Gamify the Education: A Thematic Review for Interactive Approach in Learning

Irene Yong Siew Fei[1], Ruhizan Mohammad Yasin[2], Khairul Farhah Binti Khairuddin[3]

[1]Centre of Leadership & Educational Policy, Faculty of Education, Universiti Kebangsaan Malaysia, [2]Center of STEM Enculturation, Faculty of Education, Universiti Kebangsaan Malaysia, [3]Center of Education & Community Wellbeing, Faculty of Education, Universiti, Kebangsaan Malaysia
Email: [1]ringyg@yahoo.com, [2]ruhizan@ukm.edu.my, [3]kfk@ukm.edu.my

Abstract
The curriculum undergoes periodic changes to align the education system with the latest global demands and cultivate a workforce that can contribute to Malaysia's economy. To include special needs individuals in future workplaces in developing countries like Malaysia, there is a need to give equal chances and exposure to the latest trends in education. Despite the Fourth Industrial Revolution, there is a lack of research that discusses the integration of gamified technology in special education needs (SEN). Therefore, the aim of this paper is to use a systematic literature review to find the latest trend for gamified learning that focuses on learning disabilities (LD) and arrange the findings based on themes. Thematic review using Altas-ti 23.0 synthesizes literature from the year 2014 to the year 2023. By using a keyword search from SCOPUS and WoS databases, 223 articles were identified. All the articles have gone through the inclusion and exclusion processes. Only 35 articles were considered in the final view and four themes were identified, such as game-based learning and gamification elements, digital gamified learning in SEN, impacts on LD students and special need teacher's constraints in gamified learning. The findings of this study will be a guideline for future scholars and SEN educators in developing a framework, model or intervention that focuses on adapting gamified learning.
Keywords: Gamification Elements, Digital Game-Based Learning, Gamified Learning, Learning Disabilities, Teacher

Introduction
The Fourth Industrial Revolution (IR 4.0) that includes Cyber-Physical systems, Internet of Things (IoT), Internet of Service (IoS), Augmented Reality, big data analysis and crowd information systems started in German in the year 2011 (Cubukcu et al., 2020). The influence of this advanced technology has revolutionized the way we access information, modes of communication and daily routines (Moreno-Guerrero et al., 2022). Due to the technical

advances needed in IR 4.0, demand for highly skilled employees in the Science, Technology, Engineering and Mathematics (STEM) industry has increased (Arztmann et al., 2022).

Apart from bringing changes to the workplace, IR 4.0 also bring transition to education. Digital skillset is essential for future world needs. Teachers need to catch up with the trend, change their teaching style, digitalizing teaching material and place students at the centre of the learning process. Quality of education is fundamental to an excellent nation (Subekti et al., 2023). It has been proven that nations that prioritize the quality of education, such as America, China, Japan and Singapore are experiencing rapid progress. Technological advancements led students to highly stimulating experiences, which shaped their learning expectations.

This review paper synthesises the recent issues for LD students and teachers in digital gamified learning. The aim is to promote immersive learning for LD students, who fail due to weak memorizing skills when they join conventional learning. Gamified content helps grab students' attention in learning process (Sezgin, 2020).

Even though digital gamified environment brings personalized learning to students, it generates new issues. Hence, this paper aims to do a thematic review from 2014 to 2023 on gamified learning for learning LD. The research questions are as below:

RQ1: What are the current trends in digital gamified learning that could be found in the literature from 2014 to 2023?

RQ2: What are the main themes that can be found in digital gamified learning for LD?

Literature Review

One of the significant challenges is the way to gamify the learning process. As of the year 2022, there are 17 222 special needs educators in Malaysia who teach LD students in public preschools, elementary and secondary schools (Ministry of Education Malaysia, 2022). Some degree of changes that is essential to boost the use of digital technology should be looked back on facilitating learning using Model TPACK and Theory of Planned Behavior, such as belief, teacher's attitude, content knowledge, pedagogical knowledge and instructional resources. In educational technology, pedagogy principles are the connection between theory and practice (Sapukh, 2018). Teachers need to prepare themselves with content knowledge, pedagogical or teaching approaches, and how various technologies use to create new representations or specific content (Barbieri et al., 2021).

Understanding the main difficulty faced by special needs children help to remedy a strategy in the learning and teaching practice using digital games (Chan et al., 2022). In special education, games and teaching pedagogy should be customized depending on the disability (Svela et al., 2019). A form of teaching method should be comprised of giving a variety of specially designed instructions, customize supports, services and special equipment, which intend to meet the unique needs of disabled students and help them with school accomplishments (Arenas & Dela Cruz, 2019).

Gamification changes student behavior by converting a passive learner into an active player (Zhao et al., 2022). Three main attributes that should be considered when choosing an educational game are: progression - levels and points; feedback - reward system; and behavior - infinite gameplay and collaboration (Alawajee & Delafield-Butt, 2021). Aguilar (2019) also highlight four key characteristics of game learning, that is clear goals and objectives, continuous progress, the mechanics of the game and high degree of optionality. This symbiotic learning process using gamification elements encourages students to gather required learning analytics (Sezgin, 2020).

Keller ARCS Motivational Model explains instructional designs and teaching guidance from a motivational aspect (Chan et al., 2022). Gamified learning provides trial and error opportunities to students. Trigger situation or challenge keeps students engaged and sustain their attention. The learning experience can be relevant and meaningful by creating instructions that are familiar to students. A successful learning experience fosters students' belief and builds confidence in themselves. Students will desire to learn if they experience a satisfying learning process and outcome. Extrinsic motivator, like badge stimulates student to explore the gameplay space and gradually inspire intrinsic motivation in learning.

Methodology

This paper uses ATLAS.ti version 23 as a tool for analyzing the literature. The literature search was extracted from SCOPUS and Web of Science (WoS) in the latest 10 years. The search strings are shown in Table 1.

Table 1
Search strings from Scopus and Web of Science

SCOPUS	(TITLE-ABS-KEY (gamification) OR TITLE-ABS-KEY ("digital game-based learning") OR TITLE-ABS-KEY ("gam* learn*") AND TITLE-ABS-KEY ("special needs") OR TITLE-ABS-KEY ("special kids") OR TITLE-ABS-KEY ("special child*") OR TITLE-ABS-KEY ("special edu*")	19 results
WoS	"gamification" OR "digital game-based learning" OR " game-based learning" OR "gamified learning environment" (All Fields) and "special need" OR "special edu*" OR "special child*" (All Fields)	16 results

The initial search came out with 131 articles from SCOPUS and 92 articles from WoS. The screening procedure excluded 188 articles due to non-English language, inaccessible and duplication articles. Final papers to be reviewed are 35 articles. The search protocol that involves the exclusion process is shown in Figure 1
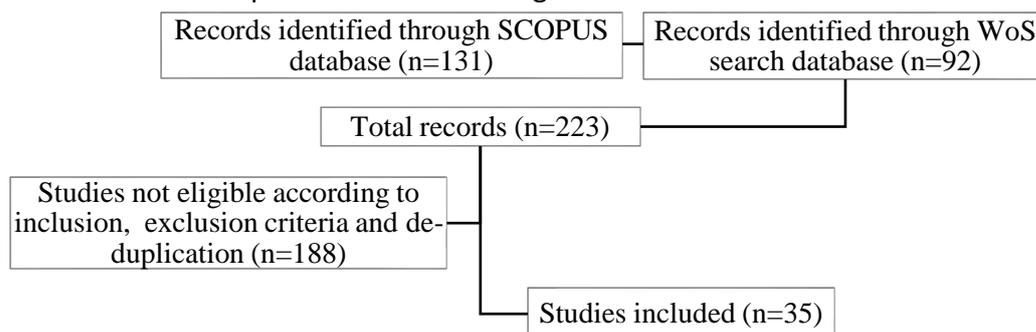

Fig. 1. Flow diagram of literature search and exclusion process

After finalizing the papers that will be included in this study, the next is finding a pattern and distinguishing the main concerns to understand the trends of gamified learning from the previous study. The main concerns will be categorized into themes. Research gaps can be discovered by analyzing and interpreting the results of the earlier findings. From the past study's limitation, new recommendations will be suggested for future scholars who have an interest in integrating gamified learning for LD.

Findings/Results and Discussion
Quantitative Findings

This part answer RQ1: "What are the current trends in digital gamified learning that could be found in the literature from 2014 to 2023?" There is a wide range of countries that have done research on gamified learning. Most papers were published in the United Kingdom (3 articles), followed by Cyprus, Greece, Indonesia, Russia, Spain, Sweden and Turkey (2 articles). Besides Indonesia and Philippines, other ASEAN countries have less research on digital gamified learning. Figure 2 shows the number of papers published in index journals:
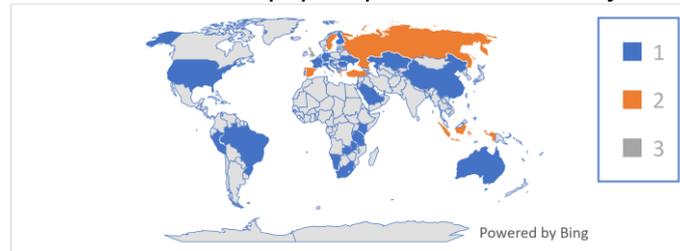

Fig. 2. Paper breakdown according to the country of publication

Based on the word cloud in Figure 3, the current study from 2014 to 2023 focuses more on the term "game" (3278 times), "student" (2494 times) and "learning" (1917 times). Other words that were frequently captured were "education", "child", "use", "learn", "research", "study", "education", "teacher", "technology" and "gamification".

Fig. 3. Word frequencies based on 35 articles

Figure 4 shows the number of published papers. The number of papers gradually increased with 8 papers published in 2021 and reach a peak in 2022 with 10 papers issued. The increment is 100% compared to the year 2014, with no article found. By Jun 2023 when the time author stops collecting papers, the number of papers was still on an upward trend.
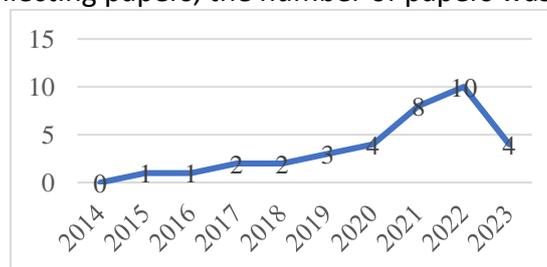

Fig. 4. Number of papers published from the year 2014 – 2023

Qualitative Findings

This part discusses RQ2: "What are the main themes that can be found in digital gamified learning for LD?" using qualitative findings. The themes found are shown in the section below:

Game-Based Learning and Gamification Elements

There are intersecting applications for game-based learning and gamification elements. With innovation, digital gaming has become a popular pastime for all ages of people (Bicen et al., 2022). Play is the most natural way for humans to learn, humans will learn and observe the world through basic instinctual actions when playing games (Sezgin, 2020). Game-based learning originates from game research in the middle of the 1950s and was first adopted in the 1970s. The research for integrating games into teaching instruction started in 1980s. Game-based learning using digital technology was widespread in mainstream classrooms only starting in 2007 (Alawajee & Delafield-Butt, 2021; Tlili et al., 2022).

Game-based learning is an application that uses the characteristics of game elements in non-game contexts to create an engaging and immersive learning experience in delivering specific learning goals, outcomes and experiences (Martin et al., 2020). In other words, game-based learning is a learning task that is redesigned into a game with a full range of game features with clear rules and challenges to motivate effective learning (Arztmann et al., 2022). Games can be divided into different genres such as lego, memory games, social game, video game, competitive games, communication games, concentration games, encouragement games, discovery and exploratory games (Avdiu et al., 2022). Role-play, puzzles, simulations and strategy games have been reported that can bring effect on student learning (Martin et al., 2020). Sandbox is another new game genre for open-world gameplay, which is socially interactive and cooperative (Alawajee & Delafield-Butt, 2021) and the learning experience is managed through the Learning Management System (LMS) (Zhao et al., 2022).

Another term that will be discussed in this paper is gamification. Gamification is a feature that adds game mechanisms into other areas of non-game environments, for example the education system or business intranet to increase participation with a product or a service. Every game has set its own rules, goals and feedback systems in an early stage (Baglama et al., 2022; Sapukh, 2018). Different games have different rules and in-game features, which are called gamification elements. Examples of gamification elements are Avatars, Badges, Competitions and Challenges, Narratives, Points and Leaderboards.

Avatars provide a simulation based on real-time presence to the users (Sezgin, 2020). It is a virtual character that represents the user in a digital world. Avatars overcome the restraint of physical to have physical consequences beyond their own vitality and free students from physical risk when they are exploring the digital world (Alawajee & Delafield-Butt, 2021). Badges represent students' performance in the game. Badges, grades and tangible rewards are the most common extrinsic outcomes (Chan et al., 2022). Badges are suitable for Attention Deficiency Disorder and younger students, as the process of earning tokens is similar to positive reinforcement techniques, such as rewarding a sticker or giving a star. This sort of incentive that can make them concentrate longer than the usual time.

Competition and challenge can be created by opponents through designing problems or solving puzzles (Kaimara et al., 2021). In-game performance, the competition was normalizing failure and strengthens children's self-esteem (Vasalou et al., 2017). The game challenges stimulate new knowledge by motivating students to keep persevering and determined to accomplish tasks (Mukh et al., 2023; Alawajee & Delafield-Butt, 2021). Narrative captures the game content through a story in the form of text, video, image, audio or their combination (Aguilar, 2019b; Prosalova et al., 2022). Visual design boosts the interest and motivation of LD students which enhance their learning experience in different behavior and concepts (Baglama et al., 2022). Point is a scoring system and immediate feedback (Zhao

et al., 2022; Lämsä et al., 2018). Accumulated points will be ranked in leaderboards (Zhao et al., 2022).

Digital Gamified Learning in SEN

To meet the needs of diverse learners across educational settings, there was increased attention on the features of technology to facilitate LD students in various content areas based on their development (Baglama et al., 2022; Martin et al., 2020). Each student is unique, and no teaching method can fit all student's needs (Avdiu et al., 2022; Kaimara et al., 2021). They have their own concept, different characteristics and behavior. It is important to look at the differentiation in every child when adopting digital gamified learning (Arztmann et al., 2022).

Most children master basic reading skills after entering school. Failure to read affects self-esteem and leads to long-term negative consequences such as behavior problems and depression (Ojanen et al., 2015). There are different categories in LD. For autism, the term "Autism" was first defined in the year 1911s by psychiatrist Eugene Bleuler. Autism is a neurodevelopmental disorder with characteristics, such as impairs in social interaction, repetitive behavior, stereotype, excessive resistance to change and restricted interest (Alves et al., 2020). Now the number of children that are diagnosed with Autism is 1 out of 54 in America and 1 out of 64 children in the United Kingdom (Alves et al., 2020). Down syndrome has short-term memories, weak gross and fine motor skills. Dyslexia affects accurate and fluent word reading, difficult to differentiate similar alphabet or words while Dyscalculia faces difficulty in learning math (Lämsä et al., 2018). Intellectual disability has significant impair for conceptual, practical, motor skills and social (Tlili et al., 2022). Emotional behavior disorder got a risk of dropping out of school because of their inappropriate and aggressive behavior. Usually, they will affix together with academic issues (Barwasser et al., 2021).

Games need to align with the student's level and understand their needs by deciding which game is appropriate and how games can apply to meet the learning outcome (Avdiu et al., 2022). Special needs teachers must be able to quickly change their teaching approach according to students' levels and their difficulties (Soboleva et al., 2022). For example, content knowledge should be shown visually using pictures, giving simple instructions, breaking down the task into smaller steps and providing more response time when teaching Down syndrome student (Arenas & Dela Cruz, 2019; Avdiu et al., 2022). Due to the slower learning rate than peers, teachers should have constant learning repetition and pause for a while according to their pace and recognition level of the concept (Arenas & Dela Cruz, 2019).

One of the interesting phenomena is that students who have low achievement and struggle in learning are eager to play games (Barbieri, 2021). Sometimes students are reluctant to cooperate and very dependent on their teachers for activities (Avdiu et al., 2022; Cubukcu et al., 2020). Gamified learning systems boosts students' interest (Zhao et al., 2022), enhance learning and address the need for LD (Arenas & Dela Cruz, 2019). Play provides a situation to practice using simple language in the form of a flexible, student-centred and experiential educational strategy (Avdiu et al., 2022). The colourful settings and other audio-visual effects engage students to spend more time on the game (Lämsä et al., 2018). Feeling being welcome, safe and confident in learning activities are core aspects of education (Alawajee & Delafield-Butt, 2021). Enjoyable and pleasurable feeling enhances a positive attitude towards the learning process (Bicen et al., 2022).

Primary school children are still in the developing process, immature and easily get influenced. They will get bored and teacher's role is to deliver content knowledge in a fun way

(Subekti et al., 2023). Students will not accept gamified systems if they are not interested in digital games. Activities need to be adapt based on student characteristics and appropriately add game elements to learning material (Kaimara et al., 2021). A trusting atmosphere by ensuring a comfortable physical and psychological environment helps to promote discovery and improve students' responses (Prosalova et al., 2022).

Inserting inappropriate material and technology can interfere with learning objectives and lead to disruptions in a learning environment (Avdiu et al., 2022; Svela et al., 2019). SEN students are easily overloaded with game interface and game rules information (Arenas 2019; Svela 2019). Learning fails due to task demand exceeds memory capacity and performance will decrease as memory load increases (Chan et al., 2022). Attention, working memory and word recognition problems resulted in poor automation of reading sight work and weak mastery of decoding skills that at the last hurdle LD students in reading comprehension, suffering from learning anxiety, get frustrated and have motivation loss (Mu & Guo, 2022; Barwasser et al., 2021; Salgarayeva et al., 2021). Teachers need to monitor the use of images, sounds and clips that keep students' attention in a gamified learning environment (Arenas & Dela Cruz, 2019).

Technology learning may become a struggle process since cognitive deficiencies hinder their working memory (Chan et al., 2022). It is the teacher's responsibility to alleviate the cognitive load challenge when introducing games different teaching methods to help students catch up with the learning process (Avdiu et al., 2022; Svela et al., 2019). Determining a significant time overhead to impose during set-up, maintenance, monitoring throughout the process and finally gathering and analyze student's results are new challenges for teachers (Zhao et al., 2022).

Impacts on LD Students

Teachers need to meet different student needs while keeping them an opportunity to practice their communication skills and exercise their social behavior. Digital gamified learning helps LD students to easily target information, communication skill and facilitates their independent life (Baglama et al., 2022). Differentiating situational learning experiences and scenarios in games improve communication skills and helps in building relationships (Avdiu et al., 2022). The use of avatars is proven to help autistic children to improve their interactions (Sezgin, 2020). Interaction occurs when children share, ask or discuss the failure in a positive way, like situation, opportunity and game strategy (Vasalou et al., 2017). Sharing about game content and their gameplay experience with peers creates a strong sense of group identification and facilitates the social interaction process.

Using digital gamified learning in a variety of contexts and content knowledge results in higher cognitive and attitudinal outcomes compared to conventional instructions (Martin et al., 2020; Salgarayeva et al., 2021). It helps in supporting students' knowledge, provides opportunities to communicate more effectively or to develop logic and skills acquisition through interactive simulation (Salgarayeva et al., 2021; Tsihouridis & Batsila, 2016). Rewards giving positive reinforcement can increase the frequency of learning behavior for a longer time (Arenas & Dela Cruz, 2019). Good behavior encourages students to achieve their learning goals (Mukh et al., 2023). Badges is powerful incentive and reward mechanism to encourage users to reach a specific target or achievement (Sitra et al., 2017). The use of different gamification element strengthens the learning process.

Games help students to work toward the accomplishment of their goals through meaningful feedback that helps to measure the level of learning achievement (Alawajee &

Delafield-Butt, 2021). Narrative stimulates the learning process, prevents students from giving up and leads them to complete the activities (Sitra et al., 2017). The immediate feedback tailors the skill practice by applying prior, making each different individual beneficial based on the development level and enjoying their learning at the same time (Lämsä et al., 2018; Tsihouridis & Batsila, 2016). Student desire behavior increases within a trial-and-error approach by a set of well-designed problems to solve in the world of games (Alawajee & Delafield-Butt, 2021; Tlili et al., 2022). The graceful failure in an immersive and safe environment encourages students to acquire knowledge differently (Arztmann et al., 2022). It helps them to master the goal with self-responsibility (Mukh et al., 2023) and reduced teacher involvement in guiding one repeated skill during practice time (Lämsä et al., 2018). The integration of exploratory approaches self-guides students in the process of retrieving knowledge, strengthening creativity besides making assessments effective and easier (Mukh et al., 2023).

Computer-mediated circumstance provides structured learning, increases the learning rate and monitors progress (Alves et al., 2020). Technology helps students to decode text and read more easily by perceive learning content in various ways (Prosalova et al., 2022). Instead of memorizing the facts, students can learn through experience (Cubukcu et al., 2020). Children who have difficulty in learning and short memory can utilize the characteristic of games through drilling and multiple repetitions (Avdiu et al., 2022; Salgarayeva et al., 2021). A touch-input system also helps disabled students remove the previous limitations of conventional teaching approaches that use pencil and paper (Chan et al., 2022). The repetition brings a new identity to explore the world until total mastery of the game dynamics which students can practice skills in real situations in their future world (Avdiu et al., 2022; Barbieri et al., 2021).

Students learn through active engagement with their surroundings, and interaction with peers, teachers and others. The principle of constructivism shows how learning modifies, rebuilds and complements by extracts from previous experience (Mukh et al., 2023). Constructive activities, such as explaining the concept using a narrative form, integrating across resources, creating content knowledge in game mechanism and constructing new knowledge based on prior knowledge engaged students cognitively (Kaimara et al., 2021). Digital gamified learning involves students and improves their development when students didn't realize that there are learning through playing (Avdiu et al., 2022). Success or failure is an additional piece of information that led students to construct more pieces of knowledge (Kaimara et al., 2021). What students learned from play becomes their basic level of real actions in the future time (Alawajee & Delafield-Butt, 2021).

Games support student motivation to practise the compromise skill for extended periods (Lämsä et al., 2018; Martin et al., 2020). Brains are motivated by new things and different tasks. Game dynamic encourages students to be committed and dedicated in a learning situation that is relaxed, motivated and comfortable (Barbieri et al., 2021). Stress and uncomfortable manifest frustration and reject behavior, while knowing the importance of learning motivates and strengthens the learning process (Benítez-Lugo et al., 2021).

During the learning process, practice should be balanced between independent play and guidance from the teacher according to the zone of proximal development. Gamified learning increases attention and helps in accomplishing tasks to achieve the desired goal among mild and moderate LD students (Arenas & Dela Cruz, 2019; Chan et al., 2022; Mukh et al., 2023). Boys seem to be more likely to challenge and compete in the world of games (Chan et al., 2022). Challenges that suit students' abilities encourage students to concentrate on

learning. In a game, a standalone approach or combined with gamification elements gives a support level to students by using feedback and scaffolding (Svela et al., 2019). Immediate support through feedback or prompt along the gameplay clarifies the connection between the manipulated elements that are relevant to skill or knowledge of student performance (Lämsä et al., 2018).

Gamified learning yields a positive result in most studies, but there are some studies that have different opinions. One of the concerns is that students that are weak in self-control should be avoided long periods of use since they may have digital addiction issues (Alawajee & Delafield-Butt, 2021; Svanberg & Bergh, 2023). Besides that, there has been a concern that technology may transition learning from a vertical deepening of knowledge to a horizontal expansion of knowledge (Sapukh, 2018). It is because gamification seeks to increase motivation by providing extrinsic rewards for completing a task, but such dependency on external rewards can demotivate learners (Sitra et al., 2017).

Game-based learning may also bring improper behavior and a drop in academic achievement since it is hard to be supervised by teachers in real-time (Mu & Guo, 2022). Students are growing in a background that has a richer educational experience (Barbieri et al., 2021). Students learning core point today is data oriented. Technology is still not fully utilised in teaching practice since the effect of using digital campaigning is not promising (Salgarayeva et al., 2021). Teachers weren't aware of students' needs, which brings a low sense of accomplishment and learning burnout that makes students fear when facing difficulties, escape psychology, low learning efficiency and lack the ability to resist setbacks (Mu & Guo, 2022). Some students reported feeling lost in game competitions (Mukh et al., 2023). We need to embrace the future. Teachers must have a positive attitude and be knowledgeable in using digital technology in gamified learning.

Special Needs Teacher's Constraints

The matter of functional diversity, which includes the differences in ability and student needs is still not contemplated (Benítez-Lugo et al., 2021). The adaptation of gamified learning faces a lot of challenges that influence user quality of experience. It includes an additional workload on teachers, lack of advanced technology support as well as an absence of customizations and personalization for users (Zhao et al., 2022). Student's behavior and attitude can use to predict their academic performance (Martin et al., 2020). However, sometimes students are reluctant to cooperate and relying on teachers for the activities (Avdiu et al., 2022; Cubukcu et al., 2020). Research on teachers' beliefs and attitudes, knowledge of technology, subject content and pedagogy of instructional practice is insufficient.

Despite the positive contribution to students' learning process, there is still some concern that needs to be addressed. Most of the games in the market contain violence which is not suitable for adopting the game in teaching (Bicen et al., 2022). Teachers need to know how different game designs can be utilized in teaching pedagogy (Chan et al., 2022; Moreno-Guerrero et al., 2022). The complexity and poorly designed game destroy students' attention to focus on the features of game elements instead of learning content (Zhao et al., 2022). In the realm of education, it is important to promote teachers' personal growth (Benítez-Lugo et al., 2021). Teacher act as a facilitator, collaborators, technicians, designers and game developers to generate learning interaction between human-human and human-computer (Kaimara et al., 2021). Teachers should carefully plan to encourage students become more proactive, reflective, critical, creative and innovative problem solvers in learning (Alawajee & Delafield-Butt, 2021; Arztmann et al., 2022; Martin et al., 2020).

Teachers' knowledge and attitude are the factors to positively accept gamified teaching (Bicen et al., 2022). The prerequisite for preparing gamified learning is the knowledge from pedagogy, teaching process, student's characteristics, subject content and ways to combine the concept of immersive games (Barbieri et al., 2021). Teaching methods should be based on students' interests for the purpose of encouraging initiative in work and facilitating students while the learning process is going on (Sapukh, 2018). Age appropriateness, safety issues, technology use and learning generalizations should be a concern when choosing a game for educational use (Alawajee & Delafield-Butt, 2021; Subekti et al., 2023). In contemporary modern society, teachers need to be literate in technology. Teachers feel the challenges in integrating the teaching pedagogy and encourage students to construct their knowledge through games (Salgarayeva et al., 2021). A teacher's personality like confidence, motivation and eagerness to try new methods in teaching until their goals are achieved is needed (Subekti et al., 2023).

Time is also one of the main problems in gamified learning. It is a challenge for teachers to stimulate student's motivation and a lot of time need to be spent on planning the teaching and finding appropriate game or materials (Kaimara et al., 2021; Svanberg & Bergh, 2023). Lack of understanding from students about setting time limits will affect their psychological aspects (Prosalova et al., 2022). Other social factors like the support from the management and administrator, equipment, location, time, money and expertise are also constraints when using technology in education (Baglama et al., 2022).

Conclusion

This review paper highlights the latest trends and main concerns in the current digital gamified. There are several issues raised by previous studies. The emergence of the digital revolution didn't mean the current educational system had lost its effectiveness. With the rapid change in cultural digitalization, there is a crack between the skill and knowledge that the individual needs to develop as a modern citizen (Aguilar, 2019b). Teachers play an important role to create visible and accessible learning spaces, supporting the development of transversal knowledge, conceptual understanding and action-directed learning in a supportive environment for SEN (Baglama et al., 2022).

Some games are poorly designed and game developers have little understanding of how to design educational games (Lämsä et al., 2018). The challenging part when using technology is that teachers should consider both the game design and the disability of students (Lämsä et al., 2018). The game design, implementation and outcome of digital gamified learning for LD students have not been sufficiently examined (Tlili et al., 2022). As classrooms become increasingly diverse, the heterogeneity of the student population is still overlooked (Arztmann et al., 2022). Further exploration should be made on the use of digital gamified learning to strengthen the demand for LD students (Lämsä et al., 2018).

Study about digital gamified learning mainly happens in computer-science-related courses like software, engineering, machine learning and multimedia courses in higher education (Sitra et al., 2017; Zhao et al., 2022). Few cases have involved STEM subjects on other educational levels and other subjects (Tlili et al., 2022; Zhao et al., 2022). There are limited studies regarding adapting digital gamified learning in SEN settings (Arztmann et al., 2022; Lämsä et al., 2018; Salgarayeva et al., 2021; Sitra et al., 2017). More studies should be focusing on the use of gamified technology at the primary level for SEN (Martin et al., 2020). For the methodology part, most SEN studies had small sample sizes (Tlili et al., 2022). Since the diversity of the learner profile in SEN, some studies fail to accurately define their target

(Alves et al., 2020). Some of the studies use lengthy surveys which leads to a sample drop-off (Tlili et al., 2022).

Existing gamified learning faces diverse limitations because the implementation was built as plugins to already designed Language Management Systems (LMSs) (Zhao et al., 2022). There are not many findings reported on how to apply educational games to enhance disabled students' learning (Tlili et al., 2022). More research should be conducted on increasing the attractiveness and popularity of digital gamified learning in SEN (Salgarayeva et al., 2021). Future research could also investigate the way teachers give more precise instruction when using dynamic games (Arztmann et al., 2022).

To effectively utilize digital gamified learning, clear short-term and long-term learning objectives should be established by considering student's age and skill level, and creating a conducive learning environment that fosters student motivation (Alawajee & Delafield-Butt, 2021; Tlili et al., 2022). Most studies are mainly focused on the teaching and learning process as well as student's attitudes towards technology (Moreno-Guerrero et al., 2022). Nonetheless, the main person in determine the success use of gamified learning is the teacher. There is an urge to study what teachers should be equipped with in digital gamified learning.

SEN is aimed at helping disabled learners to promote their social participation and independence but professionals in this area still craving to find the most effective practice (Tlili et al., 2022). The way to maintain excitement using technology in the teaching process challenges researchers and teachers (Svela et al., 2019). It is important to study from teachers' insight on how to incorporate game dynamics into the educational process with pedagogical knowledge that can cater for the SEN demand, which is still lacking (Aguilar, 2019b). Early intervention for SEN is necessary to develop coping strategies and promote awareness (Benítez-Lugo et al., 2021).

References
Aguilar, L. (2019a). Learning prosody in a video game-based learning approach. *Multimodal Technologies and Interaction*, *3*(3), 1–20. https://doi.org/10.3390/mti3030051

Alawajee, O., & Delafield-Butt, J. (2021). Minecraft in education benefits learning and social engagement. *International Journal of Game-Based Learning*, *11*(4), 19–56. https://doi.org/10.4018/IJGBL.2021100102

Alves, F. J., De Carvalho, E. A., Aguilar, J., De Brito, L. L., & Bastos, G. S. (2020). Applied behavior analysis for the treatment of Autism: A systematic review of assistive technologies. *IEEE Access*, *8*, 118664–118672. https://doi.org/10.1109/ACCESS.2020.3005296

Arenas, M. R., & Dela Cruz, J. S. (2019). Analyzing the students behavior with Down Syndrome in a gamified learning environment. *International Journal of Recent Technology and Engineering*, *8*(2), 1839–1845. https://doi.org/10.35940/ijrte.B1030.078219

Arztmann, M., Hornstra, L., Jeuring, J., & Kester, L. (2022). Effects of games in STEM education: A meta-analysis on the moderating role of student background characteristics. *Studies in Science Education*, 1–37. https://doi.org/10.1080/03057267.2022.2057732

Avdiu, E., Bekteshi, E., & Xhaferi, B. (2022). Game-based learning in inclusive classrooms: A case study in Upper Austria. *International Journal of Early Childhood Special Education*, *14*(1), 762–770. https://doi.org/10.9756/INT-JECSE/V14I1.221089

Baglama, B., Evcimen, E., Altinay, F., Sharma, R. C., Tlili, A., Altinay, Z., Dagli, G., Jemni, M., Shadiev, R., Yucesoy, Y., & Celebi, M. (2022). Analysis of digital leadership in School management and accessibility of animation-designed game-based learning for sustainability of education for children with special needs. *Sustainability (Switzerland)*, *14*(13). https://doi.org/10.3390/su14137730

Barbieri, G. G., Barbieri, R., & Capone, R. (2021). Serious games in high school mathematics lessons: An embedded case study in Europe. *Eurasia Journal of Mathematics, Science and Technology Education*, *17*(5), 1–17. https://doi.org/10.29333/ejmste/10857

Barwasser, A., Urton, K., & Grünke, M. (2021). Effects of a peer-tutorial reading racetrack on word fluency of secondary students with learning disabilities and emotional behavioral disorders. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.671385

Benítez-Lugo, M.-L., Pinero-Pinto, E., Leon-Larios, F., Medrano-Sánchez, E. M., de-la-Casa-Almeida, M., & Suarez-Serrano, C. (2021). Inclusive design in the field of education from the paradigm of early intervention. *Children*, *8*(6), 474. https://doi.org/10.3390/children8060474

Bicen, H., Demir, B., & Serttas, Z. (2022). The attitudes of teacher candidates towards the gamification process in education. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*, *13*(2), 39–50. https://doi.org/10.18662/brain/13.2/330

Chan, G. L., Santally, M. I., & Whitehead, J. (2022). Gamification as technology enabler in SEN and DHH education. *Education and Information Technologies*, 1–34. https://doi.org/10.1007/s10639-022-10984-y

Cubukcu, C., Canbazoglu, M. K., & Ozerdem, Y. (2020). Mobile game development for children with Down Syndrome. *International Journal of Interactive Mobile Technologies*, *14*(20), 174–183. https://doi.org/10.3991/IJIM.V14I20.16573

Kaimara, P., Deliyannis, I., Oikonomou, A., & Fokides, E. (2021). Waking up in the morning (WUIM): A smart learning environment for students with learning difficulties. *Technologies*, *9*(3), 50. https://doi.org/10.3390/technologies9030050

Lamsa, J., Hamalainen, R., Aro, M., Koskimaa, R., & Ayrsmo, S.-M. (2018). Games for enhancing basic reading and maths skills: A systematic review of educational game design in supporting learning by people with learning disabilities. *British Journal of Educational Technology*, *49*(4), 596–607. https://doi.org/10.1111/bjet.12639

Martin, F., Dennen, V. P., & Bonk, C. J. (2020). A synthesis of systematic review research on emerging learning environments and technologies. *Educational Technology Research and Development*, *68*(4), 1613–1633. https://doi.org/10.1007/s11423-020-09812-2

Ministry of Education Malaysia. (2022). *Special Education Databook Year 2022*. https://www.moe.gov.my/muat-turun/pendidikankhas/buku-data-pendidikan-khas/5570-buku-data-pendidikan-khas-tahun-2022/file

Moreno-Guerrero, A. J., Marin-Marin, J. A., Parra-Gonzalez, M. E., & Lopez-Belmonte, J. (2022). Computer in education in the 21st century: A scientific mapping of the literature in Web of Science. *Campus Virtuales*, *11*(1), 201–223. https://doi.org/10.54988/cv.2022.1.1019

Mu, D., & Guo, W. (2022). Impact of students' online learning burnout on learning performance – The intermediary role of game evaluation. *International Journal of Emerging Technologies in Learning (IJET)*, *17*(02), 239–253. https://doi.org/10.3991/ijet.v17i02.28555

Mukh, Y. A., Tarteer, S., AL-Qasim, M., Saqer, K., & Daher, W. (2023). Using gamification to motivate students with simple-moderate intellectual disabilities. *European Journal of Educational Research*, *12*(2), 639–647. https://doi.org/10.12973/eu-jer.12.2.639

Ojanen, E., Ronimus, M., Ahonen, T., Chansa-Kabali, T., February, P., Jere-Folotiya, J., Kauppinen, K.-P., Ketonen, R., Ngorosho, D., Pitkanen Mikko and Puhakka, S., Sampa, F., Walubita, G., Yalukanda, C., Pugh, K., Richardson, U., Serpell, R., & Lyytinen, H. (2015). GraphoGame - A catalyst for multi-level promotion of literacy in diverse contexts. *FRONTIERS IN PSYCHOLOGY*, *6*. https://doi.org/10.3389/fpsyg.2015.00671

Prosalova, V., Hryhoshkina, Y., Ivanyshyn, M., Stepanenko, O., & Zamsha, A. (2022). Gamification, coaching, scribbling, storytelling in Ukrainian literature classes: Innovative potential and effectiveness of application. *Revista Amazonia Investiga*, *11*(55), 327–333. https://doi.org/10.34069/AI/2022.55.07.34

Salgarayeva, G. I., Iliyasova, G. G., Makhanova, A. S., & Abdrayimov, R. T. (2021). The effects of using digital game based learning in primary classes with inclusive education. *European Journal of Contemporary Education*, *10*(2), 450–461. https://doi.org/10.13187/ejced.2021.2.450

Sapukh, T. V. (2018). Didactic features of educational technology "edutainment" in English language classroom at the university. *Perspektivy Nauki i Obrazovania*, *36*(6), 182–186. https://doi.org/10.32744/pse.2018.6.20

Sezgin, S. (2020). From Robo-Sapiens to Robo-Ludens: Re-thinking future learning with smart personal digital playmates. *Turkish Online Journal of Distance Education*, *21*(3), 4–17. https://doi.org/10.17718/TOJDE.761910

Sitra, O., Katsigiannakis, V., Karagiannidis, C., & Mavropoulou, S. (2017). The effect of badges on the engagement of students with special educational needs: A case study. *Education and Information Technologies*, *22*(6), 3037–3046. https://doi.org/10.1007/s10639-016-9550-5

Soboleva, E. V, Suvorova, T. N., Bocharov, M. I., & Bocharova, T. I. (2022). Using game mechanics in professional training of future teachers working with gifted children. *European Journal of Contemporary Education*, *11*(4), 1222–1235. https://doi.org/10.13187/ejced.2022.4.1222

Subekti, P., Notosudjono, D., & Retnowati, R. (2023). Improving teacher creativity through strengthening self-efficacy, knowledge sharing, and transformational leadership. *Journal of Industrial Engineering & Management Research*, *4*(2), 22–34. https://doi.org/https://doi.org/10.7777/jiemar.v2i5

Svanberg, M., & Bergh, D. (2023). Effects of gamification in a teacher education program, 2010 to 2020. *SAGE Open*, *13*(1), 215824402311609. https://doi.org/10.1177/21582440231160995

Svela, A., Nouri, J., Viberg, O., & Zhang, L. (2019). A systematic review of tablet technology in mathematics education. *International Journal of Interactive Mobile Technologies*, *13*(8), 139–158. https://doi.org/10.3991/ijim.v13i08.10795

Tlili, A., Denden, M., Duan, A., Padilla-Zea, N., Huang, R., Sun, T., & Burgos, D. (2022). Game-based learning for learners with disabilities-What is next? A systematic literature review from the activity theory perspective. *Frontiers in Psychology*, *12*, 1–16. https://doi.org/10.3389/fpsyg.2021.814691

Tsihouridis, Ch., & Batsila, M. (2016). The siLang simulation tool for business secondary technical education E.S.P. Students. *International Journal of Emerging Technologies in Learning*, *11*(4), 61–69. https://doi.org/10.3991/ijet.v11i04.5371

Vasalou, A., Khaled, R., Holmes, W., & Gooch, D. (2017). Digital games-based learning for children with dyslexia: A social constructivist perspective on engagement and learning during group game-play. *Computers and Education*, *114*, 175–192. https://doi.org/10.1016/j.compedu.2017.06.009

Zhao, D., Playfoot, J., De Nicola, C., Guarino, G., Bratu, M., Di Salvadore, F., & Muntean, G.-M. (2022). An innovative multi-layer gamification framework for improved STEM learning experience. *IEEE Access*, *10*, 3879–3889.
https://doi.org/10.1109/ACCESS.2021.3139729