The landscape of research on the use of digital game-based learning apps to nurture creativity among young children: A review

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ABSTRACT

Although in the recent study digital game-based learning (DGBL) has the potential to enable new forms of learning, it remains unclear how DGBL applications can impact young students' creativity. The main purpose of this study is to investigate whether DGBL application technologies (tablets and smartphones), can improve creativity skills in preschool children (ages 3–6). Hence, the author has reviewed the literature regularly over the past decade and found 67 articles, of which only 20 have been considered to be more relevant to the subject matter. Based on the findings, the author used PRISMA’s principles analysis of studies on the characteristics of DGBL technology to enhance creativity and learning. This classification has been focused on four areas: the objectives of current studies, impact of using technology (tablets, smartphones) on children's creativity, the theories of creativity in DGBL apps, methods of evaluation creativity. Trends and perspectives for the future are also discussed, as DGBL can potentially affect students' ability to develop creative skills and critical thinking, knowledge transfer, acquisition of skills in digital experience, and a positive attitude toward learning. The results demonstrate that the use of DGBL has had an active effect on strengthening children's creative thinking. This study provides an outlook for researchers, game designers, developers in the field of DGBL and creativity. This research provides new insights, advice, and effective suggestions on how to increase creative skills, motivate, and improve learning outcomes and demonstrate learning with DGBL composition in teaching young students.

1. Introduction

These days, evidence confirms that one of the newest trends is using the technology of digital games for children at home or at school. Playing with these apps is usually done using a tablet or smartphone. Research on digital games based on education and creativity is still active. Creativity in this modern world has been defined as one of the basic skills used to learn and work in everyday life. Creativity in modern days is defined as the essential skills used to learn and work in daily life (Hooshyar, Lim et al., 2019). Williams and Torrance (1972) define creativity as a set of abilities, skills, motivation, and the ability to find solutions to confront challenging situations or difficulty (Torrance, 1972; Williams, 1972). In summation, creative and intellectual minds will produce creative products that are original, contains a social or personal value with the purpose of enhancing creativity to the users. In this study context, the creative product refers to game-based learning apps (Hu & Adey, 2002). Educational games can enhance children's creativity and increase their learning. Developing creativity, one of the skills of the 21st century, is crucial to the future of children (Bai, Pan, Hirumi, & Kebritchi, 2012). Developing creativity also leads to other issues such as problem-solving, collaboration, and

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critical thinking (Hwang, Wu, & Chen, 2012; Shih, Shih, Shih, Su, & Chuang, 2010). Digital games, focusing on elements such as fantasy, curiosity, and challenge, raise the interest and motivation of children and cause them to interact with children (Hooshyar, Yousefi, & Lim, 2018). This type of learning based on educational games is based on curiosity to stimulate children to find new ways to solve problems and then to increase children’s satisfaction (Shin, Sutherland, Norris, & Soloway, 2012).

However, there are only a few studies that examine students’ creativity in a game-based learning environment. The studies have confirmed the close relationship between learning and creativity. Betz (1995) argued that digital games improve learning through visualization, experience, and creativity (Betz, 1995). Prensky (2001) proved that innovation in digital games helps solve the problem of individual students (Prensky, 2001). When children are encouraged to play-based learning, the decision to solve their problems becomes more creative (Bruner, 2013). Hamlen (2009) found that children with games and game-based learning enhance the child’s ability to solve problems through creative ways (Hamlen, 2009). In recent studies, only little empirical evidence on the effects of game-based learning in fostering students’ creativity among preschoolers is provided. Digital game studies are needed in order to keep with the concept of this research to investigate the effects of educational games on creativity (Hooshyar et al., 2020; Lin, Shadiev, Hwang, & Shen, 2020).

Although creativity is innate in human beings, that only specialized people like geniuses have it naturally, many people believe that it can also be taught. In the past, many researchers (Mayer, 1989; Rose & Lin, 1984; Torrance, 1972; Vass, 2007; Ward, 2007) concluded that creativity can be enhanced through educational programs. In recent researches, creative training techniques will help students to learn better (Zupan, Cankar, & Setnikar Cankar, 2018). The concept of learning through digital technology plays an important role in enhancing creativity for students. The technology is also an expression of human creativity (Cook & Bush, 2018). A lot of creativity and technology such as ideas, inventions, and applications are based on the cultivation of imagination and creativity assumptions, such as creating new products (Aflatony, Wakkary, & Neustaedter, 2018). Another way to achieve creative ideas is to foster creativity through education, by providing technology skills during childhood. In other words, “creating by doing” is another way of creativity (Creswell & Creswell, 2017). Function manual skills through technology and technology education in primary schools is becoming the most important reason for creativity. In this study, it is shown that children who use game-based learning apps are prone to develop divergent thinking when providing solutions to problems (Diefenthaler, Moorhead, Speicher, Bear, & Cerminaro, 2017; Hooshyar, Kori, Pedaste, & Bardone, 2019). While many researchers focused on the development of creativity while doing manual skills, very few studies and evidence are available to determine whether educational digital games can foster creativity (Lin et al., 2017).

In 2013, one researcher suggested that more than 70 percent of young children aged 3–5 had access to a tablet at home (Britain, 2013). Another study conducted by National Literacy Trust among 1028 young children aged 3–6 years in the UK found that more than 80 percent of children had access to a touchscreen tablet or smartphone at school or at home (Formby, 2014). On the other hand, as the number of learning-based programs in the market is increasing, parental attention has also increased. Parents need to be aware of factors that educational games will have a positive impact on their children’s skills. Parents’ awareness of these types of games and the components that will help children develop their skills for their future life is very important. In 2012, a researcher stated that more than 80 percent of the best-selling games for young children in the Apple Store focused on education (Shuler, Levine, & Ree, 2012). There are also several studies available that show that digital games based on education and technology use when using these games enhance children’s creativity (Grammenos & Antona, 2018). According to the growing use of technology and educational games to determine the kind of touchscreen and educational games that could be better to foster creativity in young children as a result of its importance and necessity. Some evidence on the use of the tablet for children less than 6 years is for development progress and to promote creativity and play in this age. Further research on the variety of games, creativity and to nurture it during games training is needed (Diefenthaler et al., 2017; Lin et al., 2020).

The wide range of research for young students has focused on the type of games as well as the main settings. However, more research is needed to investigate the impact of fostering creativity on learning in DGBL among young children (Diefenthaler et al., 2017; Noel & Liub, 2017). In addition, because of the increasing use of these technology-based learning games, children’s families have also concerned about the negative effect of this game on the behavior of young children. Some researchers also reported that these digital games can decrease creativity or other motor skill. Hence, further investigation to clear the impact of these games on young children is needed (Lin et al., 2020). Given the increasing use of technology and games among young children, many researchers have also emphasized more research into the cultivation of creativity and other 21st-century skills (Beghetto & Karwowski, 2019; Gong, 2020).

To address the above-mentioned problems, in this paper, author has reviewed the literature over the past decade and found 67 articles, of which only 20 have been considered to be more relevant to the subject matter. Based on the findings, the author used PRISMA’s principles analysis of studies on the characteristics of DGBL, and technology can be enhancing creativity (Moher, Liberati, Tetzlaff, & Altman, 2009). This classification has been focused in four areas: the objectives of current studies for the application of DGBL approaches/applications for preschoolers in the context of creativity; the impact of using technology (tablets, smartphones) on children’s creativity; the theories and pedagogy of recent studies for the application of DGBL applications for preschoolers in the context of creativity; methods of evaluation to measure creativity while using this type of apps in the current studies. Therefore, the main goals of this paper are as follows:

1) To provide an overview of using DGBL, and technology for learning and creativity in preschool level.
2) To present the overall effect on students’ learning and creativity when DGBL is integrated into preschool level education.
3) To synthesize the potential of implementing DGBL and creativity components within preschool level education.
For as much as DGBL applications are an emerging technology, it is significant to provide an overview of the progress and impact of its use in creativity skills and game-orientated educational settings. Regarding this issue, the following research questions addressed by this study are:

1. What are the primary objectives of current studies for the application of digital game-based learning approaches/applications for preschoolers in the context of creativity?
2. What is the relationship between children’s use of tablets and their creativity?
3. Which theories are used in recent studies for the application of DGBL apps for preschool level in the context of creativity?
4. Which methods are chosen for evaluation creativity while using this type of apps in the current studies?
5. What challenges, issues, limitations, and recommendations are there for future research about DGBL apps to enhance creativity?

The findings inform a sound empirical basis useful for researchers and game designers, developers in the field of fostering creativity, and game-based preschool learning.

2. Methods

In this review, the authors performed systematic analyses of the literature of studies regarding using digital game-based learning (DGBL), to improve creativity in preschool children (ages 3–6) based on the guidelines for Systematic Reviews and Meta-Analyses PRISMA (Kitchenham & Charters, 2007; Moher et al., 2009). Below is the search and review process that was used for the current study including these steps:

1) The process of making plan: Collection from online databases journals, Inclusion and Exclusion criteria of publications, and description of stages of the analysis.
2) Organize and carry out the review: Selection of study, data analysis, data combination, and data coding.
3) Reporting the review analysis of the results and discussion of the findings, to gain an understanding of the current state of the art of studies in enhancing creativity and DGBL applications at the preschool education level and conclusions.

2.1. Eligibility criteria

In this review, authors performed systematic analyses of the literature of studies regarding using of DGBL, along with the use of technologies such as tablets and smartphones, to improve creativity in preschool children (ages 3–6). As shown in Table 1, searching for data for DGBL applications and fostering creativity was collected from online databases IEEE Xplore, Science Direct, Web of Science, Springer, and Scopus. These sources are well known as the largest database, library research, and documentation. Also, this paper aims to enhance the quality of studies in the literature review thus the search was confined only to journal articles. Articles chosen in this study were intended to be only in the English language while journals in other languages were removed.

2.2. Database and keywords

This study is based on the result of five electronic databases. The initial query search resulted in 67 articles: 16 from Science Direct, 22 from IEEE Xplore, 8 articles from Springer, 8 articles from Web of science, and 13 articles from Scopus, over the span from 2011 to 2020. In order to enhance the quality of the studies selected for the literature review, the search is strictly confined to

Table 1
Inclusion and Exclusion criteria of publication ISI Web of Science.

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC1</td>
<td>Publication date 2011 (inclusive)- 2020</td>
</tr>
<tr>
<td>IC2</td>
<td>Peer-reviewed journals and conference publications in English</td>
</tr>
<tr>
<td>IC3</td>
<td>The study is conducted with research articles: qualitative and quantitative report of the game about preschoolers in Digital game-based learning(DGBL)</td>
</tr>
<tr>
<td>IC4</td>
<td>The study is conducted with specific aspect of applications that use creativity and thinking skill</td>
</tr>
<tr>
<td>IC5</td>
<td>The study uses a learning technology with an integrated creativity</td>
</tr>
<tr>
<td>IC6</td>
<td>The study reports at least one or more experimental study on use of fostering creativity in GBL</td>
</tr>
<tr>
<td>IC7</td>
<td>The study presents full research result</td>
</tr>
<tr>
<td>EC1</td>
<td>For the conference proceedings, papers published NOT as part of the main conference</td>
</tr>
<tr>
<td>EC2</td>
<td>Excluding non-English publications</td>
</tr>
<tr>
<td>EC3</td>
<td>Excluding non-Digital game-based learning(DGBL) research</td>
</tr>
<tr>
<td>EC4</td>
<td>Excluding reviews, and meta analyses</td>
</tr>
<tr>
<td>EC5</td>
<td>Excluding publications with unspecified educational level</td>
</tr>
<tr>
<td>EC6</td>
<td>Excluding ineligible publications: Mixed educational level e.g., elementary with secondary students, or secondary with university student</td>
</tr>
<tr>
<td>EC7</td>
<td>Studies that do NOT present research using a pre-post-test design (or control and experimental group)</td>
</tr>
<tr>
<td>EC8</td>
<td>Excluding preschool DGBL research unrelated</td>
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</table>
academic journal articles. The number of articles collected in the first phase directly related to the theme of digital game-based learning and fostering creativity for preschoolers has been considered. The most important keyword in the scope of this paper is “apps”. Then, the following words were applied in Fig. 1 a total of 67 relevant articles were collected and categorized.

2.3. Study selection and data analysis

After glancing over the titles and abstracts, full-text reading, 20 articles in relation to the theme of game-based learning, and creativity in preschoolers were considered (Fig. 2). Those papers were read thoroughly with the main purpose of finding out a general map for the conducted research on this emerging topic. Selected articles in this review should have; 1. Adopt evidence of advanced digital technology for learning with a game for preschoolers. 2. In addition, it has a qualitative and quantitative report of the game about preschoolers. 3. The focus is on a specific aspect of applications that use creativity and thinking skill 4. These articles are dated from 2011 to 2020.

3. Result

In this section, the results of the research are explained and then discussed. In the first stage, as explained in the previous sections, a total of 20 articles were reviewed based on the entry and exit criteria for selecting studies (Table 2).

At the time of reviewing the articles, the coding process was carried out according to the mentioned and defined categories (Fig. 3). The research methods used in the reviewed articles were different. In other cases, the overall results were analyzed and synthesized for the main themes of the studies, which have been identified and presented in the findings of this study.

3.1. Study design

As shown Table 3, the author lists the designs used in the study articles. According to this research from 20 studies, 16 studies reported quantitative data, 35 % (7 papers) studies reported quasi-experimental designs, 15 % (3 papers) on RCT (Randomized Controlled Trial) designs, 10 % (2 papers) reported survey designs, and 20 % (4 papers) reported correlation designs. The result indicates that the majority of the studies 65 % (13 papers) consisted of ‘empirical studies’ and quantitative data, while only 35 % (7 papers) reported on qualitative data. The results in quantitative data showed a considerable focus on quasi-experimental designs.

3.2. Purpose or function of the application

As shown in Table 4, the majority of collected studies on game-based learning and creativity have been attempting to evaluate applications from the flowing current of DGBL applications in the market. The main aim of these articles is the exploration of the desired features of creativity and thinking skills (14/20). Examples of this category includes the reviews of apps on creativity and collaboration (Suitsu, Souza, Souza-Concilio, & Pacheco, 2016; Varela, Del Castillo, Herrero, Monjelat, & Checa, 2014), cognitive abilities, creativity and problem solving (Coppi, 2015; Fessakis, Lappas, & Mavroudi, 2015), creative writing (Kucirkova & Sakr, 2015), mathematical concepts creativity (problem-solving) (Fessakis, Gouli, & Mavroudi, 2013), storytelling and creativity (Kucirkova & Sakr, 2015; Merchant, 2015; Suitsu et al., 2016), training in the basic settings (Lynch & Redpath, 2014), and Art & creativity (Cheng & Tsai, 2014; Fessakis et al., 2015; Shabalina et al., 2016).
3.3. Relationship between children’s use of tablet and creativity

In studying the impacts of digital technologies on using games, a number of ways have been discovered. First, digital technologies can be a platform for the use of educational games and are embedded in hardware devices that provide and promote both rule-bound play and free play (Sutton-Smith, 2009). Secondly, digital technologies can be a stimulus for imaginative play. Educational games are based on physics such as characters and narrative in video games or virtual world (Marsh, 2010; Plowman, Stevenson, Stephen, & McPake, 2012). Thirdly, digital technologies can be child’s play as objects to be used, for example, children who are using their smartphones to make phone calls pretend that they are playing with the smartphone (Lanna & Oro, 2019).

The results in Table 5 indicate that the devices used for creative and educational activities in DGBL applications are primarily smartphones, tablets and computers with camcorders. And mobility seems to be a key point, as 80% of preschool studies have used tablets instead of cameras. In other words, this may be due to the fact that most studies cover the natural sciences and are outside the normal classroom or during a field trip where mobile devices were easier to operate.

3.4. Theories are applied for creativity in GBL studies

The close relationship between the game and creativity and the rise of learning shows that play and creativity are very important for cognitive development. In this study, the relationship between the use of children from the application and the rise of creativity and the subsequent rise of learning was studied. Most of the researches used “Vygotsky theory” (35%) that points out, there is a close relationship between the game and the growth of creativity, and along with it, there is an increased level of learning among children (Vygotsky, 1978). Research on children’s creative use of day-to-day technologies, such as photographing or painting children, is available (Verenikina & Kervin, 2011). However, the need to identify and expand the scope of this researches in the other area is essential. On the other hand, its impact on the level of learning of children is also a more important issue (Table 6).
Table 2
General overview of related DGBL studies and fostering creativity in preschool level.

<table>
<thead>
<tr>
<th>Research studies</th>
<th>Game-based learning and creativity skills (Objectives)</th>
<th>Study results and observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fessakis et al. (2013)</td>
<td>To examine the effect of digital games on the creativity of the preschool level under the leadership of an educator to solve special problems.</td>
<td>The results indicated that digital games under the guidance and support of teachers have a positive impact on mental health such as creative thinking on young children and their self-efficacy. Hence, teachers can make children more encouraged to find solutions to their problems.</td>
</tr>
<tr>
<td>Kucirkova (2013)</td>
<td>To highlight the value of iPads as a new medium enriching children's experiences with challenging traditional research assumptions.</td>
<td>iPad books are reported to engage children and to have positive effects different from simple digital books.</td>
</tr>
<tr>
<td>Brooks and Brooks (2014)</td>
<td>To investigate the impact of digital games on enhancing creativity for learning surroundings in childhood.</td>
<td>The outcome indicated that teachers can be more effective in creating playful structures in the creative skills of children when interacting with children during using digital games with greater intervention.</td>
</tr>
<tr>
<td>Lynch and Redpath (2014)</td>
<td>To explore emerging patterns of iPads use among preschool students in Australia (compulsory education).</td>
<td>Encouraging a change in learning policy in Australia through the use of technology and digital games due to tensions between print-based traditions and new digital literacy has led teachers to use technology for young children, and the result of this process shown enhancing learning ability and other children's skills.</td>
</tr>
<tr>
<td>Nie et al. (2014)</td>
<td>To clarify whether games-based learning can contribute to fostering creativity</td>
<td>The outcome indicated three categories cause fostering creativity among young children; “Learning during digital games”, “Learning environmental of digital games” and “Learning both”. The results show that the use of digital games has increased children’s skills in creating alternative solutions as well as their self-efficacy in this technology. Digital game-based learning and technology-based teaching can positively affect the creative skills of young children.</td>
</tr>
<tr>
<td>Fessakis et al. (2015)</td>
<td>Investigating the effect of using a digital game under the supervision of a teacher in solving problems and creativity in young children.</td>
<td>The results suggest that the proposed model increased children’s ability to integrate reality and cyberspace and creates a platform for increasing critical and creative thinking skills independently. Combined and used suggested techniques together lead to systemic effects of digital game-based learning and develop creativity and creative thinking of learner.</td>
</tr>
<tr>
<td>Shabalina et al. (2016)</td>
<td>• Focusing on creative learning approaches and techniques. • Focusing on creative teaching methods and techniques that foster skills and learning outcomes by making students more active and engaged. • Most challenging problem in creative pedagogy is discussed</td>
<td>The results show that teachers found that the curriculum is effective and valuable using digital technology, and decided to expand and enrich the curriculum, which includes programming through digital educational games, as well as art education and creativity.</td>
</tr>
<tr>
<td>Kulikovkaya et al (2016).</td>
<td>To present and investigate an integrative model of teaching preschool level application (Fairy-tales for modern gifted preschoolers)</td>
<td>The results show that this Game can exercising creativity through storytelling among children with age of 4 years old. The findings suggest that iPads offer a mechanism to allow children to articulate their creative play and to encourage involvement in the research process. Taking pictures while playing with digital games on the market has been the most popular activity for young children.</td>
</tr>
<tr>
<td>Bae (2016)</td>
<td>To examine the procedure and meaning of creative art curriculum for young children through virtual intercultural exchange.</td>
<td>The results show that teachers found that the curriculum is effective and valuable using digital technology, and decided to expand and enrich the curriculum, which includes programming through digital educational games, as well as art education and creativity.</td>
</tr>
<tr>
<td>Suitsu et al. (2016)</td>
<td>To discuss the game Sandcastle (Castelo de Areia), a virtual story generator in which children can use their preferred characters.</td>
<td>The results show that in order to create a transferable understanding, advanced multidisciplinary lifelong learning programs are recommended for their children. Serious games seem to be incorporated into school program in a variety of ways and good quality of games seem to help children to explore different concepts with a variety of media. The results show that when using touch tablets in digital games, due to the multifaceted features of this technology, it increases children's playful activities, which in turn stimulates children's participation and increases children's communication with each other.</td>
</tr>
<tr>
<td>Arnott et al. (2016)</td>
<td>To explore the use of iPads as part of a child-centered data collection approach to understand young children’s creativity.</td>
<td>The results show that teachers found that the curriculum is effective and valuable using digital technology, and decided to expand and enrich the curriculum, which includes programming through digital educational games, as well as art education and creativity. Taking pictures while playing with digital games on the market has been the most popular activity for young children.</td>
</tr>
<tr>
<td>Mertala (2016)</td>
<td>The present study has given Finnish children a forum to express their ideas and wishes for the use of digital media in preschool.</td>
<td>The results suggest that the proposed model increased children’s ability to integrate reality and cyberspace and creates a platform for increasing critical and creative thinking skills independently. Combined and used suggested techniques together lead to systemic effects of digital game-based learning and develop creativity and creative thinking of learner.</td>
</tr>
<tr>
<td>Leggett (2017)</td>
<td>To examine the role of the educator as an intentional teacher within Australian early learning environments and investigates the relationship of this role to children’s developing creativity.</td>
<td>The role of the educator is pivotal in assisting children in the early development of creative thinking thus challenging their role as educators. Serious games seem to be incorporated into school program in a variety of ways and good quality of games seem to help children to explore different concepts with a variety of media. The results show that when using touch tablets in digital games, due to the multifaceted features of this technology, it increases children's playful activities, which in turn stimulates children's participation and increases children's communication with each other.</td>
</tr>
<tr>
<td>Kokkalia et al. (2017)</td>
<td>To investigate the use of serious games in preschool education in the domain of math, cognitive &amp; motor skills, creativity, communication, and special education.</td>
<td>The results show that in order to create a transferable understanding, advanced multidisciplinary lifelong learning programs are recommended for their children. Serious games seem to be incorporated into school program in a variety of ways and good quality of games seem to help children to explore different concepts with a variety of media. The results show that when using touch tablets in digital games, due to the multifaceted features of this technology, it increases children's playful activities, which in turn stimulates children's participation and increases children's communication with each other.</td>
</tr>
<tr>
<td>Heydon (2016)</td>
<td>To study and produce knowledge on how digital multimedia affect children’s life progress on the creative aspects.</td>
<td>The results show that in order to create a transferable understanding, advanced multidisciplinary lifelong learning programs are recommended for their children. Serious games seem to be incorporated into school program in a variety of ways and good quality of games seem to help children to explore different concepts with a variety of media. The results show that when using touch tablets in digital games, due to the multifaceted features of this technology, it increases children's playful activities, which in turn stimulates children's participation and increases children's communication with each other.</td>
</tr>
<tr>
<td>Daniels (2017)</td>
<td>To explore how much collaboration and communication during using applications in a classroom environment in childhood.</td>
<td>The results show that in order to create a transferable understanding, advanced multidisciplinary lifelong learning programs are recommended for their children. Serious games seem to be incorporated into school program in a variety of ways and good quality of games seem to help children to explore different concepts with a variety of media. The results show that when using touch tablets in digital games, due to the multifaceted features of this technology, it increases children's playful activities, which in turn stimulates children's participation and increases children's communication with each other.</td>
</tr>
<tr>
<td>Raziūnaitė et al. (2018)</td>
<td>To evaluate computer games based on music among young children.</td>
<td>The results of this study show that computer games based on music make children very interested in exploring and creating new music sounds, and this in itself is based on creativity and emotional learning. The results indicated the increasing positive effect to connect knowledge and creativity.</td>
</tr>
<tr>
<td>Chen and Lo (2019)</td>
<td>To examine an application of how children, use previous knowledge to link to new knowledge of their life and music.</td>
<td>The results of this study show that computer games based on music make children very interested in exploring and creating new music sounds, and this in itself is based on creativity and emotional learning. The results indicated the increasing positive effect to connect knowledge and creativity.</td>
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</table>
3.5. Pedagogy in GBL apps

In recent research, few articles are focused on the model of pedagogy and described a systematic approach to the development of giftedness, which includes the use of fairy-tales, active gaming technologies and working with letters. Recent researcher suggests an integrative model of teaching preschoolers for future studies. This system provides overall development of cognitive, creative and moral aspects of developing a personality (Beghetto & Karwowski, 2019; Gong, 2020; Lin et al., 2020). It enables children to integrate
the real and the figurative, build the right hierarchy of objects, phenomena of reality and a system of cultural values. In addition, this pedagogy is toward teaching the children about natural connections that exist in their life and encourages skills for independent search and critical thinking. Therefore, to provide a comprehensive analysis, of the positive impact of the educational game on creativity and learning, designing the pedagogy scheme is essential (Grammenos & Antona, 2018).

3.6. Measuring creativity in GBL studies

In most of the researches were used qualitative method “case study” such as; (Coppi, 2015; Lynch & Redpath, 2014; Merchant, 2015; Suitsu et al., 2016; Varela et al., 2014). This method includes: reading through field notes, listening to interviews or watching videos, word-of-mouths for identifying themes, repeating ideas that help write contributing to research questions (Rossman & Rallis, 2011). The first step for analyzing these interviews is open coding, which allowed the researchers to examine, analyze and compare the classification and analysis of information in separate sections. At this stage, organizing data with a constant comparison approach is intended to identify the themes and patterns within the data set. The next approach is numerical coding to respond to pre-school child interviews. The authors developed the categories and examined how the conditions, frameworks, and interactions of the classifications could be the answer to the questions and hypotheses of their research. Strauss and Corbin (1998) suggested that the axis coding of the researcher would enable the researcher to find new ways or establish connections between the categories (Strauss & Corbin, 1998). In the final step, the researcher analyzed the qualitative data collected from the interviews and films and transcripts of the users of the study. Each transcript in a systematic way was analyzed using a theoretical analysis. This analysis process allows the author to study and develop a central theory based on all dimensions and data. The reason for using this method in most of the research was to allow the researcher to get a deeper understanding of the experiences and interactions of the phenomenon desired. Each code was linked to a particular aspect of creative strengths, reflecting the strengths of selective frameworks in their research (Robson, 2014).

3.7. Effectiveness of using DGBL in educational settings and creativity skills

Table 7 displays the study results with respect to the category “Effectiveness of using DGBL in educational settings and creativity skills”. Since a single study can report more than one sub-category of effectiveness, each study can also fulfill more than one sub-
3.8. Limitations of DGBL in educational settings

Table 8 presents the data collected on the limitations of digital games based on learning in educational settings and creativity. Due to these cases, the biggest limitation of studies is the fact that teachers cannot use the same system for different subjects to manipulate educational and creative components (lack of interdisciplinary programs) (25%). Therefore, children may feel frustrated if the program does not properly track or display the data. Another limitation is that teachers need to develop additional learning material exclusive to the creativity activity needs (10%). This can occur, because “complex DGBL systems and creativity components may have a modest learning curve” (5%). A very short assessment course to measure students’ learning performance (5%) and the fact that teachers need to develop additional learning materials that are unique to the needs of creative activity (5%). Learning content should be clearly understood for young children and be related to learning goals. Case studies focus on learning and teaching and the relation of fostering creativity the needs of specific educational topics to help identify the most appropriate elements for focus. This should be accompanied by further research into the development of DGBL creativity and programming introductions so that teachers can easily create and transfer content because the quality of teaching affects students’ attention. Therefore, before achieving great progress in the field of DGBL, guidelines should be developed for designing creative educational experiences based on creativity for various topics.

### Table 8
Limitations of DGBL in educational settings

<table>
<thead>
<tr>
<th>Limitations of DGBL in educational settings</th>
<th>Number of studies</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers cannot manipulate the same system for different educational subjects and creativity (lack of interdisciplinary programs)</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>Students paid too much attention to virtual information (novelty factor)</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Teachers need to develop additional learning material exclusive to the creativity activity needs</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Complex DGBL systems and creativity components may have a modest learning curve</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Too short periods of assessment to measure student learning performance</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Lack of pedagogy scheme</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>Lack of model or framework of creativity and learning for preschooler</td>
<td>5</td>
<td>25</td>
</tr>
</tbody>
</table>

category. The majority of preschool level education studies reported that creativity components combined with game-based learning led to “Student creative thinking/activity/skills” (35 %) and “better learning performance and/or learning gains” (25 %) in educational settings. In addition, 20 % of studies suggest increases in “student motivation and engagement”, and (10 %) “student interaction/socialization/collaboration” and 5% articulate improvements in 'students' positive perception and attitudes' and 'Student critical thinking'.

3.8. Limitations of DGBL in educational settings

The ability to teach game-based learning technology in digital games has attracted the attention of many researchers because of the benefits it has for young students, including increasing their motivation and increasing their engagement in creative-based activities. According to studies published in previous years, it seems that researchers' attention to digital games based on education has increased significantly. Therefore, this review of regular literature intends to provide evidence of the potential of application-based educational games to support learning and strengthen creativity in various disciplines in preschool education. In this paper, according to the systematic study, special educational fields at the preschool level are emphasized, the application of learning methods and game-based creativity that have not been studied yet. The purpose of this paper is to update information on the status of the progress of education and creativity in game-based learning for young children. Similarly, to highlight the researches process in this topic. It also has a suggested classification of related literature. To survey researcher's efforts in response to the new technology of smartphone and tablet DGBL apps for preschoolers, mapping the research landscape from literature into a coherent taxonomy, and finding out the basic characteristics of this emerging field represented on identifying the ways in which feature of GBL applications used by preschoolers may foster play and creativity, open challenges and the recommendations to improve better acceptance and use of GBL applications on creativity in the literature among young children.

Several articles examine the subject from a preliminary point of view, other studies the number of existing apps, and others might have studied only actual apps, that are more applicable in this field. Classification of its literature helps to arrange different works and activities into a meaningful, manageable, and coherent layout. The main findings of this study are summarized below: DGBL is suitable for combining creativity and STEM topics because it has the ability to show children the invisible abstract and complex concepts based on real life. This feature can be seen through 3D or other scientific visual phenomena, which is undoubtedly a
specialized approach through digital games. On the other hand, if the components of creativity and DGBL are combined with subjects such as geography, social sciences, history, linguistics, arts, they will be more attractive to young children. Educational-based digital games, along with creative components, enhance children's ability to solve learning and interaction problems and facilitate the learning of young students. However, more studies are needed to understand how the technology works. The most important problem in these studies is the lack of evidence on the quality of the developed DGBL applications to enhance creativity and learning in preschools (Yang, 2012). Major issues include the lack of evidence of effectiveness in creativity, the lack of a research goal to evaluate the results (Laverick, 2015), the lack of content regulations (Verenikina & Kervin, 2011), and the lack of a validated framework for the development of creativity through game-based learning (Coppi, 2015). In addition, many tablet apps for this age group (preschooler's stage) are not age-specific and are no specific behavioral guidelines (Grammenos & Antona, 2018).

The study also highlights the important practical implications of creativity, especially for developers and teachers who want to use game-based learning programs in their classrooms. Teachers and designers of digital educational games need to understand how to create game-based learning and creativity experiences tailored to the subject being taught, while also considering the skills of young learners. Teachers cannot create and keep pace with technological progress and the whole innovation unless they acquire knowledge. In order to create, students do need ‘to master’ the game, or in other words, his/her knowledge, together with the capability of handling the acquired information and develop this further into a creative manner. The creativity of the teaching methods must be designed, in such a manner to embed sufficient independence for children and within the limits of pedagogical principles that lead to student /children creativity. Also, the creativity which needs to be constructed as a basic feature in the game is usually able to be developed by a creative designer (Gong, 2020). Training-based games can help learners' creative skills. This study shows that interactive learning with creativity skills using educational-based gaming technology can be designed to support a variety of activities in young children. Therefore, these games make it easier and more effective to teach in different places and learning spaces such as school classes. It seems that teaching-based games with creative components can lead to enjoyment, knowledge acquisition, increased interaction, among young children. On the other hand, it strengthens the skills of cooperation and creativity among students along with improving learning. Due to the virtual space in educational-based digital games, there is the potential to reduce the financial costs of performing creative and learning activities compared to traditional classroom methods for teachers. However, we need more research to understand how to design instructional-based games on a variety of topics with creative components. On the hand, in order to promote learning and creative thinking for young students, further research is needed to improve work experience and knowledge-building processes in digital educational games-based applications (Beghetto & Karwowski, 2019; Gong, 2020; Lin et al., 2020).

Further research is needed in various aspects of game-based learning and creativity-based applications, including the development of theoretical frameworks and assessment methods to help create DGBL education in the classroom. Many current studies report that learning theories in digital games based on education require learning theories and creativity theories. The proposed theories, while considering the interactive experiences of digital education-based games, include structuralism and creative activity theory (Kinnula, Molin-Juustila, Milara, Cortes, & Riekki, 2017; Lanna & Oro, 2019). Thus, existing studies that focus on content analysis degraded in performance (Laverick, 2015). A mixed-method with a content-based analysis that investigates behavioral and applying components of creativity for preschooler’s level have been studied. To address the problem with content based analysis a mixed-method that integrates content, behavioral and applying components of creativity, roles and relationship with learning in DGBL apps is still needed. Studies on DGBL apps by using tablet addressed to fostering creativity and enhancing learning as two separate tasks utilizing different frameworks. However, these approaches faced the problem and recent evidence and game apps demonstrate fostering preschooler’s creativity through these apps have not been successful to help young children to enhance their learning (Coppi, 2015; Leggett, 2017). Therefore, according to recent researches, this paper emphasized that it is the combination of creativity and learning components in a single model or framework that can have better performance and effect on enhancing learning in young children. On the other hand, this combination in the components of creativity and learning also stimulates children's motivation. The existing DGBL apps do not have the proper design features, to foster creativity, learning, and existing assessing pedagogy at the preschooler stage (Shabalina et al., 2016). Therefore, to provide a comprehensive analysis of the positive impact of the educational games on creativity, learning, designing the pedagogy scheme is essential.

In order to provide insight into digital game technology based on education and creativity for specific learning topics, longitudinal studies with long-term analysis of learning experiences are necessary. In relation to the potential use of digital games based on education and creativity for preschool students with special needs has not been identified and it is necessary to study this issue in the future. More guidance on how to use tablets and how to choose game apps for learning and creativity for preschool children should be designed and taken into consideration. In addition, these guides can be published by the key organizations for this group after it has been prepared (Leggett, 2017). Due to the growing use of technology and technology by children, more work is needed in this regard. It should also be ensured that all specialists who are involved in the field of children and family in this field have been invited and fully used (Such as child psychologists, physicians, and teachers) (Gong, 2020; Lanna & Oro, 2019; Lin et al., 2020).

5. Conclusion

This research is aimed at investigating the efforts of researchers in response to the new technology of smartphones and tablets in fostering creativity at educational games at the pre-school level. Searching for articles in order to categorize the findings of educational games applications for preschoolers are as follows: 1) Smartphones and tablets 2) Inspiration for creativity 3) Learning-based games apps, in five major databases: IEEE Explore, Science Direct, Web of Science, Springer, Scopus. The final collection consists of 20 articles. Perspectives for the future are also discussed, as DGBL can potentially affect students’ ability to develop creative skills and
critical thinking, knowledge transfer, acquisition of skills in digital experience, and a positive attitude toward learning. The purpose of this paper is to update information on the status of the progress of education and creativity in game-based learning for young children. Similarly, to highlight the researches process in this topic. This study provides new insights, advice, and effective suggestions on how to increase creative skills, motivate, and improve learning outcomes and demonstrate learning with DGBL composition in teaching young students.

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References


