



Increasing Clean Water Crisis Awareness by Integrating Mathematics, Environmental Education, and Islamic Value

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Abstract. Water is fundamental for human needs. Getting clean water is a right for all people, yet 1.1 billion people around the world have no access to water. This situation is getting worse because of water pollution and the climate crisis. On the other hand, some people with clean water access do not realize this situation since it is easy to think that water will be always be regenerated and available in abundance. However, the freshwater we drink and use in activities constitutes only 3% of earth water; two-thirds of that is frozen as glaciers. This study aims at increasing water crisis awareness by integrating mathematics, environmental education, and Islamic values. This research was implemented at one of the Islamic junior high schools in Yogyakarta, Indonesia. The study revealed that this integrated learning gives students new awareness. They enjoyed the learning activities as they used mathematical concepts to raise water crisis awareness and use water effectively.

Keywords: Environment Education · Integrated · Islamic Value · Mathematics · Water Crisis Awareness

1 Introduction

Around 70% of the surface planet earth is covered by water, and it is easy to think that enough water will always be available for humankind. However, freshwater that we frequently use for drinking, bathing, and irrigating our farm fields is getting rare. Only 3% of the world's water can be categorized as clean, and around two-thirds are either reserved as glacier and polar ice caps, or too inaccessible below the ground. As a result, 1.1 billion people around the world with no access to water. For at least one month each year, around 2.7 billion people face shortage of water. Many water systems that the ecosystem and human population depend on have become polluted. More than half of the world's wetlands have disappeared as rivers, lakes, and aquifers continue to dry up and become too polluted to use. If we continue our consumption at the rate we do, this situation will only worsen and by 2025, we can anticipate that two-thirds of the world's population may not have enough water for their daily life [1].

Clean water scarcity becomes a popular and important issue that students should be aware of. In school, this concern leads to designing learning that embeds water scarcity

awareness. For instance, Amahmid and colleagues [2] discovered that water-related topics are taught in curriculum using multidisciplinary approach, mostly involving Science and Geography. King [3] proposed the topic of freshwater scarcity as a context to teach proportional reasoning for middle school students. In high school, Fox and DeJarnette [4] put forward the issue of global water crisis, packaged as Desmos activity, to learn trigonometry and develop the students' 21st century skills. Using water scarcity as an environmental and social justice context to develop 21st century skills through mathematics education is also proposed by Wong [5].

As Indonesia is a Muslim-majority country, teachers can develop activities related to the Islamic value in the mathematics lesson focusing on statistical information and water volume measurement. These two topics are essential for students and in line with the curriculum. In Islam, a procedure for cleansing body parts before praying is named wudu. Learning about data will support the students to develop a sense of agency [6], that the mathematics they learn in school can help them make a difference in the world, while measuring the water volume the students use to cleanse their bodies will give them a better understanding of concept of volume. Furthermore, delivering the topic of water-scarcity through student-centered school activities can potentially make it more meaningful and effective in changing the students' attitude and behavior regarding water [2].

Although wudu is an essential and vital part of Islamic practice, the Prophet Muhammad (Peace be upon him) taught thriftiness with water. He warned against wasting water in doing wudu, even if one lives near a river [7]. According to a *hadith* (the second source of reference for Muslims all over the world after the holy Al-Qur'an consist of words and teachings of the Prophet Muhammad) by Imam Bukhari, Abdullah ibn Amr (a companion of the prophet Muhammad) reported, "While Sa'd was performing wudu, The Messenger of Allah, peace and blessings be upon him, passed by. "What is this excess?" said the Prophet, to which Sa'd replied, "Is there excess water in ablution?" The Prophet responded, "Yes, even if you were on the side of a flowing river (Hadith by Sunan Ibn Mājah 425). The Prophet himself had a habit of taking a bath with one Sa' up to five mudds of water and performed wudu with one mudd of water." In this standard, 1 mudd equals to 675 g or 688 ml.

Data is an important tool for decision-making [8], which means that being aware of their water consumption for wudu is vital in encouraging students to reduce their water usage. Students can have different opinions, such as not wasting much water and using more or less at different times of the day. Most importantly, knowing their wudu water consumption will help them to understand their role in preserving clean water to save the planet. Determining the standard of wudu water consumption can help them manage their own water usage, which hopefully will lead to their communities' consciousness of overall water use. This is in line with the definition of mathematical literacy proposed by OECD [9], which include using mathematics to understand the world, solve problem, and make rational decision as modern citizen. By being aware of their wudu water consumption, it is expected that the students will also be more mindful of their overall water consumption in other aspects of life [7].

Table 1. Distribution of activities during the designed learning.

Pre-intervention	Intervention	Post-Intervention
Activity 1	Activity 2	Activity 3
		Activity 4

2 Methods

This study utilized an action research design, which is a self-reflection research conducted to solve and find the solutions to real problems happening in the classroom through intervention in the form of teaching and learning activity [10]. Action research is a form of research that involves the active involvement of the researcher in the research process. In this study, the teacher and the students worked collaboratively to identify problems in the classroom and to develop strategies to address these problems. The outcome measured in this study is the effect of integrating mathematics, environmental education, and Islamic values to increase student water crisis awareness. Intervention included four learning activities, which is shown in Table 1.

Data was collected using observation and interviews. The students' water crisis awareness was quantified through measuring the amount of water they used during wudu. Interview was carried out to discover the students' perspective of the activity. Data was analyzed by calculating the difference between the amount of water used before and after the intervention.

3 Result and Discussion

3.1 Islamic School Context

Since wudu is a vital part of Islamic practice which Muslims do every day, students need to know the wisdom behind this practice as it is connected to preserving water. During the learning, the teacher proposed questions to students about the amount of water usage and their opinion. In the question, the teacher also mentioned terms such as less and more to illustrate water usage. However, the students answered in "moderation". On top of that, most of them did not know how much 1000 ml is.

3.2 Activities

There were four activities during the lesson. In activity 1, each student was instructed to wudu and measured the water usage. In this activity, each student practiced the wudu three times: once during the mathematics lesson and two times after school. When performing wudu, they need to place a bucket under to collect the water, as illustrated in Fig. 1. Later, they will measure their wudu water usage using the measuring cup and write down the result in the report as displayed in Fig. 2 The average amount of water used by 5 students is 1212,4 ml.



Fig. 1. The students were practicing wudu.

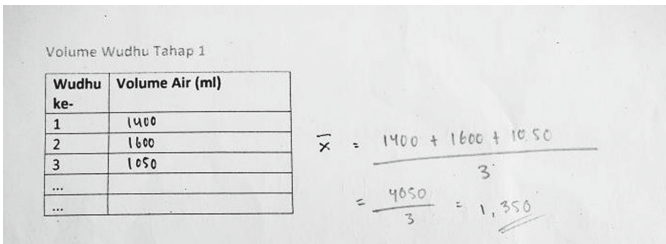


Fig. 2. The students' data on their wudu water volume.

In activity 2, the teacher explained the water crisis by integrating mathematics concepts such as statistics and volume, water issues as the environmental education, and the amount of water in practicing wudu in Islamic values.

First, the teacher asked students to prepare their wudu water consumption data and determine the average of their wudu water usage. After determining the average water consumption for wudu, students discussed various use of water with the teacher's guidance. The teacher displayed the Earth's water percentage diagram and asked them the importance of using water wisely even though the amount of water provided in the earth is approximately 70%.

After the students stated their opinion, the teacher showed them the freshwater diagram. They tried to conclude based on the diagram illustrated in Fig. 3., followed by and watching three videos about the water crisis as displayed in Fig. 4.

After watching all videos, the teacher discussed with students about the water cycle and provided them with an insight that used water needs time to become clean again. In addition, the teacher came up with the statistical data on population growth and water withdrawal as illustrated in Fig. 5. And asked students about their opinion.

Following the previous activity, the teacher brought up a hadith, as displayed in Fig. 6, about the conversation between Prophet Muhammad and his closest friends about water usage for wudu. Furthermore, the teacher showed the amount of water Prophet Muhammad used for performing wudu. The teacher asked students about what they could learn from the hadith.

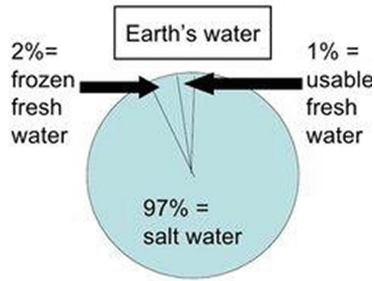


Fig. 3. The diagram of freshwater availability on earth in percentage.



Fig. 4. The students watched the three videos.

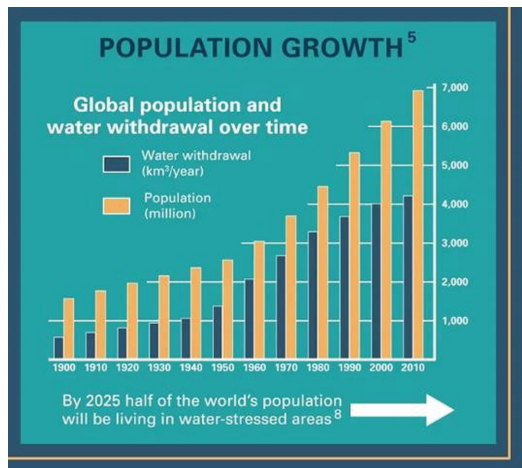


Fig. 5. Water scarcity facts and statistics (accessed from <https://www.britannica.com/story/water-scarcity-facts-and-statistics>).

Abdullah ibn Amr reported: The Messenger of Allah, peace and blessings be upon him, passed by Sa'd while he was performing ablution. The Prophet said, "What is this excess?" Sa'd said, "Is there excess with water in ablution?" The Prophet said, "Yes, even if you were on the banks of a flowing river (Hadith by Sunan Ibn Mājah 425).

The Prophet used to take a bath with one Sa' up to five Mudds of water and used to perform wudhu (ablution) with one Mudd of water. (Hadith by Bukhari).

1 mudd = 675 gram or 688 milliliter.

Fig. 6. Hadith about wudu volume.

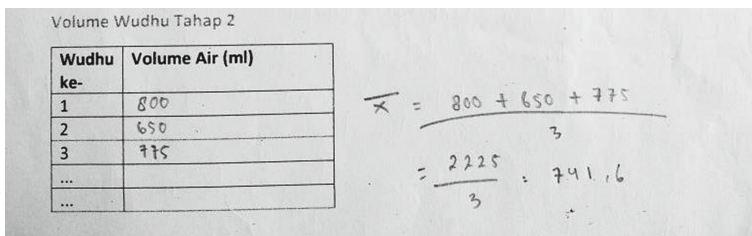


Fig. 7. Wudu data after project.

Table 2. Summary Table of Data Collected by 5 Students.

Student	Water usage before	Post-Intervention
1	1350 ml	742 ml
2	1430 ml	910 ml
3	1167 ml	463 ml
4	1645 ml	800 ml
5	470 ml	480 ml
Average	1212,4 ml	679 ml

In activity 3, each student performed wudu and collected data using the amount of water Prophet Muhammad had as displayed in Fig. 7. The average amount of water used by 5 students is 679 ml. Later on, students compared their findings on the volume of water for performing wudu twice, those were before and after the project.

In the last activity, students wrote a reflection on what they got from this project as homework related to preserving clean water. Figure 8 showcases examples of student's reflections on the activities.

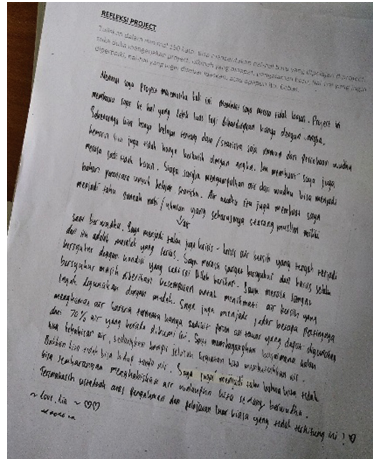


Fig. 8. Student's reflection.

Translation.

Instruction: Please, write down (minimum 150 words). It can be about something new that you learned in this project, the ups and downs, the wisdom you got, something you want to change, something you want to share with others, or anything.

Answer:

In my opinion, this math project did not make me bored. This project brought me further than just numbers. The chapter was about data/statistics. However, in the ablation practise that we did, we were not just deal with numbers. Who would have thought that collecting ablation water could be an intermediary for statistics lessons? The ablation water also made me aware of the prophet's sunnah/water regulations that a Muslim should have.

During my ablation, I also learned about the water crisis. It is serious problem. I am very grateful for the current conditions that God has given me since I am still allowed to enjoy clean water that is accessible. Then, I also become aware of how important it is to save water because it turns out that only a few percent of fresh water is from 70% of the water on this earth. I imagine what if we run out of clean water while all our activities need water. We cannot even live without water. Then, I realize that we cannot waste water even though we are doing ablation. Thank you for these countless experiences and lessons.

4 Conclusion

This study positively impacts the students' awareness on the issue of water crisis. To improve the learning sequence and students' understanding of mathematical concepts, adding more activities on statistical data is necessary. On top of that, open discussion on water conservation and students' reflection at the end of the learning is essential.

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