



Game-Based Learning and Children's Digital Literacy to Support Pervasive Learning: A Systematic Reviews

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Abstract

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In this study, we investigate the impact of game-based learning on children's digital literacy in processing and acquiring information, focusing on the generation of digital natives who excel in responding to multimedia information. Utilizing data mining and the PRISMA Protocol, we conducted a systematic review based on the keywords 'Game-based learning on children's digital literacy.' Data from the years 2017 to 2019, extracted from Sagepub and Emerald databases, reveal strong empirical support for the enhancement of children's digital literacy, particularly through game-based learning interventions, as evidenced by a significant effect size of 0.66. This translates to children becoming better at deciphering visual cues, understanding audio narratives, and critically evaluating the information presented in a variety of multimedia formats. Furthermore, game-based learning fosters critical thinking and problem-solving skills, keeping children engaged and motivated to learn in this dynamic digital landscape.

Keywords:

Children, Game-based; Pervasive; PRISMA

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INTRODUCTION

The digital native is the generation that is born along with technological developments (Tran 2019). Children born in this generation are the generation that can adapt very quickly to technology. Children can develop and increase along with technological development (Harrison and McTavish 2018). However, many negative sides that arise from the rapid development of technology, the phenomenon of gadget addiction, health problems and other negative impacts. On the other hand, technological development should have clear objectives, so that, they have a good impact on children's growth. Technologies such as artificial intelligence, virtual reality, and children's development-based games should be able to assist their growth and development as long as we as parents provide the right content and provide assistance to children when they play gadgets (Suhana 2018).

Children are often fascinated by today's new gadgets and technologies: this provides rise to wonderful opportunities also as concerns (Gillen et al. 2018). The latest media can provide children with innovative and interesting learning experiences, and permit them to be empowered and connected in new and exciting



ways through digital technologies (Harshavardhan, D, and Kumar 2019). However, for several there are concerns that children might become isolated in unhealthy interactions focussed on the consumption of screen-based materials with insufficient opportunity for human dialogues, or the interactions via the screen may become negative (Francis et al. 2018).

Children born with technological development also has excellent digital literacy, they are able to absorb the latest information and apply it in life (Gonick 2015). Like when they play a puzzle about geometric shapes in a game, then children easily arrange the shapes of objects that have the same geometric shapes when they play with their friends. Literacy for digital culture must not focus so much on technology's use skills, but in the acquisition and mastery process of ICT skills (Vélez, Olivencia, and Zuazua 2017).

The ability of digital literacy and the effects of game-based learning (Nolan & McBride, 2014) is what underlies the author to find out how much effect the resulting technology-based games have on children's digital literacy abilities. The digital literacy refer to the diversity of young children's literacy practices of across media (Sefton-Green et al. 2016).

This article presents the published articles from the Sage pub and Emerald databases from 2018-2022. The reason the authors use these two databases is that the distribution of articles is heterogeneous, and there is a filter function, making it easier for authors to find the data. The author limits several things, namely; a) the article chosen must be the result of research, b) the article selected is experimental research, c) there is no conflict of interest in the article, d) the subject of the study must be a child aged 4-10 years.

Retrieval and filtering data systematically using Prisma Protocol, then reviewed in parallel whether the article meets the criteria that have been determined, then the last step is to measure the magnitude of the effect of each article that already has criteria.

METHODS

This article uses a meta-analysis approach where data acquisition starts from searching a journal database originating from Sage pub and Emerald in 2017-2019. The keywords used in this search are game-based learning on children's digital literacy. This systematic process rests on the Prisma Protocol which starts from the process of identification, screening, eligibility, and included. In searching the identification process the author found there were a total of 550 articles identified in the Sage pub and Emerald databases.

The second process is screening, the author uses Mendeley software to detect article duplication in this process there are 32 duplicated articles, in the Mendeley software, there are tools to merge the duplicated files, so that, 518 articles are extracted. Then still in the screening process, the limitation in this process is that articles are published in 2018-2022, found around 423 articles that meet the criteria and discard 95 articles.

The third process is eligibility, the article must have a child subject with an age range of 4-10 years, in this process involving reviewers who have areas of

expertise in accordance with the content of the article, there are Five reviewers who work based on these principles. In this process, 64 articles were obtained which were appropriate and discarded 359 articles that did not have these criteria.

The last stage is the stage of entering the article into the meta-analysis stage of the boundaries used is the limitation of content, the article must be the result of experimental research that has a control class and the experiment will later be analyzed for the magnitude of its effect with the review manager application 5.3.

This meta-analysis uses the Forest plot which graphically illustrates the validity of the results of the selected studies in an interesting way. Forest plots are programmed through the Review Manager 5.3 applications developed by the Cochrane Library (Guraya. 2016). In this plot, the effect size (ES) in each study was measured using the software. Q test was used to measure heterogeneity in each study. Heterogeneity is a value to determine how different the results obtained in each study included in the meta-analysis, in this study formulated a hypothesis (null hypothesis) "all studies are equal (homogeneous)."

I squared (I²) is a statistical test to measure heterogeneity. I² values above 50% indicate considerable heterogeneity (Hippel. 2015). After conducting heterogeneity analysis, if the heterogeneity test shows homogeneity, then the Fixed Effect Model (FEM) is used. If the heterogeneity test shows heterogeneity, then the Random Effect Model (REM) (Snijder et.al 2012) is used. The significance level in this study was 5% (p <0.05). To assess the biases of the six studies Funnel plot was used. A funnel plot is a graph that represents the effect of the sample size of a study (axis y) on the results of the publication (axis x) (Jonathan et.al 2004).

RESULTS & DISCUSSION

The PRISMA Result

The results of the database search process indicate there is some relevant information in accordance with the restrictions that the authors do. However, these data must be systematically analyzed and studied in depth. In this article, the authors use the Prisma protocol to systematically analyze and make it easier for readers to understand the flow and purpose of this research.

This review starts with the identification stage, starting with finding and utilizing advanced search in the Sage pub and Emerald databases. Both of these databases are known to be data providers for the social field of humanities that are quite complete and have lots of content in them that is open access. Thus, making it easier for authors to extract data and enter it in the Prisma protocol. The following is an example of a screenshot in this stage.

The data within the image on top of shows that, the author starts the search by exploitation the advanced search feature, then will the limitation from the year of publication to the search term. In Figure one, it may be seen that there area unit 523 articles within the Sagepub information that match the keywords that the authors do. Then, the article sort indicates that there area unit many classes of articles, like analysis articles, abstracts, alternative reviews, articles, and indexes. The author can limit the search within the next steps within the Prisma protocol.

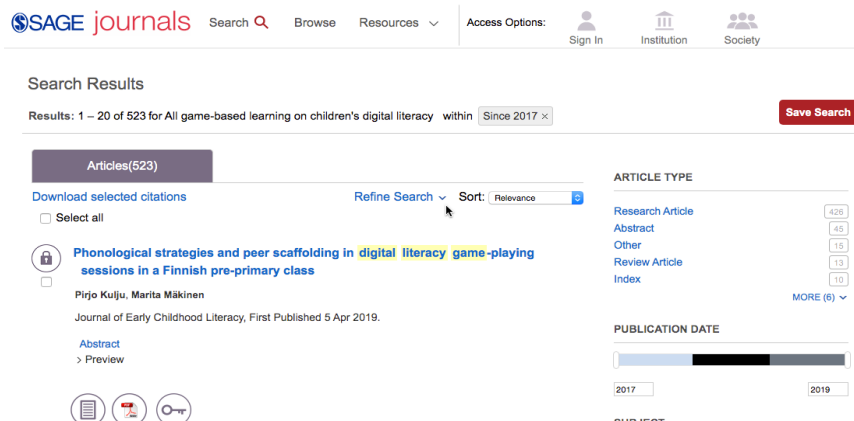


Figure 1. Some activities in particular event

The second information base is Emerald, during this information the authors conjointly do an equivalent issue so as to cut back the bias and consistency within the search results of the article. Emerald information is one amongst the databases that's quite complete and provides open access content, so the author gets the benefit within the method of finding information. Additionally, the Emerald information conjointly has an equivalent option as Sagepub, so the foundations of this study meet the standards, as a result of there aren't any biases and therefore the 2 information bases have an equivalent data search patterns. within the Emerald information, the subsequent results area unit found in Figure 2.



Figure 2. Results of a search from the Emerald Database

Figure 2 shows that there are 27 data that match the search keywords. From the search results above shows that there are significant differences. The total articles that we get are 550 articles that will be included in the duplicates removed stage. We use Mendeley which is able to collect all articles in various citation formats.

In this review we started by downloading the *bibtex* format file from the Sage pub and Emerald databases which we then downloaded and uploaded on Mendeley. The next step is to check whether there is duplication. The process of eliminating

this duplication obtained 53 articles that were identified as double published. The author's step is to combine the articles so that 518 articles are obtained in this stage. The Mendeley software and how to do the process of removing duplicates can be seen in Figure 3 below.

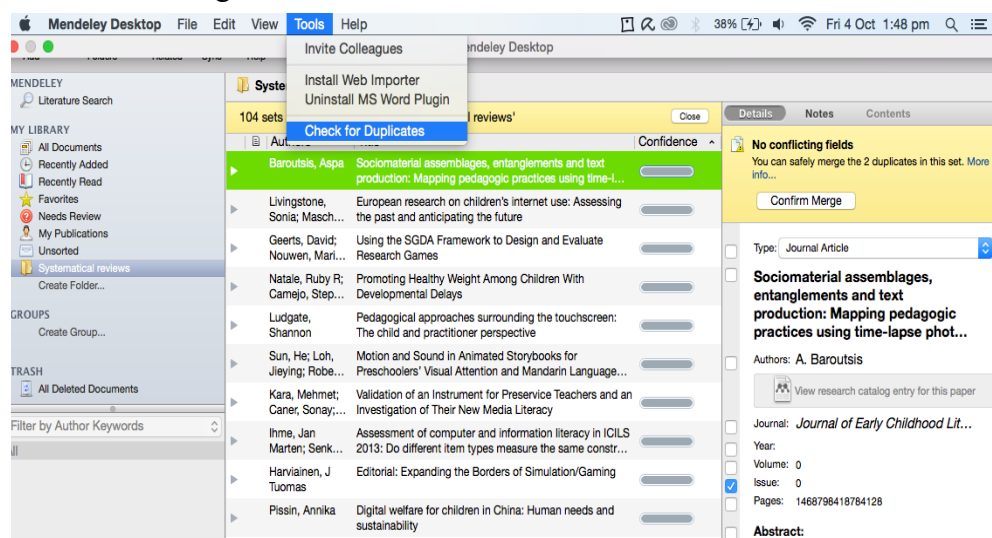


Figure 3. Check for duplicates tools at Mendeley

After obtaining 518 articles on identification. Then following method is that the screening method. during this part 423 articles were found that work the boundary, i.e. the articles to be processed were solely articles that were the results of the study, thus we have a tendency to removed concerning 95 articles that weren't a part of the analysis results.

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The next phase is one in all the foremost necessary processes during this stage. Specifically the eligibility method, the authors concerned a peer-review method by collaborating with concerning 5 reviewers to examine the content of articles that are elite. Reviewers do their work with the subsequent restrictions: 1) articles are often accessed full text 2) is that the results of an experimental analysis with experimental categories. When reviewing solely 64 articles were obtained and concerning 359 articles were discarded, a number of that weren't experimental studies with experimental categories and or articles that weren't full text.

The last stage is included. In this phase the author only chooses 4 articles that are ready to be tested for the effect size with the software manager review. Author based on removing about 60 articles because the article does not meet the limitations that the author has done. 1) The subjects of the study are not children aged 4-10 years. 2) There are some articles that do not have an ethic clearance statement. From this phase the author gets 4 articles that are ready to be analyzed in a software review manager. The flow of data above can be shown through the following flow.

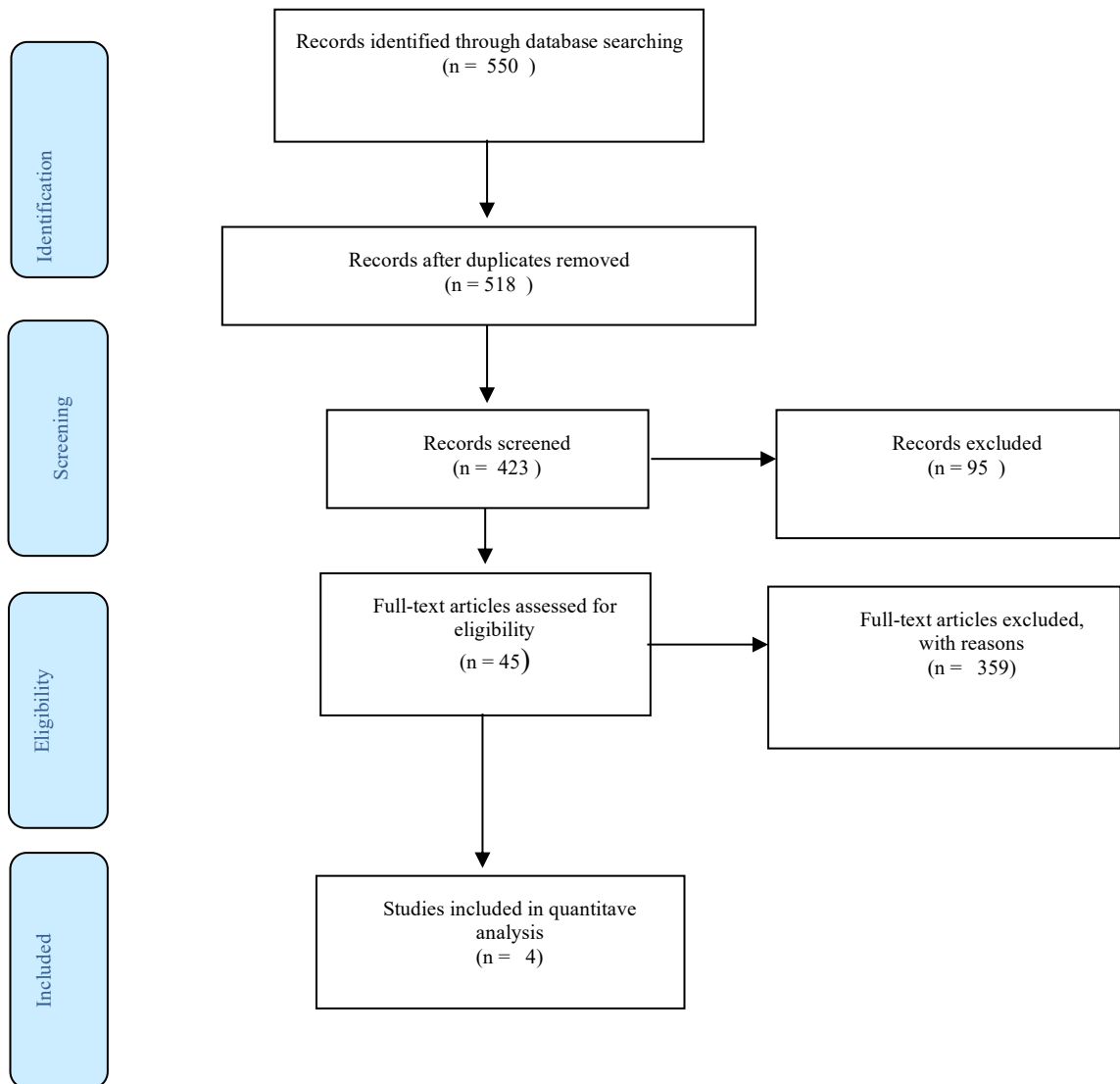


Figure 4. Flow Diagram showing step-wise selection of studies

Meta Analysis-Discussion

After going through a systematic article review process with the Prisma protocol, 4 articles were chosen in accordance with the specified problem limitation. The data is then analyzed and extracted to determine the effect size of each article. For more details, it will be shown in Figure 5 below.

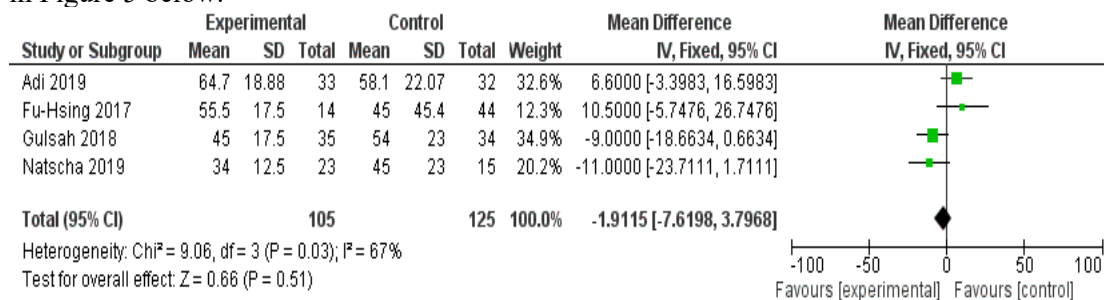


Figure 5. The result of forest plot showing effect summary form selected studies

In this article Forest plot is used which illustrates that the level of confidence (confidence intervals) is at the level of 95%. Each study has an Effect size that is indicated by a symbol box and the level of confidence is indicated through a horizontal line (Rother, 2007; Varela et al., 2016) This plot also shows that there is a broad level of confidence and different responses / inconsistent response rates which indicate that there is clear heterogeneity in this study. To confirm statistical heterogeneity as reviewed in statistical analysis, this study uses Q test, I^2 dan Tau^2 .

The forest plot results in Figure 6 show that Conchre Q ($Chi^2=9.06$) with a significance level of 5% indicates that the null hypothesis was rejected, which means heterogeneous data. An I^2 value of 67% is categorized as data from the four studies above, including the moderate heterogeneous category. Based on the results of Conchre Q and I^2 , the random effect model is more suitable for use in this study (Kitchenham, 2004).

A summary of the effects of each study is illustrated by a symbol (diamond) which has a standardized mean difference (SMD) of -1.9115 with confidence intervals of -7.6198-3.7968. Figure 5 above shows that there is a picture that there are two studies that have the magnitude of the effect that occurs predominantly in the control group Adi (Elimelech and Aram 2019) and Fu-Hshing (Tsai 2017). Then, there are two studies that have a dominant effect size in the experimental group namely Gulsah (Dubé et al. 2019) and Natascha (Notten and Becker 2017). Z test with a value of 0.66 with a significance level of 5% shows that game based learning has an impact on digital literacy of children aged 4-10 years by using random-effect models.

CONCLUSION

The data we have with success gathered during this analysis shows that there is some evidence that the digital literacy skills of children have a good tendency to develop (Andrews et al., 2011). Therefore, sensible stimulation will facilitate children in their method of obtaining information (Sari et al., 2019). The data suggests that this meta-analytical study support the theory ranging from the I^2 results of 67 and therefore the Z check with a worth of 0.66 that supports that digital literacy of children are often aroused and one of them is through game-based learning. Thisse findings are supported by research from Maureen (Maureen, van der Meij, and de Jong 2018) on the use of story telling to improve children's digital literacy skills. Their research involving 45 children with a digital story telling approach was able to prove that children's literacy skills can increase with these activities.

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