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Instilling trash throwing behavior through play in early childhood: a review

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ABSTRACT

The waste problem is a serious problem that affects the environment and human health. Involving young children in waste management is very important because they are the future generation. One effective method for instilling waste disposal behavior in young children is by providing educational games. This literature review aims to find out how to instill waste disposal behavior through games in early childhood. The method used is systematic review and meta-analysis (PRISMA). Based data obtained from Google Scholar, PubMed/NCBI, UpToDate, Springer, Wiley on Library, ScienceDirect, MedRxiv, DOAJ, MDPI, and JAMA Network. A total of 3,728 journals were found which were then filtered based on related titles and 1,400 journal titles were obtained. Next, selection was carried out based on research variables, where there were 764 journals that were excluded because there were no suitable variables, namely those related to instilling trash throwing behavior in children through games, so that the remaining 636 journals were then filtered based on the research method used. It was found that 444 journals did not use the method cross sectional study, cohort, experimental study, quasi experiment, and field research so that the remaining 192 journals were then filtered again based on journal access and journal indexes to obtain 14 journals.

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1. INTRODUCTION

Sustainable waste management is one of the most important of the global environmental agenda in the 21st century. The uncontrolled increase in the amount of waste has resulted in increasingly complex problems in waste management. The waste problem is currently a very complex and urgent global problem to be given the right solution because it has an impact on health, environmental, economic, and social problems. Waste is a major problem in various parts of the world and affects all aspects of life. Global population growth, consumerism and industrialization result in the amount of waste increasing every year [1]–[5]. Based on data from 168 countries, it was found that globally, on average each person produces around 435 kg of waste every year [6]. In recent years, every country has tried to implement a sustainable waste management system. To achieve this goal, an integrated approach must be taken so that waste management can be proportional, effective, and efficient. Waste management must be carried out by looking at effectiveness and sustainability both financially, technically feasible, social aspects, legally acceptable, and environmentally friendly [7]. In accordance with global trends, waste processing systems are oriented towards sustainability issues, especially

through the incorporation of reduce, reuse, and recycle (3R) technology [8]. High-income countries such as Japan and South Korea are able to incorporate 3R technologies and focus on *"Zero Waste"* and/or *"Zero Landfilling"* which of course is still very expensive for developing countries like India or Indonesia. The increase in waste generation from year to year is a serious problem in developing countries [9]. The main challenge related to managing waste generation is the separation of waste at its source, the collection process, and waste disposal sites. Most of the waste is disposed of in landfills without processing the waste first [10]. Even though minimizing waste (behavior *zero waste*) is believed to contribute to the least environmental impact, but is given less attention by researchers and authorities who try to promote the recycling of production waste [11]. This is more effective than recycling waste because the environmental impact is less [12].

Waste generation is estimated at more than 2 billion tons per year or around 4.5 trillion pounds per year, and it is estimated that this figure will continue to increase. Global waste is expected to reach 3.4 billion tonnes by 2050. The Ministry of Environment and Forestry (KLHK) released data regarding the amount of waste generated, where it was found that around 37.3% of waste in Indonesia came from household activities and there is an increase of 8% every year. In addition, socio-economic factors (income, gender, and employment status) influence household waste management behavior [13]. Many diseases are caused by these biological vectors, such as diarrhea, dysentery, digestive problems, worm infections, food poisoning, dengue fever, cholera, leptospirosis and bacterial infections; irritation of skin, nose, and eyes; as well as respiratory symptoms [14], [15].

In Indonesia, the amount of waste generation spread across 296 districts/cities is estimated at around 34.5 million tonnes/year, with managed waste accounting for 56.44% or 19.5 million tonnes/year and unmanaged waste or 15.1 million tonnes/day. Based on the type of waste, it consists of 39.9% food waste, 17.1% plastic, 13.8% wood/bran/leaves, 12.2% paper. The behavior of disposing of waste that is not disposed of properly and without a prior sorting process. For this reason, it is very important to instill waste disposal behavior in the community in the waste management process. The results of studies in China provide an illustration that people's behavior in disposing of waste needs to be improved in terms of knowledge and motivation [16]. Behavior management there are 5 types of household waste, namely composting, anaerobic digestion, burning, as pet food, and can also be thrown into the trash [17].

A research study related to waste disposal behavior that was carried out in Indonesia involving 300 research samples revealed that only 143 respondents (47.7%) disposed of waste in the right place and sorted it first, while 157 respondents (52.3%) did not sort it). People who carry out discrimination because of personal awareness are 74 respondents (74%). People who (recycle) 15 respondents (5%) while those who do not carry out the recycling process (recycle) 285 respondents (95%). The 53.3% of people recycle based on personal awareness. There were 27 respondents (9%) who composted, while 273 respondents (91%) did not compost. Factors include culture, lack of infrastructure, or habits. For the most part, the intention to protect the environment is high but nil in practice [18]. Several recent research findings have found that game applications with the black box method on smartphones with the Android system can provide good education to children (Early Childhood Education) [19]. Waste sorting games are very user friendly to use on children and proven to be an Android platform as an effective educational learning technology media [20]. Game-based learning and gamification in elementary school children can overcome waste management problems [21]. Other games such as Trash Hero can provide effective learning for elementary school children, especially related to how to sort waste, how to recycle waste, and how to manage types of waste [22]. Other recent findings show that (STEAM) science, technology, engineering, arts, mathematics can be an alternative solution for the development of waste management literacy in school children [23].

The condition of the waste problem has been studied based on theories and research results. One theory that is widely used in understanding waste separation behavior is theory of planned behavior. In this model, attitudes, subjective norms, and behavioral control are defined as independent variables, while intentions and behavior are dependent variables. This model was then developed by adding the facility support variable as an independent variable [24]. The results of research studies using this theoretical framework show that inadequate support facilities will have a negative influence on people's behavior in managing waste and instilling good waste processing behavior in the community needs to be done from an early age. From an early age children must have a good understanding regarding health, so that this is an opportunity for the environment, in this case parents-teachers-schools, to provide the widest possible educational influence on children, to help develop positive child behavior [25].

Developing the thinking and learning patterns of early childhood and preschool children can be done through play activities. One media that can be used to increase good understanding and health education in children is through educational games. By playing using educational game tools, children can be trained, accustomed to, and instilled with character education values. Games can improve children's character which is shown by good self-quality and self-confidence. Play methods are not only used in the school environment but can also be started in the family environment [26]. Apart from traditional games, children's character

development can also be done by playing video games. Games video games can be a media for health education for pre-school children. An educational game can be a medium for education and training to increase environmental awareness on early childhood. A study with the development of game ideas in waste management found that the game vehicle "*junkbox*" is very effective in learning about waste recycling and waste sorting [27]. Other research shows that games can be used as a means of education about healthy eating patterns and guidelines for children aged 8-10 years. Game facilities can be a strategy to facilitate and strengthen learning [28]. Games have the capacity to increase exposure to messages about health behaviors. Games can be used as a health promotion medium for children because they are suitable for children who still like to play. Educational games can eliminate boredom and boredom when children learn. Games can also stimulate social creativity and intellectual growth in children and can improve concentration.

Literature studies on the cultivation of littering behavior in early childhood are highly relevant. Specifically, through a literature review, we can understand the factors that influence the development of littering behavior in young children. This includes internal factors such as cognitive and emotional development, as well as external factors such as social and family environment. In addition, this study helps identify methods or approaches that have been proven effective in cultivating littering behavior in early childhood. This allows us to design more effective and targeted programs or interventions. Thus, literature review plays an important role in understanding and promoting the cultivation of responsible littering behavior in early childhood. This is a crucial first step in the effort to shape future generations who care about the environment.

In this literature review, the problem of waste will be discussed, its correlation with early childhood, and education with games. This literature review aims to identify methods or approaches that have proven effective in teaching children about the importance of disposing of trash properly, and how play influences in shaping children's behavior, as well as understanding how children learn and behave, which is influenced by activities such as play. In this literature study, various reference sources from various parts of the world will be used to find effective methods for cultivating littering behavior in early childhood and how appropriate interventions are to provide education related to good and correct littering behavior. In addition, a review will be carried out on previous findings regarding the types of games that have a very good impact on the formation of behavior in early childhood, especially in public health aspects.

2. METHOD

The method used is systematic review and meta-analysis (PRISMA). The data sources used are accredited national journals and reputable international journals as well as Scopus indexed journals. The data based used come from Google Scholar, PubMed/NCBI, UpToDate, Springer, Wiley on Library, Science Direct, MedRxiv, DOAJ, MDPI, and JAMA Network. The inclusion and exclusion criteria are explained in Table 1. The list of journals included in the review according to the inclusion criteria is shown in Table 2.

Table 1. Inclusion and exclusion criteria

Criteria	Inclusion	Exclusion
Problem	National and international journals from different databases, and related to the same problem formulation, namely related to instilling waste disposal behavior in early childhood through games	National and international journals from different databases, but have different problem formulations
Design studies	Cross-sectional study, cohort, experiment study, quasi experiment, laboratory, field research, and modeling	Besides cross-sectional study, cohort, experimental study, quasi-experimental, laboratory, field research, and modeling
Publication year	Journal published from 2017 to 2022	Journals published before 2017
Journal index	International journals indexed by Scopus/reputable journals, or national journals indexed by Garuda	Apart from international journals indexed by Scopus/reputable journals, or national journals indexed by Garuda
Access the journal	Journal that can be accessed online, full text	Journals that cannot be accessed online, full text
Language	Indonesian and English	Apart from Indonesian and English

3. RESULTS AND DISCUSSION

Figure 1 shows the process of searching for literature in the journal of planting garbage disposal behavior through games in early childhood. Based on journal searches on search engines, 3,728 articles were obtained based on keywords and year categories. From the data obtained, a selection was made based on the title, 1,400 results were obtained, then a selection was made based on variables with a total of 636 results. For the next stage, selection was carried out based on the method and 192 results were found.

Table 2. List of journals included in the review according to the inclusion criteria

Reference no.	Study design	Results and conclusion
[26]	Time series design	There was a significant increase in the average handwashing self-efficacy score in the intervention group compared to the control group when playing educational games. Android-based educational games can be an effective medium for increasing hand-washing self-efficacy in preschool children.
[29]	Quasi experimental	Playing sociodrama (Ko-Berdrama) significantly increases knowledge, attitudes, and skills in preventing diarrhea as well as knowledge related to clean and healthy living behavior (PHBS) in school-aged children.
[30]	The study design follows the multimedia development life cycle	The results of the research are the design and development of a waste classification edugame application targeting elementary school children. Educational games can be used as educational learning related to waste management.
[31]	Quasi Experimental	This research reveals that game applications can improve children's learning about nutritional information. Game applications contribute to the understanding of how to convey effective nutritional information to children. Game applications can increase children's learning about nutritional information and children's interest in the characters in the game.
[32]	Mix method	The research results show that children are very active and motivated to learn the difference between biodegradable and non-biodegradable with game applications. Children aged 4 - 5 years are very effective in learning educational mobile games, especially those related to waste sorting.
[33]	Companion modeling (ComMod)	There is great potential for the development, use and scale-up of educational games for more sustainable water, sanitation, and hygiene (WASH) interventions. Games can be used as a promotional medium and a hygienic practice in schools at low cost.
[34]	Single-blind, randomized controlled pilot study	Compared to the control group (n=34), children using Foodbot Factory (n=39) experienced significant improvements in overall nutritional knowledge p<0.001, and in the Vegetables and Fruits sub-score (p<0.001), Protein Foods (p<0.001), and Whole Grain Foods (p=0.040).
[35]	Randomized controlled trial	The significant main effects of mobile gaming were choosing the number of healthy foods (treatment 2.48, control 1.10; p<.001; Cohen's d=1.25) and (treatment 7.3, control 6.94; P=.048; Cohen's d=25).
[36]	Quasi experimental	There was no significant difference between the behavioral and game intervention groups in BMI and BMI z-score points (p=0.130 and p=0.706). The family-based treatment and play group (Kaledo) intervention was found to be effective in the management of childhood obesity in this study.
[37]	Quasi-experimental	Compared with the control group, the intervention group was found to have a significant association with increased mental health knowledge after the intervention (beta=.46; P=.01) and in the 6-month post-intervention period.
[38]	Mobile game experiment trial	Significant differences (F2,124=6,341; P=.002) in diary entry compliance, with the ePRO Game-Motivated group having the highest compliance (mean completion 86.4%, SD 19.6%), followed by the ePRO group (mean completion 77.7%, SD 24.1%), and finally, the Paper PRO group (mean completion 70.6%, SD 23.4%).
[39]	Randomized pilot cluster trial	Self-reported frequency and duration of physical activity increased significantly in the treatment group compared with the control group at both post-assessments. Additionally, a significant increase in healthy food consumption and a significant decrease in junk food intake was observed in the treatment group.
[40]	Randomized cluster design	The ToyBox intervention had a small positive effect on European preschoolers' computer/video game use on weekdays and weekends, but not on TV/DVD/video watching or quiet games.
[41]	Randomized control trial	There was a significant difference (p<0.05) in prevalence after intervention. Control and prevention of soil-transmitted helminthiasis (STH) improved significantly (p<0.05) from 5.2% to 97.9% in the intervention group compared to 6.2% to 7.1% in the control group. The Worms and Ladders board game shows potential for teaching and promoting good hygiene behavior.

The final stage is carried out by selecting access and indexes and finding 14 results that are in accordance with the inclusion criteria. From 14 articles that fit the inclusion criteria, it can be concluded that technology-based educational games, especially mobile games, and board games, have great potential in improving various aspects of children's health and behavior, including self-efficacy of hand washing, clean and healthy living behavior (PHBS), waste management, nutrition knowledge, and obesity prevention. Game-based interventions have been shown to be effective in improving children's knowledge and skills in these areas and can be an effective educational tool at low cost. However, it is important to continue to develop and evaluate these types of play to have a sustainable and measurable impact in improving children's health and well-being. An important finding in this literature review is that android-based educational games and other educational games in children are proven to provide good and correct garbage disposal behavior in early childhood. The results of these findings are very helpful to find out the right intervention model in handling waste problems and can be the development of effective strategies and more effective interventions in cultivating waste disposal behavior in early childhood.

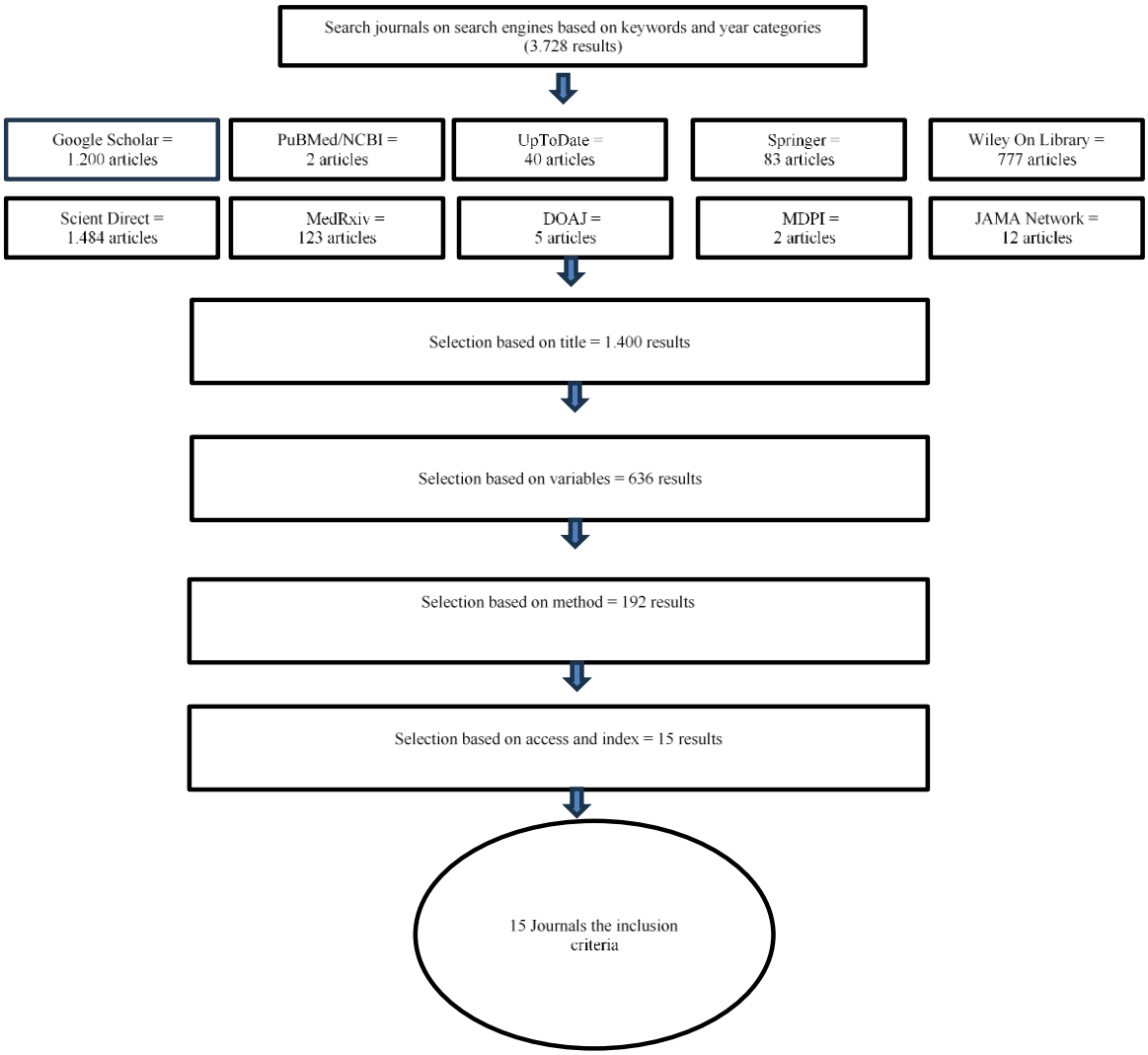

Figure 1. Journal literature search process instilling trash throwing behavior through games in early childhood

Educational games are a form of tool or means of play that contains educational values in it. Play is a series of activities or activities for children to have fun. Whatever the activity, if it contains an element of fun or happiness for young children, it can be called play. A game is something that is used and used as a means of playing activities. Therefore, there are many variations of this game, from traditional to modern. Children generally have an ecocentric attitude towards habits acquired at home and school [42]. Previous research results show that children are involved in management practices trash and do refraction in life everyday including in home and living environment [43].

Student behavior towards trash plays important role in management success sustainable waste in school level [44]. Additionally, found that in terms of management waste during the pre-school, religious education and extrinsic motivation and other intrinsic needs done to instill environmental concern and waste management for children [45]. Other research results show that there is a significant difference in students' knowledge before and after six months of activities workshop. Lectures and group games can increase knowledge about waste management [46]. Other findings show that the foodbot factory has the potential to be an effective educational tool to support children in learning [29], by exploring and praising its pure intentions, having the opportunity to instill stereotypes in children if they are accepted in their environment [47].

The results showed that the accuracy level of children's waste classification increased significantly after playing with the designed toys for two weeks [48]. Game named web-based application trash war developed for children's learning regarding waste recycling and other waste management. The concept in this game is to throw rubbish in the correct place (4 rubbish bins have been provided) which will appear on the user's screen. Then, each round of 90s, correct and incorrect choices will be highlighted along with the

score/value and comparison with other players displayed on the user's screen. Trash war it is hoped that it will be effective in maintaining environmentally friendly behavior as easy as recycling rubbish and throwing rubbish in its place. Games in learning are very effective in increasing students' level of knowledge and awareness regarding waste, recycling, and the benefits of recycling [49]. Environmental visualization can create emotional responses in children that can change their behavior [50]. However, further intervention is needed to increase positive changes related to waste management in children [51]. One of them is a role model carried out by teachers, such as the teacher's action of picking up rubbish [52]. Apart from that, the positive behavior of peers also influences children's trash throwing behavior [53]. Other findings show that the appearance of trash cans both at school and in the home environment can influence children's trash throwing behavior [54].

4. CONCLUSION

Waste management in developing countries, especially Indonesia, is not yet running well. Ineffective waste management can cause environmental pollution and become a breeding ground for disease-causing vectors. Waste management is influenced by the socio-economic conditions of a country. Waste management must involve the community, especially at the household level. Community involvement is greatly influenced by the behavior of the community itself. It is important to instill behavior from an early age because it is the golden age for learning and developing thought patterns. Instilling waste management behavior in early childhood can be done by playing game online, telling (narrating) the importance of managing waste well, also giving direct examples.

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