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Environmental Engineering Innovation to Tackle Water Crisis in Modern Era

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ABSTRACT
Water crisis has become one of the major challenges of the modern era, with increasing demand for clean water and decreasing availability of quality water resources. In this context, environmental engineering innovations are crucial to effectively address this challenge. This research aims to explore various environmental engineering innovations that can be used to address the water crisis in the modern era. The main focus of this research is to identify technical solutions that can be applied to improve water management and increase the availability of clean water. The research method used involved an in-depth literature survey to gather information on recent environmental engineering innovations in addressing the water crisis. In addition, the research also involved a comparative analysis of various solutions that have been implemented in different regions around the world. The results show that there are various environmental engineering innovations that can be effective in addressing the water crisis in the modern era, including water treatment technologies, sustainable water resource management, and the use of renewable energy in water treatment systems. The conclusion of this research is that environmental engineering innovations play an important role in addressing the water crisis in the modern era. By implementing these innovative solutions, it is expected to achieve water quality restoration and sustainable increase in clean water availability.

Keywords: *Engineering Innovation, Environment, Water Crisis in Modern Era*

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INTRODUCTION

Water crisis has become one of the major challenges facing humanity in this modern era (Lapitan et al., 2021). Decreasing availability of clean, quality water and increasing demand for water are causing a significant imbalance in water resources management (Ahmed et al., 2022). Water crisis has far-reaching impacts (Kar et al., 2022), including

threats to human health (Ibrar et al., 2019), environmental sustainability, and economic stability. Limited access to clean water also increases social and economic inequality.

This research aims to explore the role of environmental engineering innovation in addressing the water crisis in the modern era (Jafari et al., 2021). The main focus is to identify technical solutions that can help improve water management and increase the availability of clean water (Chen et al., 2023). In the face of a worsening water crisis (Jansen et al., 2023), important to find innovative and sustainable solutions (Ahmed et al., 2022). Environmental engineering innovations promise a holistic and effective approach to addressing these challenges.

By exploring and implementing environmental engineering innovations, such as advanced water treatment technologies (Yates et al., 2019), integrated water resources management (Howe et al., 2021), and sustainable practices in water management (Burke, 1966), we can build effective and sustainable solutions to the modern-day water crisis.

Water crisis is a serious concern in this modern era due to the increasing demand for clean water and decreasing availability of quality water resources (Wang et al., 2020). Therefore (Cohen et al., 2020), This research was undertaken to explore and develop innovative solutions using environmental techniques to address these challenges.

This research will fill a gap in the literature by investigating innovative environmental techniques that can be applied to improve water management and increase the availability of clean water (Maican & Cocoradă, 2021). We will use a combined approach of in-depth literature analysis and case studies to understand the potential and effectiveness of the proposed solutions.

The research will evaluate the state of the art technologies and practices in water resources management, including the latest water treatment technologies (Ferri et al., 2020), integrated water management systems, and the application of renewable energy in water management. We will also propose new innovations that can improve efficiency (Hayes et al., 2020), sustainability, and availability of clean water.

The novelty of this research lies in its holistic approach to water crisis management by integrating the latest technologies and practices in environmental engineering (Castañeda-Babarro et al., 2020). Compared to previous research that often focuses on one aspect only (Else, 2023), This research will provide a more comprehensive and integrated view.

Furthermore, the research will identify the practical implementation of the proposed innovations and conduct a performance evaluation of the solutions. We hope that this research can provide valuable guidance for researchers and practitioners in addressing the water crisis in the future.

RESEARCH METHODOLOGY

Research Design

This research uses a quantitative research design, which is inputted into google form as many as 20 items (Payal et al., 2024). Which includes what influences will be caused when students use technology-enabled language learning (Favale et al., 2020). This

method is used in order to formulate a new thought that is useful for every level of students (Spernjak, 2021). Then developed into a research that can be held accountable for its accuracy (Dong & Liu, 2023), which is tailored to each event experienced by the student (Selwyn, 2019). This collection method is useful to test the feasibility of language-based learning itself to improve student learning achievement (Shadiev & Yang, 2020). The quantitative method can also be interpreted as a research stage that begins with making a questionnaire containing 20 items (Gosal et al., 2019), then every answer given by students is processed using the spss application (Pardo et al., 2019). The data obtained can be proven accurate through a google form created by the researcher. And researchers also input the highest gain and also the lowest gain from the questionnaire distributed to each student. Then conclude these statements.

Research Procedure

The steps taken in this study began by asking permission from the campus and working with English teachers. Then each filled in by students (Else, 2023), from the beginning of the questionnaire made by the researcher until it reaches the acquisition of filling which the researcher considers to have met the expected acquisition by the researcher (Besser et al., 2022). Then the researcher is also very concerned about ethics in making questionnaires that use good language and are also polite (Kapasia et al., 2020). So that students can fill out this questionnaire in a short period of time (Chow et al., 2023), which makes it easier for researchers to examine various Exploring the Potential of Renewable Energy in Today's Engineering Development

Research Subjects

The subjects of this research are students of UIN Mahmud Yunus Batusangkar, the role of the researcher is to collect every answer given by students (Dube, 2020). Researchers are also assisted by English lecturers who teach at UIN Mahmud Yunus Batusangkar, especially educators who teach in the field of technology (Dubey, 2021). This study is to measure the ability of students using questions in the form of tests and then counted from the highest series of acquisition numbers to the lowest series of numbers (Hao & Ho, 2019). The researcher then inputted the score obtained through the research subject which became a reference to determine the category of Environmental Engineering Innovation to Handle Water Crisis in the Modern Era (Alma Çallı & Ediz, 2023). The type of research conducted is research that strongly considers every answer given by students, which aims to determine the effect of Exploring the Potential of Renewable Energy in Contemporary Engineering Development.

Research Ethics

Of the approximately 1000 students enrolled at Mahmud Yunus State Islamic University Batusangkar, only 50 students contributed to this study (Dwivedi et al., 2023). Of these. 50 students participated in this study, of which 25 were male and 25 were female with a maximum age of 19 years and 18 years (Maulida et al., 2023). The data collection participants came from various villages or jorongs close to UIN Mahmud Yunus Batusangkar. This research has obtained permission from the lecturer who teaches language courses. This research uses several principles of research ethics (Oulaich, 2020).

First, there is no coercion in filling out the questionnaire. This research only expects the volunteerism of students and female students who study here. Then every question must be answered completely without leaving any part of the questionnaire. This formular is very supportive and upholds rights and there is no coercion at all. This is done to ensure that the participants understand the essence of this study, out of 50 participants 80% expressed their willingness to fill out this questionnaire.

Data Collection Technique

The technique used by researchers in collecting data is to obtain various information that can be measured, compared, and calculated carefully. Through the google form format created by the researcher (Ibrar et al., 2019), which was filled in by 50 students of UIN Mahmud Yunus Batusangkar. Data collection was carried out on first semester students in the 2023/2024 academic year. After obtaining permission to conduct research from the language lecturer (Jansen et al., 2023), and also IT links online questionnaires distributed to students of various majors. This questionnaire was distributed from March 1, 2024 to March 30, 2024 (Memon et al., 2021). The process of processing data that has been collected from respondents in the research field. The questionnaire data is then downloaded into an Excel file and then transferred to SPSS. The final score data is recorded in the SPSS application which can be verified. Then recapitulated as interesting as possible so that readers are interested in reading articles made by researchers.

Data Collection and Analysis

Then the data that has been collected is inputted and processed using the SPSS application. Distributed in the form of tables and diagrams that can calculate the scores obtained from students (Teimouri et al., 2022). The way the data is analyzed is by comparing each answer given by each student with previously conducted studies (Cohen et al., 2020). Data is presented in the form of average scores and percentages (Castañeda-Babarro et al., 2020). Then the data was tested using the oneway anova test (Kang et al., 2022). Which compares the acquisition score of each group that fills in each statement related to the questionnaire made by the researcher (Loewen et al., 2019). Researchers also really take into account the scores obtained by each student who fills out the questionnaire previously made by the researcher (Betlem et al., 2019). And will never leave any answers given by students from the beginning of filling out the questionnaire until the last student fills out this questionnaire (Shadiev & Yang, 2020). Furthermore, the researcher will also summarize in an accurate conclusion.

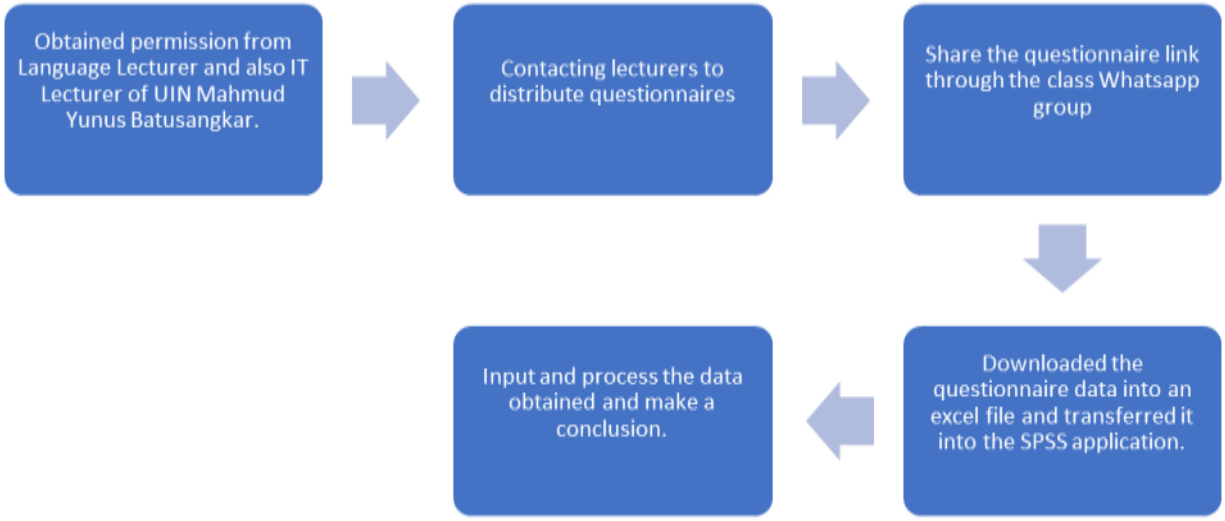
Table 1. 1
Categories of Acquisition of Environmental Engineering Innovations to Handle Water Crisis in the Modern Era

No.	Gain category	**Value interval**
1	Strongly agree	>90%
2	Agree	70-80%
3	Disagree less	50-60%
4	Do not agree at all	0-40%
Total		100%

Table 1. 2
Research Sample Details

No	Student Batch	Gender		Total
		Male	Female	
1	T.A 2022	10	10	20
2	T.A 2023	15	15	20
	Total	**25**	**25**	**50**

Flowchart of quantitative research



RESULT AND DISCUSSION

Table 1.3
Acquisition of Environmental Engineering Innovation to Handle Water Crisis in Modern Era

No	Statement	SS	S	KS	SKS
1	Innovative desalination technologies have enabled the conversion of seawater into safe and affordable drinking water, helping to address freshwater shortages in areas lacking water resources.	70%	30%	0%	0%
2	The development of smart water management systems using sensors and Internet of Things (IoT) technologies enables real-time monitoring and efficient management of water use in	60%	40%	0%	0%

	households, industry and agriculture.				
3	Innovations in biophysical engineering strengthen the soil's capacity to store water and reduce surface runoff, minimizing flood risks and increasing groundwater supply.	70%	30%	0%	0%
4	Renewable energy-based water treatment systems such as solar panels and wind turbines help reduce the carbon footprint of the water treatment process, creating an environmentally sustainable solution.	65%	30%	5%	0%
5	Advanced nanofiltration and membrane technologies enable more efficient and accurate water filtration, even in removing microscopic contaminants such as heavy metals and harmful chemicals.	60%	40%	0%	0%
6	The development of intelligent water management systems based on artificial intelligence (AI) enables prediction and mitigation of water crisis risks with sophisticated data analysis and predictive modeling.	80%	20%	0%	0%
7	Innovations in hydrological engineering create adaptive and responsive flood management systems, including green infrastructure such as rain gardens and eco-friendly flood retaining walls.	60%	40%	0%	0%
8	Improved rainwater harvesting technologies, including innovative and environmentally friendly water storage systems, help reduce reliance on surface and underground water sources.	75%	20%	5%	0%
9	The use of drones and satellite imagery technology in water resources monitoring and management enables more extensive and accurate surveillance of water distribution, soil moisture, and water availability levels in hard-to-reach areas.	65%	30%	5%	0%
10	The development of eco-friendly building materials that promote	75%	20%	5%	0%

	groundwater infiltration and rainwater collection, as well as innovative waste management systems, are important steps in reducing the negative impacts of development on the local and global water cycle.				

Table 1.4
Acquisition of Environmental Engineering Innovations for Handling Water Crisis in the Modern Era Tested for Feasibility by One Way Anova Test
ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
X.01	T. A 2022	2,400	4	,500	.	.
	T. A 2022	,000	5	,000		
	Total	2,400	9			
X.02	T. A 2022	1,100	4	,275	2,750	,148
	T. A 2022	,500	5	,100		
	Total	1,600	9			
X.03	T. A 2022	2,100	4	,525	.	.
	T. A 2022	,000	5	,000		
	Total	2,100	9			
X.04	T. A 2022	,900	4	,225	.	.
	T. A 2022	,000	5	,000		
	Total	,900	9			
X.05	T. A 2022	1,600	4	,400	4,000	,080
	T. A 2022	,500	5	,100		
	Total	2,100	9			
X.06	T. A 2022	2,100	4	,525	.	.
	T. A 2022	,000	5	,000		
	Total	2,100	9			
X.07	T. A 2022	1,600	4	,400	4,000	,080
	T. A 2022	,400	5	,300		
	Total	2,100	9			
X.08	T. A 2022	2,100	4	,525	.	.
	T. A 2022	,000	5	,000		
	Total	2,100	9			
X.09	T. A 2022	1,600	4	,400	.	.
	T. A 2022	,000	5	,000		
	Total	1,600	9			

X.10	T. A 2022	1,900	4	,475	4,750	,059
	T. A 2022	,500	5	,100		
	Total	2,400	9			

Environmental engineering innovations play an important role in addressing the water crisis in the modern era. One significant innovation is the development of desalination technology. Desalination is the process of removing salt from seawater or other salty water, making it safe for human consumption and use in various purposes. This technology has helped countries experiencing water crises by expanding available water sources.

In addition to desalination, wastewater treatment technologies are becoming increasingly important in addressing the water crisis. Efficient treatment systems can enable reuse of wastewater for non-potable purposes such as irrigation, industry, or cleaning. Thus, not only extending existing water resources, but also reducing pressure on clean water resources.

Furthermore, innovations in stormwater management are also key in addressing the water crisis. Techniques such as rainwater collection, infrastructure development that allows infiltration of water into the ground, and rain garden systems can help reduce environmentally disruptive runoff and provide additional water supply.

The utilization of sensors and monitoring technologies has also helped in water resources management. By using sensors to monitor water quality and quantity, governments and environmental agencies can respond quickly to changes in water conditions and take necessary actions to protect water resources.

In addition to technology, innovative approaches in urban infrastructure design can also help reduce pressure on water resources. Sustainable urban design including the use of abundant vegetation, the use of permeable surfaces, and stormwater detention strategies can help reduce surface water runoff that causes pollution and water shortages.

Innovations in public education and awareness are also important components in addressing the water crisis. Education and awareness programs can improve people's understanding of the importance of water conservation, water resource management, and sustainable practices in water use.

In addition to technology and education, regulations and policies are also needed to address the water crisis. The government needs to implement policies that encourage the use of innovative technologies, water conservation and protection of water resources. Strict regulations on industrial and agricultural waste are also needed to prevent water pollution.

Partnerships between the public, private and civil society sectors can also help accelerate the development and implementation of environmental engineering innovations. Through collaboration, different parties can support each other in facing the challenges of the water crisis by bringing together their resources, knowledge and expertise.

Furthermore, innovations in water storage technologies are also important in addressing the water crisis. Efficient water storage, such as reservoirs and advanced

rainwater storage systems, can help address the challenges of water supply uncertainty and increase resilience to climate change.

Finally, the integration of environmental engineering innovations with ecology-based approaches can also be an effective solution in managing the water crisis. By strengthening and restoring natural ecosystems, such as forests, swamps and wetlands, we can improve water quality, reduce soil erosion and improve the overall water cycle.

CONCLUSION

The conclusion of environmental engineering innovations to address the water crisis in the modern era is that with the adoption of innovative technological solutions, such as seawater desalination, efficient wastewater treatment, and sensor-based smart water management, we can tackle the challenges of the water crisis more effectively. These innovations allow us to expand clean water sources, increase water use efficiency, and improve monitoring and management of water resources. In doing so, these efforts not only support the sustainable fulfillment of water needs for a growing global population, but also contribute to the mitigation of climate change impacts and overall environmental protection.

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