

‘LEAVE NO ONE BEHIND’: A SYSTEMATIC LITERATURE REVIEW ON GAME-BASED LEARNING COURSEWARE FOR PRESCHOOL CHILDREN WITH LEARNING DISABILITIES

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ABSTRACT

The rapid growth of multimedia pedagogy in the education sector has brought about a game-based technological approach that is shaping the learning of children nowadays. The focus of the approach is to encourage active participation from children; the effect can be seen in their interaction, involvement, and engagement throughout the learning content. Active participation in a learning environment would have a substantial impact on children’s self-development and academic achievement, particularly for those with learning disabilities (LD). Therefore, the purpose of this paper is to systematically analyze research conducted on Game-Based Learning (GBL) courseware to support the education of children with LD. A systematic literature review was undertaken, following the PRISMA framework for paper selection. A total of 109 articles were retrieved from the Scopus and Science Direct databases by using a specific keywords search. 14 articles were finalized at the end of the screening based on the inclusion and exclusion criteria. Results reveal the trend of publications, approaches used, and research themes of the selected papers, which include the courseware requirement, student adaptation, and impact of the implementation. The findings demonstrate that GBL is one of the effective methods to be applied in preschool education. It has a significant impact on the development of cognitive skills and assists children who have difficulty in reading, writing, and arithmetic. The findings in this paper can be used as a guide in developing GBL courseware that is developmentally appropriate and effective for children with LD.

Keywords: courseware, digital, education, game-based, learning disabilities, preschool

INTRODUCTION

Modern inventions have a profound impact on the lives of children in the twenty-first century, who are the most regular users of emerging digitalized technologies (Dağal et al., 2022). Nowadays, children are growing up with digital platforms like Instagram and YouTube, and they know how to operate an electronic tablet even before they can talk. The pace of technological change calls for changes in how education represents student learning and competency (Ahmad Shahrizal et al., 2022; Bay, 2022; Mohamad et al., 2022; Raja Hassan & Rahmatullah, 2022; Roslin et al., 2022; Samuri et al., 2021). Education has always placed technology at the forefront where the usage of appropriate technology can significantly contribute to knowledge development. According to Mou et al. (2021), digital-age children want an active learning experience that is social, participatory, and supported by rich media. Therefore, children are encouraged to explore something new to provide an experience that can be practically used in daily life.

Game-based Learning (GBL) is an approach in the form of interactive education that can support the development of children's learning in a world where global technology is rapidly expanding and immersive learning is currently being emphasized (Aslan et al., 2022). The approach is aligned with the finding that children can examine and comprehend their surroundings by engaging in activities and games as a means of mastering certain learning goals (Zosh et al., 2018). GBL may offer a variety of learning content in interactive settings and interfaces that will motivate children to learn and discover. Hence, GBL is being employed in education, whether online or in the classroom, to foster cognitive development among children. However, there are relatively fewer interactive games designed to promote learning skills in children with Learning Disabilities (LD) than for normal children. This is because, in order to use such interactive games properly, children are sometimes expected to have the skills and abilities of a normal child (Mohd & Shahbodin, 2015). Furthermore, many of these games lack the inclusion of a reliable evaluation tool to assess young children's skills and abilities when they use the system.

Learning Disabilities (LD) concern a wide range of developmental disorders of school skills, ranging from speech and language disorders to motor skill disorders. Challenges in oral expression, listening comprehension, written expression, basic reading skills, reading fluency skills, and reading comprehension are categorized under learning disabilities (Table 2 in Lipkin et al., 2015). In the current situation, many preschool children face serious problems related to LD (Touloupis, 2021). Parents, teachers, and other caregivers must first educate themselves on the various types of learning disabilities in order to gain a better understanding of the potential reading, writing, and concentration difficulty (Ahmad, 2015; Taouil et al., 2018). The emphasis should be on the importance of developing children's learning skills despite these challenges.

Numerous studies have placed an emphasis on the game-based learning approach in the teaching and learning process since it may both benefit children's cognitive development and assist those with learning disabilities (Benavides-Varela et al., 2020; Kokol et al., 2019; C.-Y. Lin & Chang, 2015). Fun activities, exploration and contact with the environment, accessibility and organized games, self-experimentation, and opportunities for focused attention are all part of this approach. In simple terms, this approach requires children to be actively involved throughout the learning sessions (Hassan et al., 2014). The GBL approach can assist children in satisfying their curiosity by allowing them to explore the game environment while also improving their cognitive ability, gross and fine motor skills,

imaginative and creative skills, and assisting them in overcoming anxiety and depression in a learning environment (Samuri et al., 2018). It helps the children to maintain their attention and motivation in a teaching and learning session by providing a fun and interactive experience (Taouil et al., 2018).

It is vital to have good educational courseware that covers all aspects of children's learning while also stimulating their interest in learning. GBL courseware involves interactive learning environments that require children to be active and participative throughout the learning. The learning process in GBL requires some combination of more than one type of media (alphabet or numbers), symbols, pictures, audio, and videos for enhancement or memorization. It also supports verbal commands using static and dynamic images in the form of visualization technology for better expression and use (Alemdag & Cagiltay, 2018). Effective courseware must have essential multimedia elements applied to the teaching aids.

Any use of multimedia technology elements in the learning process of children must be developmentally appropriate for knowledge acquisition. As stated by Newton et al. (2019), the sequence of learning develops through three stages, namely concrete, pictures, and symbols. This is in line with Bruner's Cognitive Development Theory which has three modes of representation, namely enactive (based on action), iconic (based on images), and symbolic (based on language) (Takaya, 2015). Modes of representation are ways humans store and encode knowledge or information in their memory. This constructivist theory suggests that learner's approach new content by progressing from enactive to iconic to symbolic representation. Another implication is that even very young learners can learn any material, as long as it is organized to suit their current level of ability. However, most preschool teachers are more likely to use the teaching approach that immediately introduces learning materials of Level 3 (text reading and number operations), which is symbolic in nature, without offering gradual exposure to either of the earlier levels (Newton et al., 2019). The children would therefore be pushed to a more advanced level of learning without properly mastering the previous levels. This will indirectly cause children to start losing interest in learning if they find the content material exceptionally difficult for their level.

The integration of educational technologies comprising old and new media that are appropriate for children's skills and abilities in the development of the GBL courseware would enable the introduction of the proper learning sequence in the preschoolers learning process. Among the examples defined under older media are printed materials, and broadcast media such as radio and television, telephone, e-mail, the Web, etc. Videoconferencing, Internet telephoning, virtual and augmented reality, and other Internet-based real-time technology are examples of new media (Jang & Park, 2016). Internet-based real-time technology, which is the trademark of the current generation, could provide young learners with numerous opportunities to engage in authentic meaningful learning appropriate for their age. It can foster spontaneous interaction with peers and teachers, making the children more engaged with activities. This is aligned closely with modern teaching paradigms that promote interactive task-based learning and learner autonomy. Interactive courseware modules implemented with the current educational technologies would help in engaging and motivating children with LD to continue learning and strengthen their current existing skills, and gradually advance them to the next level.

The purpose of this review study was to explore various aspects involved in the Game-Based Learning (GBL) courseware proposal as a learning approach to support the education and learning environment of preschool children with learning disabilities. The results can be used to develop better, more effective GBL courseware for those special-need children. The remainder of the paper is organized as stated. The next section outlines the research method for screening and extracting the previous research article. A systematic literature review of findings is carried out in the subsequent sections, focusing on the tabulation of data and themes that emerged from the detailed reading of the selected research papers, demonstrated through graphical representation and thematic discussions. Finally, the last section is the conclusion presented along with research constraints and future research recommendations.

METHODS

Similar to the research conducted by Kamalulil and Panatik (2021), the method employed in this systematic review is based on search strategies formulation, databases selection, screening using inclusion and exclusion criteria, and thematic analysis of the findings. The systematic review follows the procedure guideline in the Preferred Reporting Items for Systematic Reviews and Meta-analysis for Protocol (PRISMA-P) 2015 as provided in the work of (Moher et al., 2015). For this purpose, each article from the academic database had an equal chance of being selected. Some clear principles are being set and adapted to form inclusion and exclusion criteria to avoid biased selection. Figure 1 below depicts the steps and explanation of review protocols that have been used in this study. These methods are utilized in this study because they are effective for reviewing and comprehending the substantial body of literature on the subject (Yas et al., 2018). Key points are summarized in tables, and quantifiable components are analyzed to synthesize the identified articles.

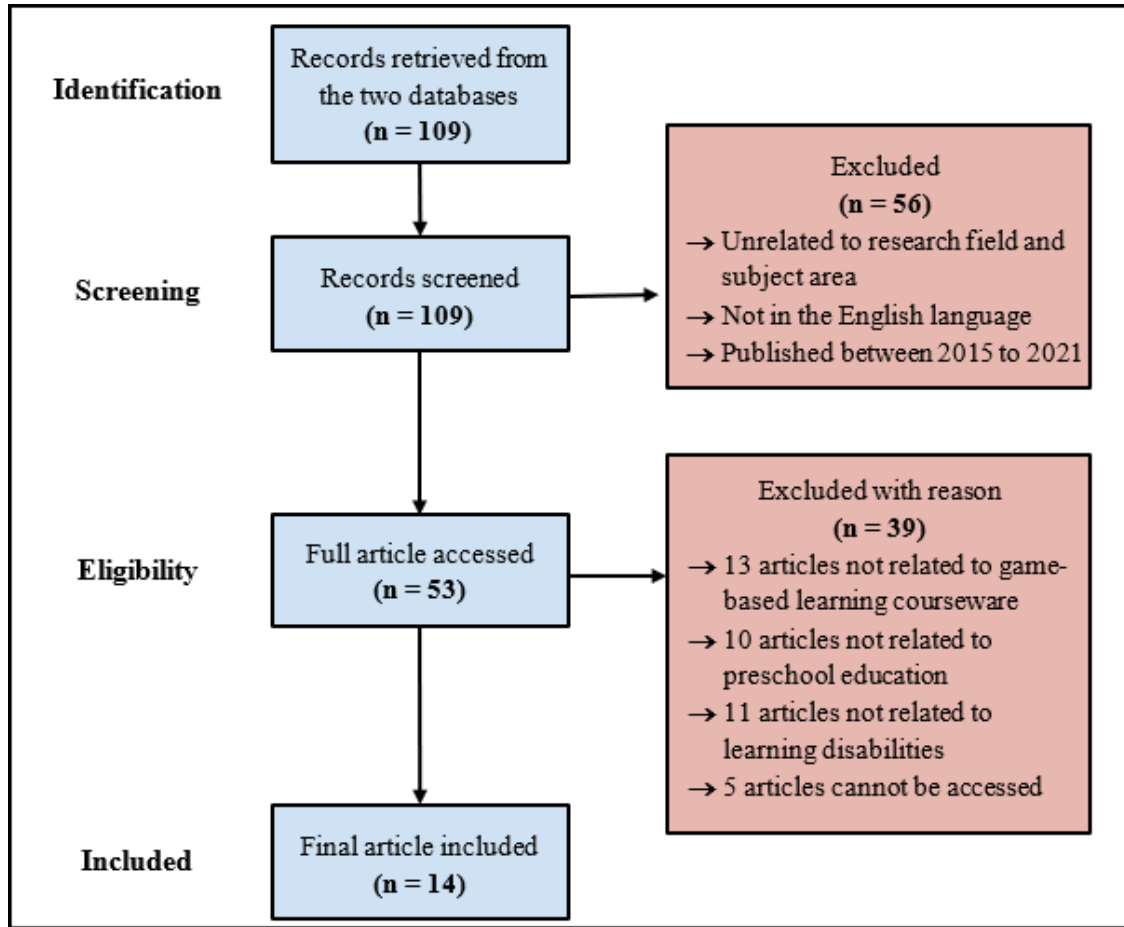


Figure 1. PRISMA Flowchart of Screening Procedures

Data Sources

The quality of any systematic review is largely decided by the data sources used to identify the articles that should be included in the review. The academic databases and a variety of journals considered for this review are those covered by ScienceDirect and Scopus Elsevier. The articles extracted from these databases are original research articles and review articles.

Search Keyword

In order to ensure appropriate search terms and relevant papers are selected, the literature search method shown by (Ridley, 2012) was adopted. Even though searching with the main string is sufficient for the query output to collect all relevant papers, but somehow this is not always the case; thus, substring insertion has been performed. According to Abdulrahaman et al. (2020), some limitations associated with the databases used for this study are:

- i. Some do not have automatic root recognition.
- ii. Some databases offer advanced or expert searches.
- iii. ScienceDirect has a limitation of 10 keywords to use.
- iv. ScienceDirect has a limitation of 8 Booleans to use.
- v. Some do not offer open-accessed articles, although it shows the articles are open to the institution's databases.

The search terms for relevant research findings in the academic databases and journals specified in data sources are:

- i. (application* OR computer OR courseware OR digital) AND (disabilities) AND (game* OR gami*) AND (preschool OR kindergarten)
- ii. (“application” OR “courseware” OR “digital”) AND (disabilit*) AND (“game” OR “gaming”) AND (“preschool” OR “kindergarten”)

Inclusion and Exclusion Criteria

For this purpose, each article from the academic database and libraries had equal chances of being selected. There are some clear principles being set and adapted to form the inclusion criteria to avoid biased selection. These criteria are:

- i. The article is related to Game-Based Learning courseware.
- ii. The article is written in the English language.
- iii. The article is either a review/survey article or a research paper.
- iv. The article is published between 2015 to 2021.
- v. The article mainly focused on preschool children with Learning Disabilities.
- vi. The article described experimental or empirical case studies on how children adapt to the learning environment and respond to Game-Based Learning courseware.
- vii. The article evaluated the effectiveness and impacts of Game-Based Learning courseware in education that include children with Learning Disabilities.

Thus, the queries from the academic databases using the stated search strings led to a pool of 94 articles on the subjects of interest that were written in the English language and had been filtered to related subject areas. All publications found in the time frame of the search, which was from the year 2015 to the year 2021, had been included. The cutoff date for the

search was 5th Jan 2022. In the process of the final screening of this pool, a total of 53 articles met the purpose of the study in the subject area, which was outlined in the next section.

Exclusion from Pooled Articles

The elimination procedure is represented in Figure 1, which shows the flow of the whole procedure of article screening processes for the study. Thus, the process of reducing the number of eligibility articles from the database keywords search by elimination procedure is outlined as follows:

- i. Elimination of papers unrelated to the research scope of GBL courseware and preschool children, leading to a reduction from 53 to 30.
- ii. Elimination of papers that are not linked to research studies of children with Learning Disabilities by examining the abstracts and content, lowering the number of articles from 30 to only 19.
- iii. Elimination of papers that are inaccessible, despite the databases' claims that they are open-access articles; this resulted in a reduction from 19 to 14 articles used as a reference for this systematic review.

Data Collection and Synthesis Mechanisms

Based on the selection mechanism, 14 articles were listed for the analysis. Each article was reviewed and extracted for data tabulation. The articles are scrutinized for their study objectives, approaches used, sample sizes, findings and outcomes, and limitations of the study. The objectives information that has been sorted out included the following:

- i. The courseware components needed in Game-Based Learning, particularly for children with learning disabilities.
- ii. The children's engagement and adaptation to the Game-Based Learning courseware.
- iii. The impact of Game-Based Learning courseware on children with learning disabilities.

The reviewed article and the extracted findings are presented in the next section for analysis and synthesis.

RESULTS

After applying the procedures for selection as outlined in the methodology, each of the 14 shortlisted articles was subjected to a systematic review which involved extracting information as mentioned in the data collection and synthesis mechanisms. All information was collected for further classification according to the themes of each data item. The articles extracted in these databases are original research articles and review articles. Table 1 summarized the data extraction of the studies according to title and year of publication, location of the study, types of research, approaches used, and classifications into suitable themes.

Table 1
Summary of shortlisted articles.

<i>Authors, Year</i>	<i>Location of study</i>	<i>Types of research</i>	<i>Approaches Used</i>	<i>Themes Classifications</i>
(C.-Y. Lin & Chang, 2015)	Taiwan, China	Experimental Research - using Scratch 2.0 model	Mixed-Method	i. Essential needs for courseware development ii. Student's adaption / engagement
(Mohd & Shahbodin, 2015)	Malaysia	Experimental Research - Case Study	Mixed-Method	Impact of GBL courseware
(Suratin & Bahari, 2016)	Malaysia	Review / Survey	Qualitative Method	i. Essential needs for courseware development ii. Impact of GBL courseware
(Y.-H. Lin & Hou, 2016)	Taiwan, China	Experimental Research - Case Study	Mixed-Method	i. Essential needs for courseware development ii. Student's adaption / engagement
(Puolakanaho & Latvala, 2017)	Finland	Experimental Research	Quantitative Method	Student's adaption / engagement
(Suhaimin & Mohamed, 2017)	Malaysia	Proposing Model without experiment (Research)	Qualitative Method	Essential needs for courseware development
(Hong et al., 2018)	Taiwan, China	Experimental Research involving Embodied Interactive Video Game (EIVG) model	Quantitative Method	i. Student's adaption/ engagement ii. Impact of GBL courseware
(Lai et al., 2018)	Malaysia	Review / Survey	Qualitative Method	Impact of GBL courseware
(Taouil et al., 2018)	Morocco	Proposing Model without	Qualitative Method	i. Essential needs for courseware development

continued

		experiment (Research)		ii. Impact of GBL courseware
(Kokol et al., 2019)	Germany	Review / Survey	Qualitative Method	i. Essential needs for courseware development ii. Student's adaption / engagement
(Putra & Setyaningrum, 2019)	Indonesia	Experimental research	Quantitative method	i. Essential needs for courseware development ii. Impact of GBL courseware
(Benavides-Varela et al., 2020)	Italy	Review / Survey	Qualitative Method	Impact of GBL courseware
(Verhoeven et al., 2020)	Netherlands	Review / Survey	Mixed- Method	i. Essential needs for courseware development ii. Impact of GBL courseware
(Wang et al., 2020)	Taiwan, China	Experimental Report using Exer-Learning Playground Game system model.	Quantitative Method	i. Student's adaption/ engagement ii. Impact of GBL courseware

The shortlisted data extraction above listed the 14 articles that have been selected to be used in this review. Based on the two databases used, articles related to preschool children with learning disabilities using Game-Based Learning are relatively few. Based on the study's location, the geographical distribution of the articles reveals that Malaysia and China each have four articles, while the rest have one each. The qualitative method was the most popular approach used in the selected articles above. The tabulation of findings and classification of the articles are described in detail in the next subtopics for ease of analysis and synthesis.

Tabulation of Findings

The articles had been classified into several categories including classification of articles according to the year published with the types of paper, classification of approaches used in data collection, and classifications of articles according to types of paper and their themes.

Classification According to Types of Study and Year Published.

The article was divided into three main types of categories, the first of which consisted of articles where experimental research was conducted with specific models. The second category includes articles that propose models without conducting any experiments, and the final category includes review/survey articles. As mentioned in the inclusion and exclusion criteria, the articles that have been chosen are published between 2015 to 2021. The tabulation of types of study and publication years are presented in Figure 2.

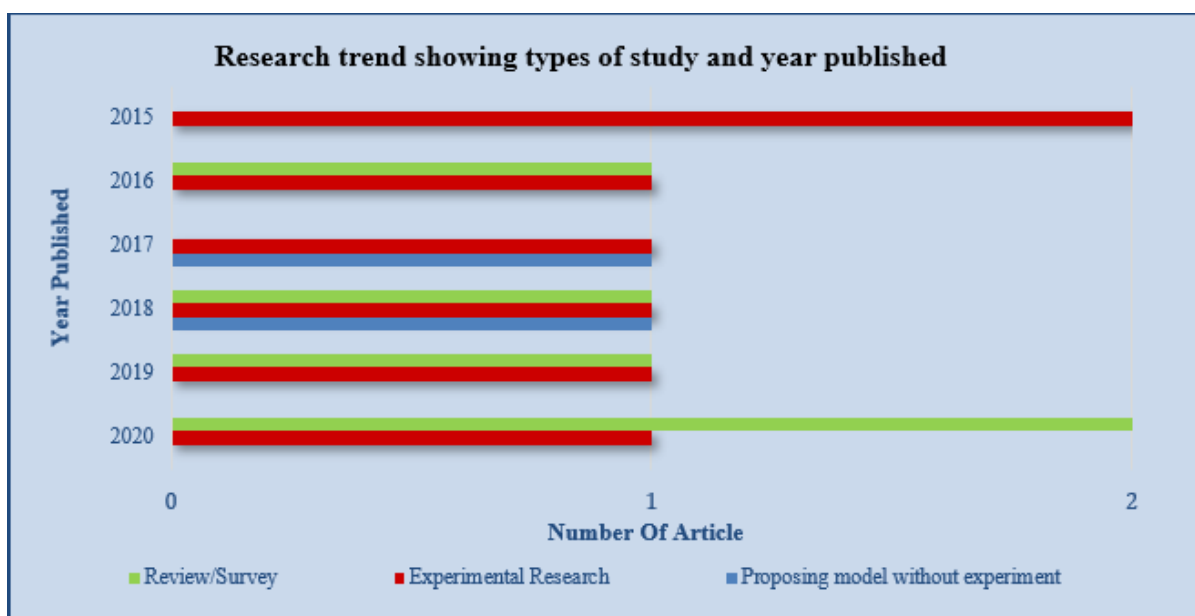


Figure 2. Relationship between the types of study and the year of publication.

The findings for the first category, which is the experimental study, were seven out of 14 articles. The experimental type of study was published yearly from 2015 to 2021, with 2015 having the highest number of papers. The second category is for studies that proposed any model but without experimental research; only two out of 14 articles published in 2017 and 2018 fit into this category. The remaining five articles were review/survey studies on the GBL courseware among preschool children with LD. The highest number of papers (total of two) of the review/survey studies were published in the year 2020 and one paper each was published in 2016, 2018, and 2019.

Classification According to Research Methods

Research methods can be generally divided into three main categories: qualitative method, quantitative method, and mixed methods. All the articles chosen had been categorized according to these methods. The details of the article types are also included for each category of research methods. Figure 3 shows a tabulation of the research methods used in the selected articles, as well as information on the types of study included in each category.

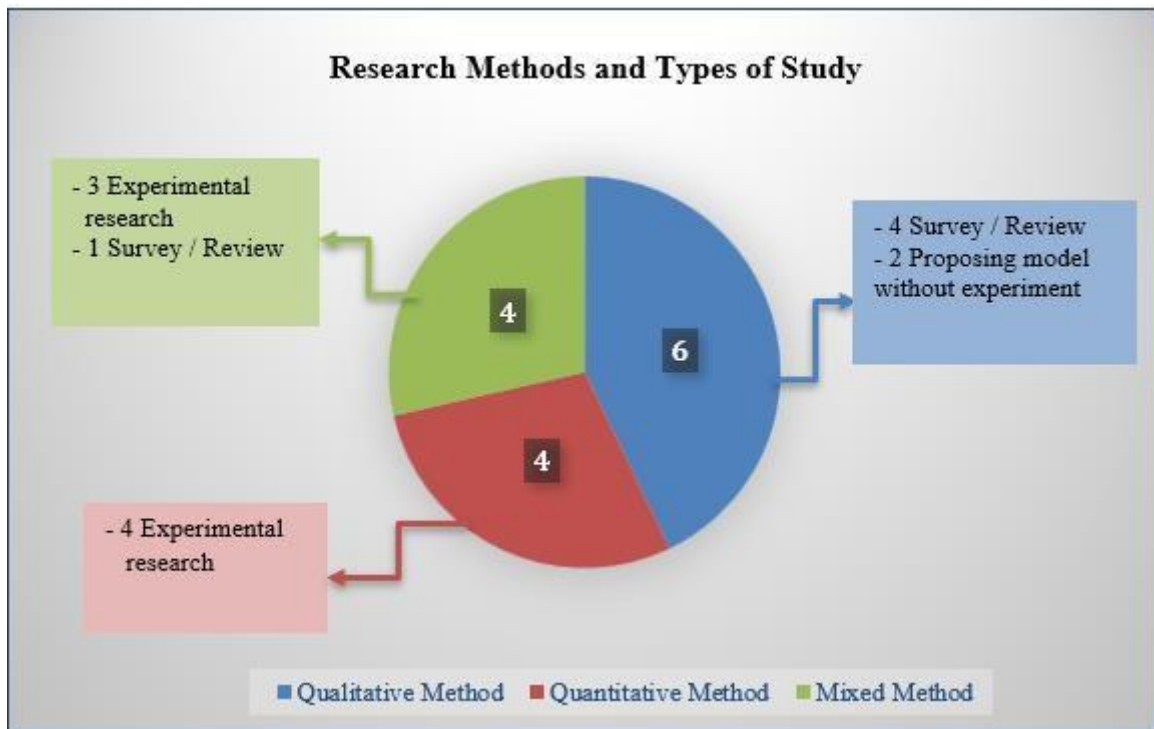


Figure 3. Classification of articles according to the research methods.

Out of 14 selected articles, six studies were conducted using the qualitative method. In this category, the articles that used qualitative methods are of two types; two out of the six articles proposed a model without experiments and the remaining four are survey/review types of articles. For the quantitative methods, four articles were identified under this category and all of them are experimental research. The remaining four articles were conducted using mixed-method, of which three articles are experimental research and the last remaining is a survey/review article.

Classification According to the Themes of the Paper

From the 14 articles that have been selected, the data extracted are read and analyzed in detail to look for any common themes. Therefore, each article will have an appropriate theme according to the objectives of this systematic review article. Three essential themes emerged once the theme setting is complete, and some selected articles portrayed more than one theme. Three themes emerged from the data extraction and analysis: *Essential requirements for courseware development*, *Student adaption/engagement*, and *the Impact of GBL courseware*.

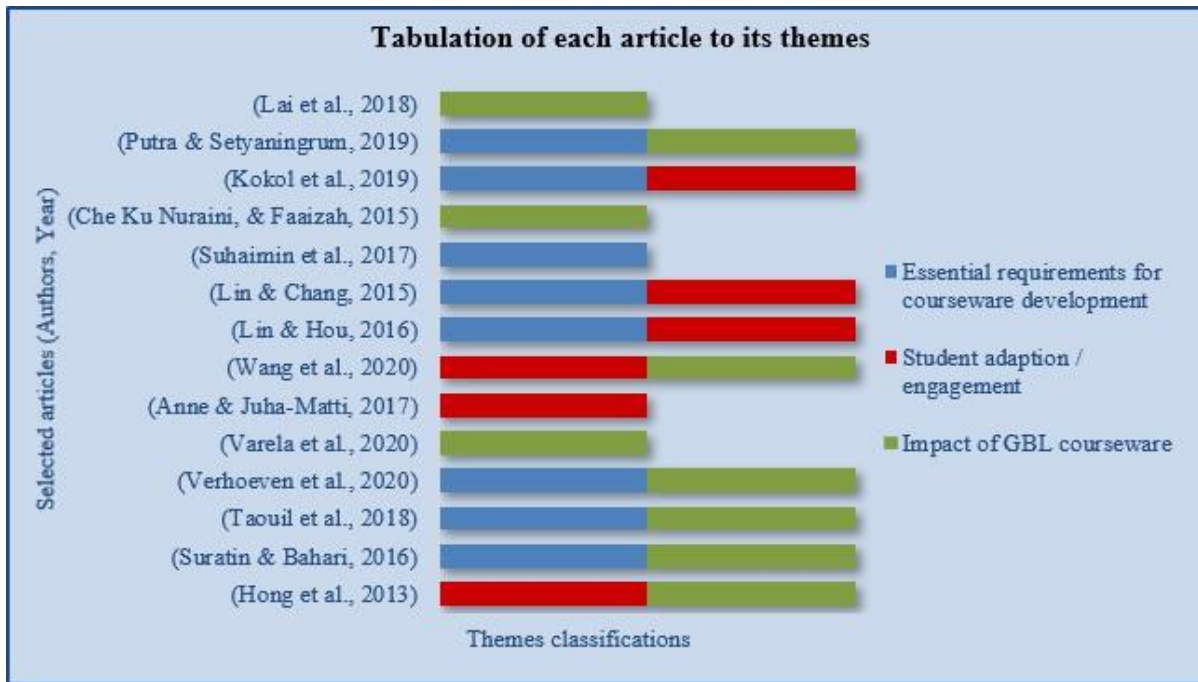


Figure 4. Tabulation of articles according to the study themes.

Figure 4 shows the tabulation of essential themes that have been identified from the selected articles, while Figure 5 presents the total number of articles under each of the three main themes illustrated in a pie chart form. From the division, it can be concluded that five articles address only one theme in their study while nine articles cover two themes in their study. Of those 14 articles, eight of them address the aspects of essential requirements for courseware development while six articles cover student adaption/engagement towards the GBL courseware. The theme which has the most coverage, performed by nine articles, addresses the issue of the impact of GBL courseware on children with LD. The themes depicted proved to be related to the objectives of this article reviewed, making the themes valid and relevant for use in this study. The overall goal is to provide a comprehensive overview of the studies on GBL courseware application in supporting children with LD, which could aid in the improvement of their learning abilities.

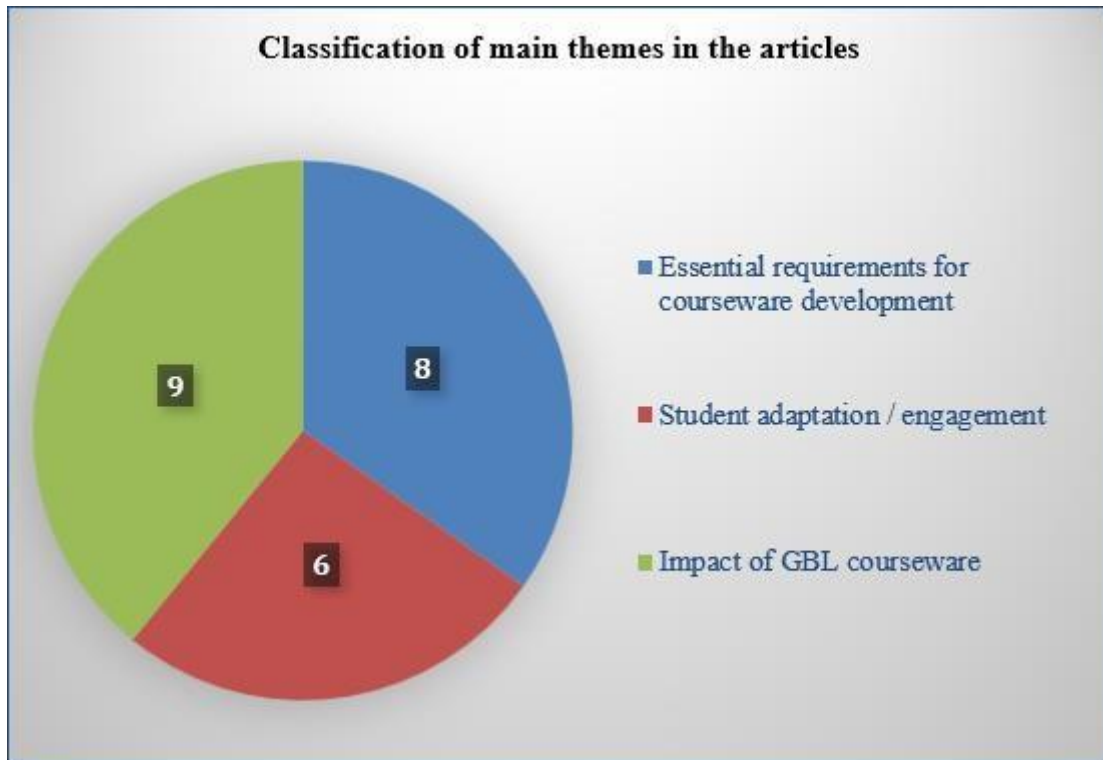


Figure 5. Classifications of articles according to the identified themes.

DISCUSSION

This section will go over the study's findings based on the thematic analysis that was performed. Following the completion of the theme settings in a taxonomy form, a full discussion of each theme and its relationship to the study's key objectives is presented.

Taxonomy

After reading and researching in detail the themes that emerged from the chosen articles, a taxonomy of the study was formed. Figure 6 depicts each category and subcategory of the framed theme, as well as the tabulation of the entire taxonomy. It can be seen that each theme is divided into several important sub-points, which help to demonstrate the result of this systematic study.

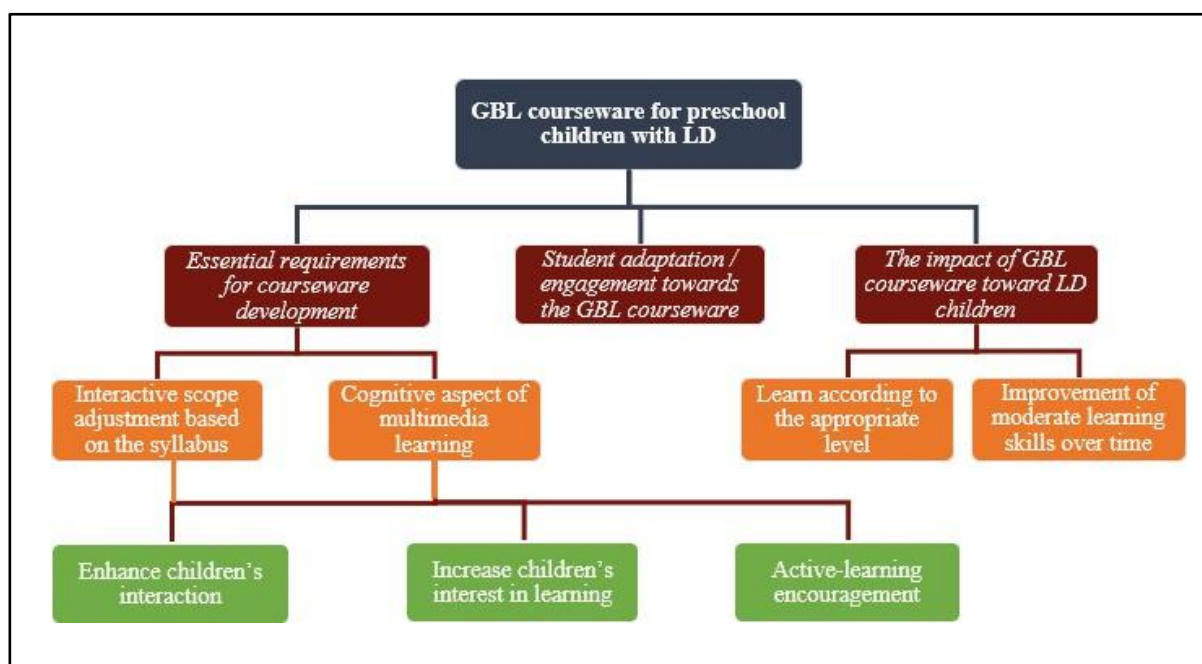


Figure 6. Taxonomy framework based on thematic analysis findings.

Essential Requirements for Courseware Development

Interactive learning material is one of the main criteria that need to be applied during the lesson to attract children to their learning. Teaching through games is considered an active learning session as it allows children to interact with each other. Teachers should be aware of how to use appropriate multimedia tools in GBL courseware so that lessons are appealing and easily absorbed by children, and they understand what they are learning. According to Dale's Cone of Experience, integrating different senses through multimedia will facilitate information processing and assists learners to recall the activities they participated in better (Yilmaz et al., 2022).

When designing and implementing GBL courseware, one needs to take into account several factors that can affect the effectiveness of the game. Effective educational games allow students to achieve learning objectives while having fun learning (Kokol et al., 2019; Putra & Setyaningrum, 2019). One of the essential requirements for courseware development is an adjustment of interactive scope based on the syllabus. Figure 7 shows the percentage of multimedia components that should be applied to develop the courseware (Abdulrahman et al., 2020). The analysis confirms that text (27%) is the predominant multimedia component used in most educational materials. In addition, there are other components that are commonly found in multimedia materials for teaching and learning. These components can be categorized into four main categories; namely text, video, audio, and images, all of which provide the best interactive learning outcomes for children. Although children learn in an interactive environment to keep them engaged and remain interested in learning, the learning materials must be consistent with their learning plans (Suratin & Bahari, 2016). Further to that, children will interact more through the learning environment, resulting in an indirect active learning environment. To effectively stimulate children's interest in learning and improve their learning performance, the effort of integrating GBL with classroom learning must continue and should

be linked to the latest and most innovative technology available (C.-Y. Lin & Chang, 2015; Y.-H. Lin & Hou, 2016; Suhaimin & Mohamed, 2017).

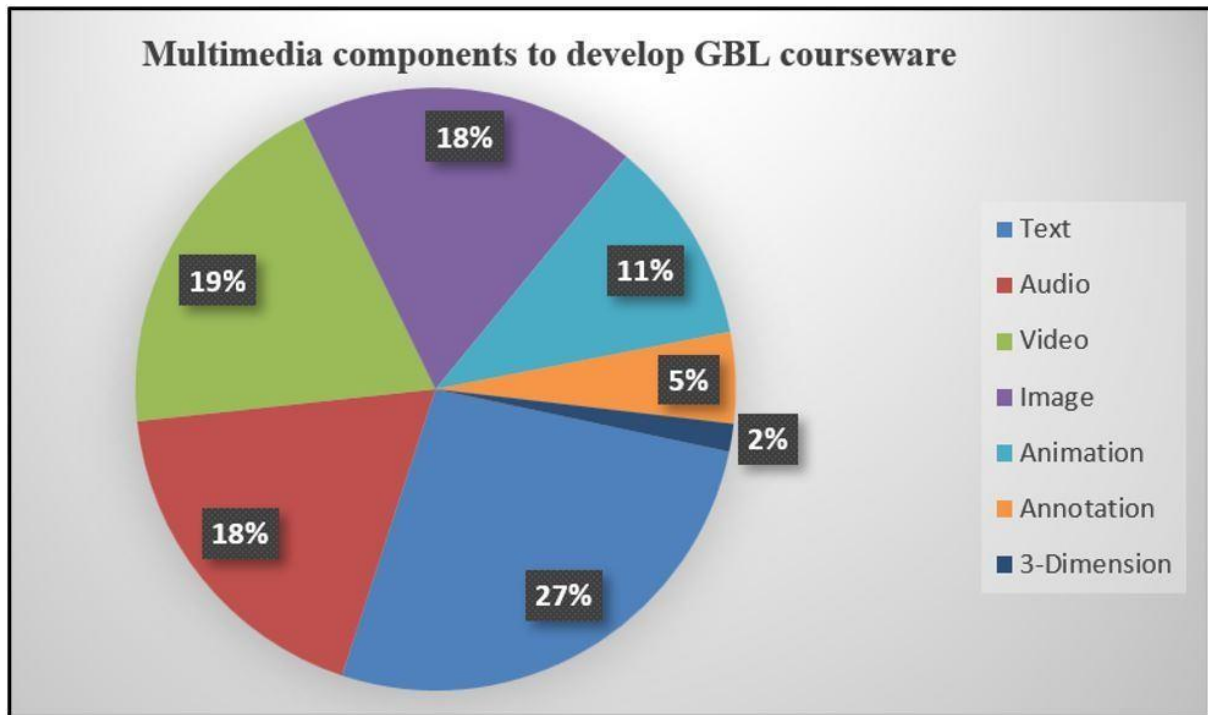


Figure 7. Multimedia components in GBL courseware development (adapted from (Abdulrahaman et al., 2020).

The other essential requirement is to ensure that the cognitive aspects of multimedia learning were applied in the development of GBL courseware. There are several play-based pedagogical elements in schools: resources and learning materials that are appropriate for the child's development, identification and enhancement of interests, creativity and motivation, planning and implementation of learning activities, and establishing positive behavior in the play process (Mohamad Ashari & Baharuddin, 2017). These pedagogical elements can be used as a guide in the design of a GBL courseware as they can generate interest and foster interaction between children and teachers, contributing to the development of cognitive skills.

In accordance with Bruner's Cognitive Development Theory, children learn through three stages: enactive, iconic, and symbolic (Verhoeven et al., 2020). As a result, incorporating these cognitive aspects into the development of GBL courseware indirectly facilitates children with LD in gaining knowledge and comprehension of the learning session. All these aspects of requirements are important in developing GBL courseware because they would provide an interactive learning environment that directly encourages children to be active throughout their learning and can foster their interest. By recognizing the importance of the requirements to unlock the potential and possibilities offered by GBL for children with LD, educators, researchers, and game developers can work synergistically to formulate deliberate strategies for developing and implementing games in learning sessions (Taouil et al., 2018).

Student Adaptation/Engagement towards the GBL Courseware

One of the most important factors in the success of any learning session is the child's active participation and interaction with the teacher and the content presented. Serious games are one of the effective ways to encourage the active anticipation of children, who learns by making interaction with the game environment. Therefore, it is important to develop GBL courseware that understands the needs of children so that they can be engaged and adapt easily to the technology and the learning materials. The needs of children with LD are different from those of normal children; they necessitate a unique approach to learning sessions (Wang et al., 2020). To enable children with LD to adapt to the GBL environment that promotes active learning, the courseware used should be efficient, user-friendly, and have an appealing interface that can increase the learning enjoyment of the children (C.-Y. Lin & Chang, 2015; Y.-H. Lin & Hou, 2016).

Hence, the process of redesigning the content of learning materials is needed as a response to technological changes in the educational environment where students have varying abilities, experiences, and expectations in terms of knowledge acquisition and enhancement. Children's learning development should begin at an appropriate level to ensure that their learning does not surpass their aptitude and capability (Mohd & Shahbodin, 2015). Failure to do so would cause some children to lose interest in learning, and they will start facing problems as they struggle to adapt and understand lessons that are way above their cognitive level. Ideal learning courseware should contain appropriate levels of learning syllabus encompassing the overall contents in the GBL environment (Wang et al., 2020). (Newton et al. (2019) stated that the sequence of learning development is through these three levels – concrete, pictures, and symbols. Adapting this technique in the GBL courseware can indirectly help children with LD learn to progressively move through these three levels at their own pace.

Customization of GBL courseware educational materials is a critical aspect in children's adaptation to the materials and would ensure that children with LD are actively involved with the contents during the learning session. Children's feelings towards their learning experience will have an impact on how they adapt and engage with the learning sessions, and potentially whether they will complete them (Hong et al., 2018). Customization of the GBL courseware (such as the option of adding more new activities and constructing custom-designed multiple-choice exercises with multiple choice that consider every child's unique characteristic) would enable personalized learning for children, as it could be added gradually or as the needs arise (Kokol et al., 2019). The customization can help to facilitate children's ongoing learning efforts and to maintain a steady level of interest in their participation. The practice of such serious games resulted in improved attention and retention, as well as frustration tolerance in children with LD (Kokol et al., 2019).

Therefore, outcomes of GBL courseware have a massive impact on the world of education. The learning outcomes such as the acquisition of knowledge, skills, and abilities can be achieved by children with LD as a result of the GBL process. GBL has the potential to highlight learning outcomes by presenting knowledge in a consistent exciting manner. It is proven that using GBL courseware stimulates the brain and can increase children's engagement and adaption, and retention of teaching-learning sessions (Puolakanaho & Latvala, 2017). These effects are more difficult to achieve with traditional education materials.

Impact of GBL Courseware on Children with LD

Multimedia learning education of GBL courseware nowadays has a significant impact on teaching and learning sessions. GBL has a high appeal in stimulating and developing children's thinking skills while having fun playing games compared to a traditional learning environment. Indeed, the GBL blended learning approach appears to be highly preferred by children (Putra & Setyaningrum, 2019; Suratin & Bahari, 2016). With the emergence of the flipped classroom, GBL courseware can make fundamental changes in teaching and learning.

In order to improve learning skills over time, GBL courseware is developed to fulfill the criteria needed by children with LD. Much research shows that GBL can attract children with LD to learn and improve skills in early education and integrate learning processes by engaging them with learning and playing which can help build their cognitive skills (Benavides-Varela et al., 2020; Lai et al., 2018). GBL also had a positive effect on children's learning of route-planning strategies, which can be improved with the game's support where children demonstrated high technology acceptance toward the game (Hong et al., 2018; Verhoeven et al., 2020)). These research show that GBL courseware can increase children's enjoyment and improve learning skills over time. Children also receive encouragement and motivation to learn new things interactively. The GBL courseware application is one of the strategies that offer cognitive development and improve learning over time among children with LD (Taouil et al., 2018).

One such study's results revealed a significant improvement in balance movement in the GBL courseware group when compared with that of the control group who received the traditional physical therapy program (Boato et al., 2022). GBL could also be used to identify LD in children at an early stage of their schooling, allowing support to begin so that the children do not fall behind their peers in other areas (Puolakanaho & Latvala, 2017). This, in turn, will minimize other school-related problems including motivational and behavioral shortcomings that may have notable effects on the child's forthcoming learning paths.

CONCLUSION

The use of GBL in children with LD has proven to have a beneficial effect on their learning process. However, there are some limitations to adapting GBL courseware that has been outlined in some selected articles. Current educational GBL courseware for children with LD is inadequate in both quantity and quality as it requires more supportive tools and technologies that can help children with special needs in learning more effectively (Suratin & Bahari, 2016). This can be proved through the process of article screening from databases highlighted in the method section, which shows the lack of articles research related to GBL courseware for preschool children with LD. Besides that, only a small-scale sample was used in this GBL study for children with LD (Y.-H. Lin & Hou, 2016; Puolakanaho & Latvala, 2017). Further empirical studies should be undertaken with larger samples to ensure additional evidence and result verification. The quality and quantity of GBL courseware developed for children with LD can be enhanced with more comprehensive research on the subject.

For future studies, it is hoped that more research on children with LD will focus on providing solutions using GBL to help overcome their learning challenges. In addition, GBL courseware can be developed and practically applied to accommodate various levels of education. As a recommendation, a solid pedagogical model of GBL courseware could be systematically developed to enhance effective learning in early education. This will enable more research on the learning processes across the entire educational system. Furthermore, teachers need the training to be more creative in applying interactive GBL courseware to ensure their lessons could attract and encourage children's interactions and engagements with the learning process (Rahmatullah et al., 2021). Therefore, appropriate resources and learning content could be presented in interactive courseware according to the syllabus that has been set to ensure learning outcomes can be achieved. As a result, this GBL courseware will be essential material in helping children with LD. Their passion for learning will grow, and the children will be empowered to overcome the challenges in learning from an early age or preschool level.

In conclusion, the use of GBL courseware in helping children with LD could lead to a new practice of multimedia learning environments in line with the technological advancement of Industry 4.0. This multimedia learning approach must always be aware of the current needs of children, aside from ensuring that content is developed according to the required scope and criteria. This would ensure that the GBL courseware is developed and implemented according to the child's developmentally appropriate level, supported by technological trends. This will have a tremendous impact on the effectiveness of the GBL courseware for children with LD.

Ultimately, this GBL courseware approach could offer an effective alternative to the teaching and learning approach that can help children with LD at various stages of the education sector. As a result, our younger generations will have a better understanding and more opportunities in learning, allowing them to acquire and improve skills that are relevant to current and future needs.

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CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this study.

AUTHOR CONTRIBUTIONS

The author was responsible for the conception and design of the study, data collection, data analysis, interpretation of the findings, and preparation of the manuscript.

DECLARATION OF GENERATIVE AI USE

No generative artificial intelligence (AI) tools were used in the design, data collection, analysis, interpretation of the findings, or writing of this manuscript.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the author upon reasonable request.

REFERENCES

- Abdulrahman, M. D., Faruk, N., Oloyede, A. A., Surajudeen-Bakinde, N. T., Olawoyin, L. A., Mejabi, O. V., Imam-Fulani, Y. O., Fahm, A. O., & Azeez, A. L. (2020). Multimedia tools in the teaching and learning processes: A systematic review. *Heliyon*, 6(11). <https://doi.org/10.1016/j.heliyon.2020.e05312>
- Ahmad, M. (2015). Parents of children with learning disabilities: Factors preventing parents from getting learning support. *Southeast Asia Early Childhood Journal*, 4, 68–80.
- Ahmad Shahrizal, A. Z. S., Rahmatullah, B., Ab Majid, M. H., Mohamad Samuri, S., Hidayanto, A. N., M. Yas, Q., & Purnama, S. (2022). A systematic literature review on the use of podcasts in education among university students. *ASEAN Journal of Teaching & Learning in Higher Education*, 14(1), 222–236. <https://doi.org/10.17576/ajtlhe.1401.2022.10>
- Alemdag, E., & Cagiltay, K. (2018). A systematic review of eye tracking research on multimedia learning. *Computers and Education*, 125, 413–428. <https://doi.org/10.1016/j.compedu.2018.06.023>
- Aslan, S., Agrawal, A., Alyuz, N., Chierichetti, R., Durham, L. M., Manuvinakurike, R., Okur, E., Sahay, S., Sharma, S., Sherry, J., Raffa, G., & Nachman, L. (2022). Exploring Kid Space in the wild: A preliminary study of multimodal and immersive collaborative play-based learning experiences. *Educational Technology Research and Development*, 70(1), 205–230. <https://doi.org/10.1007/s11423-021-10072-x>
- Bay, D. N. (2022). The perspective of preschool teachers on the use of digital technology. *Southeast Asia Early Childhood Journal*, 11(2), 87–111. <https://doi.org/10.37134/saecj.vol11.2.6.2022>
- Benavides-Varela, S., Zandonella Callegher, C., Fagiolini, B., Leo, I., Altoè, G., & Lucangeli, D. (2020). Effectiveness of digital-based interventions for children with mathematical learning difficulties: A meta-analysis. *Computers & Education*, 157, 103953. <https://doi.org/https://doi.org/10.1016/j.compedu.2020.103953>
- Boato, E., Melo, G., Filho, M., Moresi, E., Lourenço, C., & Tristão, R. (2022). The use of virtual and computational technologies in the psychomotor and cognitive development of children with down syndrome: A systematic literature review. *International Journal of Environmental Research and Public Health*, 19(5), 2955.
- Dağal, A. B., Dörterler, S., Öcal, Kanburoğlu, V., Yağcı, M., & Uyanık, G. (2022). Developing preschool teachers' belief scale regarding educational technologies: A validity and reliability study. *Southeast Asia Early Childhood Journal*, 11(2), 136–151. <https://doi.org/10.37134/saecj.vol11.2.9.2022>
- Hassan, H., Rahmatullah, B., & Mohamad Nordin, N. (2014). Towards School Management System (SMS) success in teacher's perception. *Malaysian Online Journal of Educational Technology*, 2(4), 50–60.
- Hong, J.-C., Tsai, C.-M., Ho, Y.-J., Hwang, M.-Y., & Wu, C.-J. (2018). A comparative study of the learning effectiveness of a blended and embodied interactive video game for kindergarten students. *Interactive Learning Environments*, 21(1), 39–53. <https://doi.org/10.1080/10494820.2010.542760>
- Jang, S., & Park, M. (2016). Do new media substitute for old media?: A panel analysis of daily media use. *Journal of Media Economics*, 29(2), 73–91. <https://doi.org/10.1080/08997764.2016.1170021>
- Kamalulil, E. N., & Panatik, S. A. (2021). Socioeconomic status and mental health among low-income employees: A systematic literature review. *Pertanika Journal of Social Sciences and Humanities*, 29(3), 1853–1874. <https://doi.org/10.47836/pjssh.29.3.20>
- Kokol, P., Vošner, H. B., Završnik, J., Vermeulen, J., Shohieb, S., & Peinemann, F. (2019). Serious game-based intervention for children with developmental disabilities. *Current Pediatric Reviews*, 16(1), 26–32. <https://doi.org/10.2174/1573396315666190808115238>
- Lai, N. K., Ang, T. F., Por, L. Y., & Liew, C. S. (2018). The impact of play on child development - a literature review. *European Early Childhood Education Research Journal*, 26(5), 625–643. <https://doi.org/10.1080/1350293X.2018.1522479>

- Lin, C.-Y., & Chang, Y.-M. (2015). Interactive augmented reality using Scratch 2.0 to improve physical activities for children with developmental disabilities. *Research in Developmental Disabilities*, 37, 1–8. <https://doi.org/10.1016/j.ridd.2014.10.016>
- Lin, Y.-H., & Hou, H.-T. (2016). Exploring young children's performance on and acceptance of an educational scenario-based digital game for teaching route-planning strategies: a case study. *Interactive Learning Environments*, 24(8), 1967–1980. <https://doi.org/10.1080/10494820.2015.1073745>
- Lipkin, P. H., Okamoto, J., Health, C. on C. with D. and C. on S., Norwood Jr, K. W., Adams, R. C., Brei, T. J., Burke, R. T., Davis, B. E., Friedman, S. L., & Houtrow, A. J. (2015). The Individuals with Disabilities Education Act (IDEA) for children with special educational needs. *Pediatrics*, 136(6), e1650–e1662. <https://doi.org/10.1542/peds.2015-3409>
- Mohamad, A. I., Rahmatullah, B., Ibrahim, L. F. M., Saari, E. M., & Downing, K. J. (2022). Exploring parents perception of online learning through a systematic literature review. *Borneo International Journal EISSN 2636-9826*, 5(1), 8–15.
- Mohamad Ashari, Z., & Baharuddin, M. (2017). Play based pedagogy in pre-school: A meta analysis research. *Man in India*, 97, 237–243.
- Mohd, C. K. N. C. K., & Shahbodin, F. (2015). Personalized learning environment: Alpha testing, beta testing & user acceptance test. *Procedia - Social and Behavioral Sciences*, 195, 837–843. <https://doi.org/https://doi.org/10.1016/j.sbspro.2015.06.319>
- Moher, D., Shamseer, L., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., Shekelle, P., Stewart, L. A., Altman, D. G., Booth, A., Turner, L., & Whitlock, E. (2015). Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic Reviews*, 4(1). <https://doi.org/10.1186/2046-4053-4-1>
- Mou, T.-Y., Kao, C.-P., Lin, H.-H., & Yin, Z.-X. (2021). From action to slowmation: Enhancing preschoolers' story comprehension ability and learning intention. *Interactive Learning Environments*, 29(8), 1231–1243. <https://doi.org/10.1080/10494820.2019.1635496>
- Newton, N., Record, A. E., & Mello, A. J. (2019). *Fluency doesn't just happen with addition and subtraction: Strategies and models for teaching the basic facts* (1st ed.). Routledge. <https://doi.org/10.4324/9780429055553>
- Puolakanaho, A., & Latvala, J.-M. (2017). Embedding preschool assessment methods into digital learning games to predict early reading skills. *Human Technology*, 13(2), 216–236. <https://doi.org/10.17011/ht/urn.201711104212>
- Putra, W. D. P., & Setyaningrum, W. (2019). The effect of game-based learning toward conceptual understanding. *Journal of Physics: Conference Series*, 1157(4). <https://doi.org/10.1088/1742-6596/1157/4/042117>
- Rahmatullah, B., Yassin, S. M., & Omar, J. (2021). Local community involvement in Malaysian early childhood care and education centers. *The International Journal of Educational Management*, 35(1), 143–157. <https://doi.org/10.1108/IJEM-05-2020-0259>
- Raja Hassan, R. M. F., & Rahmatullah, B. (2022). Systematic review on students' awareness on cyberbullying at high school level of education. *Insight: Jurnal Ilmiah Psikologi*, 24(1). <https://doi.org/10.26486/psikologi.v24i1.1978>
- Ridley, D. (2012). *The literature review: A step-by-step guide for students*. SAGE Publications Ltd.
- Roslin, A. R., Rahmatullah, B., Zain, N. Z. M., Purnama, S., & Yas, Q. M. (2022). Online learning for vocational education: Uncovering emerging themes on perceptions and experiences. *Journal of Vocational Education Studies*, 5(1), 1–15. <https://doi.org/10.12928/joves.v5i1.6097>
- Samuri, S. M., Emang, D. A., Agus, R., Rahmatullah, B., Mohamed Salleh, N. S., & Mustafa, M. C. (2021). LACLOD: Learning Analytics for Children's Logic Development. *The International Journal of Multimedia & Its Applications (IJMA) Vol, 13*.
- Samuri, S. M., Rahmatullah, B., Abdullah, N., Ahmad, A., Isa, Z. M., & Hamed, H. (2018). Early childhood research landscape on children's profile: Coherent taxonomy, motivation, open challenges, recommendations and, pathways for future research. *Child Indicators Research*, 11(5). <https://doi.org/10.1007/s12187-018-9536-5>
- Suhaimin, S. H., & Mohamed, M. (2017). Intervention for children with Specific Learning Disabilities (SpLD) in mathematics disorders: A framework. *Sains Humanika*, 9(3–2). <https://doi.org/10.11113/sh.v9n3-2.1278>
- Suratin, S. F., & Bahari, M. (2016). A review of learning courseware for children with learning disabilities in Malaysia. *Journal of Information Systems Research and Innovation*, 10(3), 1–8.
- Takaya, K. (2015). Bruner's theory of cognitive development. In *International Encyclopedia of the Social & Behavioral Sciences: Second Edition* (pp. 880–885). Elsevier Inc. <https://doi.org/10.1016/B978-0-08-097086-8.23095-X>

- Taouil, M., Begdouri, A., & Majda, A. (2018). Adaptive dialogue system for disabled learners: Towards a learning disabilities model. *Colloquium in Information Science and Technology, CIST, 2018-October*, 422–427. <https://doi.org/10.1109/CIST.2018.8596651>
- Touloupis, T. (2021). Parental involvement in homework of children with learning disabilities during distance learning: Relations with fear of COVID-19 and resilience. *Psychology in the Schools, 58*(12), 2345–2360. <https://doi.org/10.1002/pits.22596>
- Verhoeven, L., Voeten, M., van Setten, E., & Segers, E. (2020). Computer-supported early literacy intervention effects in preschool and kindergarten: A meta-analysis. *Educational Research Review, 30*, 100325. <https://doi.org/https://doi.org/10.1016/j.edurev.2020.100325>
- Wang, Y., Bian, Y., Song, Y., Huang, R., Gai, W., Liu, J., Yang, C., & Meng, X. (2020). Exer-learning: A new genre combines learning, exercise and fun for children. *Procedia Computer Science, 174*, 735–745. <https://doi.org/10.1016/j.procs.2020.06.150>
- Yas, Q. M., Zaidan, A. A., Zaidan, B. B., Rahmatullah, B., & Abdul Karim, H. (2018). Comprehensive insights into evaluation and benchmarking of real-time skin detectors: Review, open issues & challenges, and recommended solutions. *Measurement: Journal of the International Measurement Confederation, 114*. <https://doi.org/10.1016/j.measurement.2017.09.027>
- Yilmaz, R. M., Topu, F. B., & Takkaç Tulgar, A. (2022). An examination of vocabulary learning and retention levels of pre-school children using augmented reality technology in English language learning. *Education and Information Technologies*. <https://doi.org/10.1007/s10639-022-10916-w>
- Zosh, J. M., Hirsh-Pasek, K., Hopkins, E. J., Jensen, H., Liu, C., Neale, D., Solis, S. L., & Whitebread, D. (2018). Accessing the Inaccessible: Redefining play as a spectrum. In *Frontiers in Psychology* (Vol. 9).

