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Education of Water Hyacinth

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ABSTRACT

This study aims to provide information about the use of water hyacinth for learning materials and media, especially in Indonesia. This research was conducted based on a literature review. We searched for data on water hyacinth in education from articles on Google Scholar with the keywords "education in Indonesia about water hyacinth". We limit the article data to only the last five years. The results of this literature review found that research on the use of water hyacinth for sources and media learning is still rare. However, there are still several studies on water hyacinths in the field of education. Among them, water hyacinth is used as a source and learning media at the level of early childhood education, elementary schools, and secondary schools. Content related to this learning includes water hyacinths used in crafts, creativity, traditional objects, biology, science, economics, industry, and the environment. This research also presents the use of water hyacinths for education in several other countries. In several other countries, water hyacinth is used in environmental studies and bioenergy studies. This study was intended to serve as both a reference and a source of examples for readers regarding the use of water hyacinth as a source of media in the implementation of education. Other researchers hoped to expand the application of water hyacinth in the larger field of education.

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1. INTRODUCTION

Water hyacinth is a water plant that has very good reproductive abilities. These aquatic plants are known to be able to perform eutrophication or rapid reproduction of aquatic plants if they obtain sufficient nutrients. Indonesia is a country that has many waters area, ranging from offshore oceans, rivers, lakes, or dams. The large number of water areas in Indonesia makes water hyacinths grow abundantly in Indonesia. However, if the abundance of water hyacinth is not handled properly, its growth will cause various problems. So that this water hyacinth must be managed and used for various aspects of life, one of which is as a learning media material (in the education field).

It was reported in the research of Hofifah & Nandiyanto (2024) that the use of water hyacinth as a medium or source of learning is still rarely done. Research on water hyacinths is mostly carried out in the field of pure science such as the use of water hyacinths for phytoremediation, crafts, bioenergy, economic research, material synthesis, and others. Water hyacinths can be used as a learning resource in environmental materials, biodiversity, plant anatomy, plant physiology, plant reproduction, and even to study green energy (Nandiyanto *et al.,* 2024).

The use of water hyacinth in education can be carried out at various levels starting from the foundation phase (early childhood education), phase A (grades 1–2 elementary school), phase B (grades 3–4), phase C (grades 5–6), Phase D (grades 7–9 junior high school), to phase E (Class 10 senior high school). Water hyacinth can be used as an object in learning natural sciences such as biology, chemistry, and physics which are carried out on a project basis. Project-based learning that is carried out using local materials can provide concrete learning experiences for students. This is in line with learning outcomes in the independent curriculum in Indonesia or known as CP. That is, at the end of the learning phase, students are required to be able to propose solutions to local, national, and global issues around students about various aspects of life, one of them is the environmental aspect (see https://guru.kemdikbud.go.id/kurikulum/referensi-penerapan/capaian-pembelajaran/).
Thus water hyacinth has the potential to be used as a source and media for local-based learning materials related to the potential and challenges it has.

Therefore, this study provides information on the use of water hyacinth as a source and learning media, especially in Indonesia. This research is based on a literature review. In addition to the use of water hyacinth as a source and learning media in Indonesia, this study also provides information on several studies using water hyacinth as a learning medium in several other countries. This research was expected to be a reference as well as information for readers about examples of using water hyacinth as a source or media in the implementation of education. It was hoped that other researchers can develop the use of water hyacinth in the wider world of education.

2. METHODS

We collected data on the theme of education in Indonesia about water hyacinths through a literature study. We are looking for data on various articles indexed by google scholar. The keyword used was "education in Indonesia about water hyacinth". We limit the searched data to only the last 5 years. The development of research on water hyacinth education over the last 5 years obtained as many as 996 articles and book data. After that, we took several sample article data for us to analyze and discuss.

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3. RESULTS AND DISCUSSION

In Indonesia, there are many waters such as rivers, lakes, or dams, which allow water hyacinth plants to grow in Indonesian waters (Nastiti *et al*., 2020). The abundance of water hyacinths in Indonesian waters is great potential to be used as a medium or source of learning based on local wisdom. Education about providing an understanding of water hyacinth is given at various levels of education in Indonesia, from kindergartens to universities and even the community. **Table 1** presents an analysis of several studies on water hyacinth education in Indonesia. The results of the analysis show that water hyacinth plants are used as learning materials and media in education in Indonesia. This plant is important to teach because it has several benefits in everyday life. In the world of education, water hyacinth can be processed into various products and can even become commercial goods to be produced. This material is taught because it is based on local wisdom.

Education in Indonesia about water hyacinth has been carried out since Kindergarten and Elementary School (grade 6), where this can be obtained from the official website of the Indonesian Directorate General of Education (see https://ayoguruberbagi.kemdikbud.go.id/artikel/mengajarkan-cara-mengolah-sampah-eceng-gondok-di-masa-pandemi/). In elementary school students, water hyacinth was introduced as a eutrophicated plant and its potential to be used as a traditional craft material.

Table 1. Water hyacinth education in Indonesia.

No	Educational stage	Research content	Result	Scope	Reference
1	Kindergarten	Education about water hyacinth plants is taught to kindergarten students and their parents. Water hyacinth plants are used as learning media in the material for making smart dolls. An understanding of the utilization of water hyacinth is provided to teach how to use water hyacinth as a material for making smart dolls. Parents and students were given an understanding of water hyacinth waste management starting from fiber selection to making media. Water hyacinth is used by teachers as a learning medium for kindergarten students.	The use of water hyacinth waste as a learning medium aims to hone teacher creativity in online learning through making smart dolls. The activity of making smart dolls from water hyacinth has been successful and has provided positive benefits to teachers and children. Based on the results obtained, exploring creative ideas in making learning media is very necessary. This is done to hone the teacher's ability to increase children's learning interest in online learning. The utilization of natural materials that can be developed into easy and environmentally friendly learning media is becoming more developed.	Learning media	Rusmiati *et al.* (2021)

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Table 1 (continue). Water hyacinth education in Indonesia.

No	Educational stage	Research content	Result	Scope	Reference
2	Kindergarten	Education about water hyacinth plants is taught to kindergarten students. Water hyacinth plants are used as learning media in collage-making materials. An understanding of the use of water hyacinth is given to instill ways to use water hyacinth as a material for making collages. Water hyacinth is dried and used by kindergarten students to make collages.	The results of this research test show that children's learning interests can be influenced by interesting pictures, even though the situation and conditions are still during a pandemic. The creativity of early childhood learning can be applied by doing through learning water hyacinth plant collages so that the quality of children's skills becomes better.	Learning media	Rusmiati & Iskandar, (2021)
3	Kindergarten	Education regarding the utilization of water hyacinth waste is carried out by teaching students to make works from this plant. Students are asked to be as creative as possible in making various works, especially mask hangers and curtains	The development of children's creativity in utilizing water hyacinth waste is classified as good, especially in the three indicators observed, namely (1) originality, (2) fluency, and (3) flexibility. The use of water hyacinth waste is taught to kindergarten students by making mask hangers and curtains.	Learning material	Karmini *et al.* (2021)
4	Elementary school	In art education material, natural materials are needed to be used in the learning process. The water hyacinth plant is used as a natural material for learning works of art.	The results showed that water hyacinth plants can be used as natural materials in the learning process. Particularly in the subject of works of art, the theme taken is the making of webbing. The process of making water hyacinth plants needs to be dried first.	Learning Media	Sari *et al.* (2017)
5	Elementary school	Ethnomathematics are used by the community when they carry out their daily activities or carry out various traditional ceremonies. The concept of mathematics (geometry) which is more complicated is applied by the community to the motifs of woven hats, one of which is made from water hyacinth.	The education curriculum applied the use of water hyacinth plants as learning media. The material provided is flat shapes with the method of making woven water hyacinth-based woven. This makes it easier for students to understand the material being taught.	Learning Media	Hartoyo, (2021)

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Table 1 (continue). Water hyacinth education in Indonesia.

No	Educational stage	Research content	Result	Scope	Reference
6	Junior high school	The results of this study indicate that 15 identified local materials can be used as learning resources. One of the categories of local environmental problems is the impact of the water hyacinth population explosion. The results of this study can be used as a reference for teachers in implementing biology science learning in junior high schools and can be used as a reference in developing teaching materials sourced from local materials in the muara enim regency.	The impact of the explosion of water hyacinth populations in freshwater is on fish ponds. Point no 3.9 requires students to be able to describe pollution and its impact on living things. The nutritional content of fish pond water makes water hyacinth easy to grow. In addition, the growth of water hyacinth is more rapid when water hyacinth grows on a stagnant water surface, this is supported by the condition of fish ponds which have stagnant water conditions. The impact of the water hyacinth population explosion on the environment that can be observed is that rapidly growing water hyacinths cover the water surface of fish ponds, causing a lack of incoming sunlight. Lack of incoming sunlight causes reduced oxygen content in the water and disrupts the fish ecosystem in the pond. In addition, water hyacinths if left unchecked pollute the pond, and dead water hyacinths sink to the bottom of the pond, causing the pond to become shallow.	Learning material	Pradietha *et al.* (2014)

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Table 1 (continue). Water hyacinth education in Indonesia.

No	Educational stage	Research content	Result	Scope	Reference
7	Junior high school	The results of the study discuss the use of the surrounding environment as learning material for junior high school students. The selection of material is based on an analysis of local wisdom in the surrounding environment. This is stated in science subjects, the selection of water hyacinth material is one of the selected alternatives. This shows that it is very important to teach water hyacinth material to students because this plant is a plant that easily grows in the aquatic environment where students live.	Material about water hyacinth can be found in basic competency 3.9 (describing pollution and its impact on living things). The material is covered in local wisdom with detailed material: a. Cultivation of carbon-absorbing plants, b. Water hyacinth to decompose factory waste. C. Plants that give rise to aromatherapy. This material will be taught to class VII students in science subjects	Learning material	Parmin (2015)
8	Junior high school	The water hyacinth plant is used as one of the local wisdom materials in the middle school science module in Kalimantan. This explains that the water hyacinth plant is used as an environmentally friendly technology product. The results showed that the material validation test on student learning outcomes showed good presentation results.	The results showed that the water hyacinth plant is used as a material for environmentally friendly technology products based on local wisdom. This is because the water hyacinth plant is a typical wetland plant, including phytoremediation plants. After all, it can filter waste in the water. Local wisdom from south Kalimantan, namely the water hyacinth plant as a phytoremediation plant, the construction of traditional banjar houses in sustainable development, and the utilization of water hyacinth plants.	Learning material	Febriati *et al.* (2021)

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Table 1 (continue). Water hyacinth education in Indonesia.

No	Educational stage	Research content	Result	Scope	Reference
9	Senior high school	Material about water hyacinth is one of the topics discussed for learning plant anatomy and materials for making handicrafts.	The epidermis is tightly packed in one layer. The inner parenchyma forms the air parenchyma or aerenchyma. Scleroid with tapered ends of the fingers are in the parenchyma cell space. The vascular bundle type is closed collateral. Xylem forms air passages called lacunae. The wall thickening of the collenchyma found on water hyacinth leaf stalks is angular collenchyma. Collenchyma cell walls look like pearls and are bright and shiny. Collenchyma cells are assembled to form a thickness with four to eight layers. 8 preserved water hyacinth preparations were declared very feasible while 2 were declared feasible as learning media.	Learning media	Das *et al.* (2021)
10	Senior high school	The material for water hyacinth is taught in class X biology with basic competency 4.10, namely solving environmental problems by designing waste recycling products and efforts to preserve the environment. Water hyacinth is used as an experimental material for providing additional media or fertilizer for mushroom growth. The results showed that the addition of water hyacinth media affected weight gain.	The results showed (1) the application of moringa seed extract as a herbicide affects reducing the growth of water hyacinth weeds; (2) the application of the model improves the learning outcomes of class X students. Coconut dregs as a mixture of planting media to increase the growth of oyster mushrooms (Pleurotus ostreatus) and their application as material in high school biology learning.	Learning media and material	Arnesti *et al.* (2015)

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Table 1 (continue). Water hyacinth education in Indonesia.

No	Educational stage	Research content	Result	Scope	Reference
11	College	Water hyacinth material is given to students as knowledge about the utilization of this plant. Water hyacinth plants are processed and used as the basic material for making three-dimensional textured clothing. This material is given to students through direct learning methods for fashion design.	The water hyacinth natural fiber textile material as a result of exploration can be classified as an environmentally friendly material. The process used in the manufacture of women's couture clothing from water hyacinth-processed natural fiber textiles can increase community profits and minimize negative impacts on the environment. The results of this study can be used as a learning model for ordinary people who own small and medium-sized textile industries to be able to produce high-quality, unique fashion products. This exploratory research on three-dimensional water hyacinth material can also be used as a medium for learning basic design, both for the public and for elementary-level design students.	Material	Hinanto *et al.* (2019)

Then, more water hyacinth education was reported in grade 7 junior high school based on the 2013 curriculum. Water hyacinth has been introduced to have potential biomass energy such as agricultural waste, forest waste, human waste, and livestock manure. Water hyacinth is also introduced to grade 5 in "interaction relations and natural appearance", where this topic discusses the benefits of water hyacinth including its use for animal feed as well as handicraft materials and supporting flower arrangements. This topic is important for increasing student creativity as well as student encouragement and entrepreneurship (Harun *et al.,* 2021). The discussion of water hyacinth was reintroduced in grade 10. Through learning outcomes or known as CP in natural science learning elements, water hyacinth can be taught about the environment, biodiversity, or even green energy. Apart from that, in the field of economics, students are taught to use water hyacinths for simple products, such as photo frames, flower vases, sandals, tote bags, and other souvenirs.

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Apart from Indonesia, education about water hyacinth plants has been carried out in various countries (see **Table 2**). Although most countries make this plant an object of pure scientific research, it is different from Indonesia, which starts from various levels of education. **Table 2** shows that there is still little research development on water hyacinth found with special discussion at every level of education in various countries. Research by Hofifah & Nandiyanto (2024) also explains that research on the use of water hyacinth as a medium and source of learning is still very rare. Therefore, this is initial information and data that there are still very wide opportunities to make water hyacinth a medium and source of learning at various levels of education.

Table 2. Water hyacinth education in various countries.

No	Scope Topic	Target Participants	Country	Results	Reference
1	Teaching Material	Elementary School	Thailand	Water hyacinth as an environmental issue to increase elementary school students' awareness of environmental issues. This is indicated by a change in attitude and a score of 100 for each student.	Rakthai (2017)
2	Teaching Material	Elementary School	Africa	Environmental problems caused by the invasion of water hyacinth which have an influence on the attitudes and behavior of environmental students.	Chiang *et al.,* (2014)
3	Teaching Material	Horticultural Student	Belgium (AlterIAS)	The AlterIAS project which was developed to provide an introduction and understanding to holcultura students has an impact on changing attitudes. This can be seen from the results of surveys conducted from time to time.	Halford *et al.,* (2014)
4	Teaching Material	Middle School	United States	Understanding of layout in preventing the plant invansion (water hyacinth) went well, as seen from the attitude post test scores where the experimental class got the highest score compared to the control class. This score indicates that there is a change in caring behavior towards the environment outside of school	Dresner & Fischer (2013)
5	Teaching Material and Media Learning	university students	Indonesia	e-modules that focus the development of cognitive, emotional, and psychomotor aspects in a balanced approach are used to raise environmental literacy on average since learning	Wahyudyawati & Amin (2021)

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Table 2 (continue). Water hyacinth education in various countries.

No	Scope Topic	Target Participants	Country	Results	Reference
				using this model is thought to be more meaningful. modules to enhance pupils' environmental literacy skills have passed rigorous testing.	

4. CONCLUSION

This study intends to explain the use of water hyacinths for media and learning materials, especially in Indonesia. The findings from this literature analysis reveal the lack of studies on the use of water hyacinth as a source and learning media. The results of this literature review found that research on the use of water hyacinth for learning resources and media is still rarely carried out. Even so, there are still several studies in early childhood education, elementary schools, and secondary schools regarding the use of water hyacinths as a teaching resource and tool. Related topics include water hyacinth crafts, creativity, traditional goods, biology, science, economics, industry, and the environment. The use of water hyacinths for teaching in many other countries is also discussed in this study. In many other countries, water hyacinth is used in environmental research and biofuels. Concerning the use of water hyacinth as a source or media in the implementation of education, this research is designed as a reference as well as a source of examples for readers. It is hoped that the use of water hyacinths in the wider field of education can be expanded by further researchers.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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