems impede the construction of cognitive maps.	Brown et al. (2013)
A more secure and interesting emerging application might be provided by virtual reality (VR).	When comparing memory span to standard training and control groups, VR greatly outperformed them in cooking, cleaning, and memory span.	Cheung et al. (2022)
This study aimed to co-design, with children with autism spectrum disorder and/or Intellectual Disability, personalized computer-based reward systems. It sought to understand their preferences to create more engaging and effective digital rewards, moving beyond standard, one-size-fits-all approaches in educational technology.	The research found that children's reward preferences were highly individualistic, favoring dynamic, sensory-based digital rewards (e.g., animations, sounds) over static ones. The co-design process successfully generated a diverse set of motivating rewards, demonstrating the value of participatory design for this population.	Constantin et al. (2017)
Children who suffer from ID frequently struggle with social integration, leading to behaviors such as aggression, aloofness, low self-esteem, and emotional instability.	All of the examined groups showed high levels of motivation, while the groups with minor disabilities performed the best in terms of scoring and coordination.	Dandashi et al. (2015)
This study investigated the impact of a computerized working memory training program on cognitive abilities in children with mild intellectual disability (MID). It aimed to evaluate if	The training group showed significant improvement in visuospatial working memory and fluid intelligence compared to the control group. This suggests that computerized working memory training is a potentially effective intervention for	Delavarian et al. (2015)

such training could improve their working memory and fluid intelligence.	enhancing core cognitive functions in children with MID.	
This study investigates the effects of an e-learning environment utilizing game-based educational software on the learning outcomes of students with ID.	The results showed that pre- and post-course attitudes and student academic achievement scores increased significantly. According to gender, pre-course and post-course attitudes and academic achievement scores were similar. Men had higher academic attainment and attitude post-test scores than women. greater daily mobile device usage experience was associated with greater post-test and academic achievement scores.	Demir (2022)
This study aimed to evaluate the test-retest reliability and clinical feasibility of a motion-controlled computer game designed to improve literacy and numeracy skills in children and adolescents with intellectual disabilities.	The motion-controlled game demonstrated good to excellent test-retest reliability across most measures, indicating consistent performance. It was also found to be a clinically feasible tool, with high participant acceptance and positive engagement during the intervention sessions.	Guarnieri et al. (2019)
This study investigated the effects of Nintendo Wii Fit® balance game training on the static and dynamic balance abilities of students with intellectual disabilities. It aimed to determine if such exergaming is an effective intervention for improving their balance.	The Wii Fit® training group showed significant improvements in both static and dynamic balance scores compared to the control group. The study concluded that using Wii Fit® games is an effective method for enhancing balance ability in students with intellectual disabilities.	Hsu (2016)
People who have ID may encounter it challenging to do routine tasks.	Throughout the course of the four participants, the percentage of correct task steps arose.	Kang & Chang (2019)
Independent automated teller machine (ATM) skills are an essential life skill for people with ID, as well as to other daily living tasks.	The instructors thought the augmented reality game was very helpful in helping their students develop the ATM skills.	Kang & Chang (2020)
Children with ID need motivation and interest to train. This study offered Neuro-World, a game-based cognitive training program for motivation and interest induction and analyzed its performance against a standard cognitive training program after professional therapists executed both programs.	Pre- and post-test findings of the game-based cognitive training program were statistically significant and superior to the conventional program. The game-based cognitive training program proposed in this study using digital media should improve cognitive learning ability.	Kim & Lee (2021)
Children with ID have attention issues that affect their cognitive, academic, and social development. This study evaluated a computerized attention training program for ID children.	Children in the attention training condition improved selective attention more than those in the control condition. Three months after training ended, these benefits persisted. The attention training program did not increase sustained attention, attentional control, or inattentive/hyperactive behaviors.	Kirk et al. (2016)
This study evaluated the effectiveness of active video game (AVG) interventions on body composition, physical activity levels, and motor proficiency in children with intellectual disabilities, comparing outcomes against those who received traditional physical education.	The AVG group demonstrated significant improvements in motor proficiency and increased physical activity levels compared to the traditional PE group. However, no significant between-group differences were found in body composition measures such as body fat percentage.	Lau et al. (2020)
A computer game-based telemonitoring program designed to help persons with ID improve their money management skills.	They seem to favor the game, Payments, possibly because it allows for greater multitouch device involvement.	Lopez et al. (2014)
A pretest-posttest quasi-experimental	The findings revealed a significant difference in the	Pashapoor et

study involving a control group was carried out.	attention of students with ID between the experimental and control groups.	al. (2018)
To develop instructional strategies for children with ID by determining the specifications for their creation and application in those children' classrooms.	These results confirm that the questionnaire's suggested needs are all highly relevant for utilizing digital game-based learning in educational settings for children with ID.	Saleh et al. (2020)
This study aimed to develop and evaluate an accessible serious game platform to teach daily living and safety procedures to people with intellectual disabilities, assessing its usability and effectiveness as a learning tool.	The serious game platform demonstrated high usability and accessibility. User testing showed it was effective in successfully teaching the target procedures, indicating its strong potential for practical learning applications among individuals with intellectual disabilities.	Santórum et al. (2023)
This pilot study investigated the feasibility and effectiveness of a computerized cognitive training program for adults with intellectual and developmental disabilities, aiming to improve their cognitive functions.	The training group showed significant improvements in memory and attention compared to the control group. The study demonstrated that computerized cognitive training is a feasible and potentially effective intervention for this population.	Siberski et al. (2015)
This study examined how GBL affects emotion recognition in children with ID in the educational setting and improve socio-emotional skill of emotion perception in intellectually disabled children.	The study found that GBL did not improve emotion recognition in intellectually disabled children. This contradicts previous study on GBL and ID and socio-emotional skill, which found significant effects.	Vorkapic & Christiansson (2022)
This study aimed to evaluate the effectiveness of a Digital Game-Based Learning (DGBL) approach in developing number concepts among students with intellectual disabilities, comparing its outcomes with traditional teaching methods.	Students who learned with the DGBL method showed significantly greater improvement in understanding number concepts compared to the control group taught by traditional methods, demonstrating the pedagogical value of game-based learning for this population.	Wajiuhullah et al. (2018)
Children with ID have greater susceptibility to health issues compared to their ordinarily developing counterparts. Evidence of efficacious therapies is limited.	This study's findings advance the creation and execution of physical activity treatments aimed at mitigating obesity and enhancing health-related physical fitness in children with ID.	Wang et al. (2021)