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# Identifying Gaps within the Education System in Uganda to Prepare Students for More Sustainable Water Management in the Future

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**Abstract:** Due to climate change and increased urbanisation, the current level of freshwater withdrawals and corresponding water usage in Uganda has increased, affecting the availability of these resources and becoming a concern. Education can play a crucial role in providing support to and training students on sustainable water use, both at home and in relation to school activities. Therefore, it is imperative that the education system develops actions, approaches and materials to achieve this goal. The paper assesses the current state of existing Ugandan education on this subject, by identifying the water-related topics currently featured in the curriculum at different class levels, with the aid of questionnaires conducted in four schools in Uganda. Three questionnaires (one for primary school pupils, one for secondary school pupils and one for teachers) were designed for collecting targeted data, and thematic analysis was adopted to analyse the data collected. The results revealed important insights regarding students' behaviours towards water usage at home. They also revealed that water sustainability topics are delivered in the science curriculum at the primary level, as opposed to geography at the secondary level, confirming that overall, there is a lack of integrated practical teaching incorporated within the courses currently taught in Ugandan schools.

**Keywords:** water management; sustainable; education; curriculum; Uganda; environmental



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## 1. Introduction

Uganda is known for its abundant water resources, which include Lake Victoria, Lake Kyoga and the River Nile. Approximately 15 per cent of the country's land surface is covered by open water resources and 13 per cent by wetlands [1]. However, the availability of water resources per person in Uganda is reducing day by day due to increasing pressure on these resources. The water shortage in Uganda is mainly due to climate change [2] and the uncertain water demand as a consequence of urbanisation [3]. Uganda has a tropical climate with two rainy seasons every year [4]. The rainy seasons last from March to May and October to November, with rainfall ranging from 500 mm to 2000 mm [5]. Throughout the year, the country experiences mean annual temperatures of about 22.8 °C, with monthly temperatures ranging between 21.7 °C in July and 23.9 °C in February [4]. According to Nuwagira and Yasin [6], Uganda has experienced incidences of climate change effects in previous years, which include an increase in temperature and increased drought due to low rainfall in the country. Since late 2020, four consecutive rainy seasons have failed in the East African region, a climatic event not seen for at least the previous forty years [7]. The prolonged dry season has increased drought occurrence in Uganda causing water resources to dry up, hence leaving more than two hundred people dead from

hunger and half a million facing starvation in Karamoja [8]. Uganda is rapidly urbanising, whereby the current population of the capital city Kampala is 3.8 million people, and it is estimated to reach 6.4 million by 2033 [9]. In addition, Uganda is aiming to become a developed economy by 2040, and industrialisation is regarded as one way to achieve this. Therefore, there has been increased industrialisation in the urban areas of the country [10]. The unforeseen population growth due to rural–urban migration coupled with a rise in industrialisation in urban areas of Uganda has not only increased the water demand but also led to the degradation of water quality due to the increased pollution released in the freshwater resources.

Whilst climate change and urbanisation have affected the existing freshwater resources in Uganda, water usage in the domestic sector is also becoming a serious concern. According to the report by UBOS [11], the average water use for each household per day in Uganda increased from 47.8 L in 2017 to 48.5 L in 2020. This has increased the amount of water withdrawn from freshwater resources, such as Lake Victoria, for domestic purposes, hence affecting the availability of the resources in the country. Several measures have been set up to avoid the critical conditions of water scarcity in the country. Uganda has implemented strategies for recycling water, such as the Bugolobi recycling plant [12], and is building new treatment facilities, such as the Katosi treatment plant [13], as a way of increasing the water supply to its citizens. Water recycling plants convert wastewater from communities or industries into water that can be reused for different purposes, such as agriculture and domestic use [14]. Water treatment plants in Uganda use conventional treatment processes [15] to treat water extracted from freshwater resources, such as lakes and rivers, before it is supplied to the public for consumption. The Ugandan government has focused on implementing legislation, for example, the National Water Policy (1999), which was revised and updated in 2021 [16] and the National Environment Act 2019 [17,18], that protects water sources from pollution and over-abstraction. It has also increased water supply prices as a way of reducing people's water consumption. The National Water and Sewerage Cooperation (NWSC), for example, increased water prices in 2022 for domestic users from 0.97 USD per unit a litre to 1.03 USD per unit a litre [19]. Technical and regulatory measures alone may not be effective for improving water usage and management. For that reason, there is scope to build on a burgeoning interest in harnessing education as a solution for environmental and sustainability issues, such as water management [20–23].

Education can play a significant role in achieving a long-term change in positive attitudes, knowledge and behaviours around water resource concerns [24–27]. Most studies evidenced that people who have received little or no education have a lower concern for the environment and natural resources [28,29]. Therefore, educating people on such topics was significant in increasing awareness about water resource concerns, and the most appropriate time for doing so is during primary and secondary school levels, before they develop negative or contradictory behaviour around water use. It is therefore crucial to instruct students about environmental problems starting from their childhood. In addition, the future use of water resources in time will be decided by today's children, and the most effective way to prepare the next generation with knowledge and appropriate behaviour towards water usage is through educating them at school [30]. Educating adults can be extremely rewarding due to the incredible amount of knowledge and experience they can bring to class. However, teaching adult learners has its barriers. Adult learners normally have limited time for classes due to their work or personal commitments and may not have received the same level of formal education as their younger counterparts [31]. The choice of techniques may also require adaptation when incorporating participants from across the age range, as there is the potential for them to reject techniques and approaches often considered to be "child-focused" because of their use in research [31]. This, therefore, is why water education should be introduced to children in schools rather than, or in addition to, adults. Countries such as Singapore and Australia have integrated water education into their curriculum [32–35], encouraging teachers to train students about conserving water.

This study was conducted to identify student behaviours regarding the use of water. It also analyses the existing educational curriculum in Uganda and identifies the water-related themes that appear in the different subjects taught at different class levels. The study will include recommendations to fill the identified gaps.

## 2. Materials and Methods

### *2.1. Source of Data and Location*

In order to conduct this study, data was collected from primary and secondary school students and teachers. Four schools were visited in Uganda for data collection. These were: Kampala Quality Primary School, Busy Burgs Junior School, Kampala High School and Buddo Secondary School. The schools were considered for inclusion because they follow the Uganda National Curriculum. As shown in Figure 1, two of the schools are located in urban areas, and the other two schools are located in rural areas. The locations were considered important to determine how students in urban and rural areas behave towards water usage.

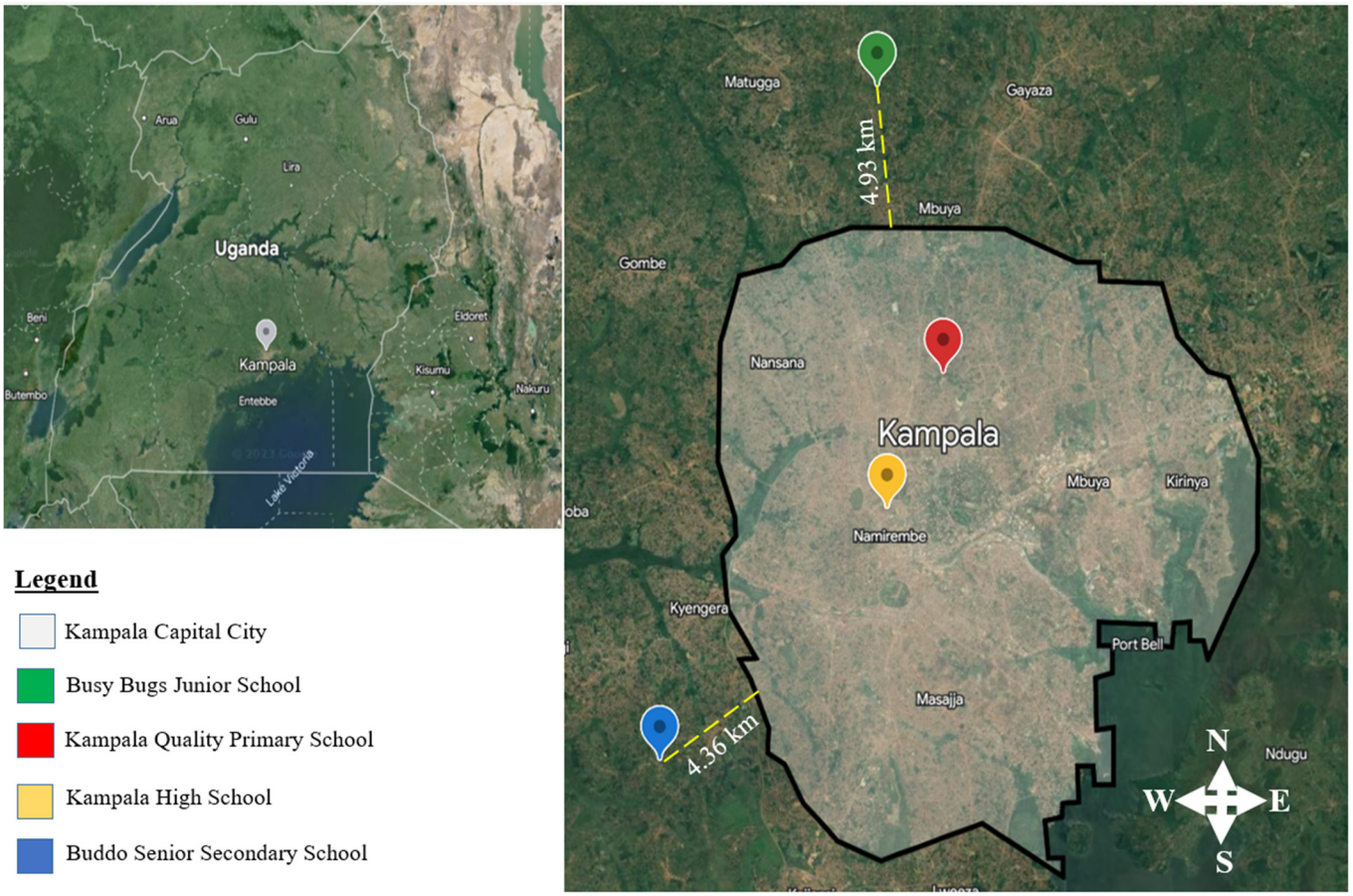


**Figure 1.** Map of Kampala showing the location of the schools.

### *2.2. Data Collection Tools*

For data collection from students and teachers, both paper-based and online questionnaires were used from 23 May to 30 June 2022. Questionnaires are a cost-effective method for collecting data from many people [36]. Questionnaires for primary school pupils (Questionnaire 1, Supplementary Material), secondary school students (Questionnaire 2, Supplementary Material) and teachers (Questionnaire 3, Supplementary Material) were designed and contained both closed and open-ended questions. Closed-ended questions are questions where respondents can select from a range of pre-written answers. For example, ranked ordered answers or multiple-choice [37]. These questions were used because they

produce a better completion rate by the respondents [38], because they find them straightforward and can be responded to quickly [39]. They also offer an opportunity for statistical analysis. Closed-ended questions, however, may prevent respondents from fully and accurately expressing their feelings since they must choose from the responses provided to them [40]. Therefore, open-ended questions were also used in the questionnaires such that the respondents may be able to express their opinion without being influenced [41]. Questions such as '*Do you have anything you would like to add to the project, if others please specify?*' were used in the questionnaires to get the participants' opinions. This should offer more comprehensive views from the respondents since they are given an opportunity to express their feelings.

### 2.3. Questionnaire Design

Students' questionnaires were printed and circulated in person, and teachers' questionnaires were designed using JISC Online Surveys [42] as they were distributed online prior to the researchers visiting Uganda. On both platforms, clear instructions were provided at the beginning and throughout the questionnaires to enable the participants to navigate through the questions. For example, the first page of the questionnaires described the aim of the research and provided directions (tick the answer of your choice and use the space provided for any other information) to the respondents on how to complete the survey. In addition, the participants were instructed not to provide their names to ensure anonymity. The questionnaires were designed with subtopics which enabled the participants to understand the types of questions they were going to respond to. The questionnaires were designed to be straightforward, starting with non-sensitive questions followed by questions about water habits. Questions about knowledge which could have been recognised as more sensitive were included towards the end of the questionnaire. The respondents are less likely to stop once they have invested some time in completing the questionnaire that starts with non-sensitive questions and ends with delicate questions [43].

### 2.4. Distribution of Questionnaires

In 2020, the Ugandan government initially allowed the use of phones and tablets in schools by students [44]. A recent U-turn by the Ministry of Education, however, has suggested that they are still discussing the matter of authorising the use of mobile phones by students in the school setting [45], and currently, the government have asked schools to stop students from bringing phones to school. With that in mind, mobile phones and tablets are considered to be illegal (unauthorised) possessions at most non-international schools [45]. Subsequently, questionnaires to students were paper-based. The questionnaires were distributed to students who were eight years of age and above. In primary schools, the questionnaires were given to the class teachers, who distributed them to the learners. However, in secondary schools, permission was granted for the researcher to go to classes and distribute the questionnaires to the students. Due to the limited time and transport costs, the students had to complete and return the questionnaires on the same day.

Since teachers can have their phones at school, the teachers' questionnaires were distributed using WhatsApp, text messages and email. A questionnaire link was shared with the teachers who were willing to participate in the study. Teachers without access to the link were provided with a phone or laptop to complete the study. In order to increase the number of teachers participating in the study, snowball sampling alongside purposive sampling was used.

### 2.5. Ethical Considerations

Ethical principles were observed during the data collection process. It is essential for any study to gain permission and consent from the respondents [46]. Informed consent forms were created for the parents whose students were below the age of eighteen. The forms were given to the parents for signing. However, parents who were not comfortable with or unable to sign the forms had the option of providing their consent verbally. To

acknowledge the agency of the children in the research, it was also ensured that they also gave their verbal consent before they participated in the survey to verify understanding. For students who were above the age of eighteen and the teachers, participant consent forms were given to them for signing.

### 2.6. Data Analysis

Descriptive analysis was used to summarise the data collected from the students and teachers [47]. The descriptive statistical tool in the Statistical Package for the Social Sciences (SPSS) was used to measure the frequency of the data, for example, the number of males and females who participated in the study. It was used to measure the central tendency of the data, such as the median age of the students who participated in the survey. Cross-tabulation, another tool under descriptive statistics, was used to examine relationships within the data that were not obvious by just looking at total responses from the study. For example, the tool was used to determine a relationship between gender and behaviour towards water usage at home. Regarding analysing the qualitative comments collated within the questionnaire data, thematic analysis was used as an approach to identify key messages within the text, which was then coded using a set of themes agreed upon by the research team. Nowell et al. [48] suggested that thematic analysis can be a useful approach across a range of research methodologies and epistemologies. Therefore, we found it valuable for contextualising the statistical data presented in this paper.

## 3. Results and Discussion

### 3.1. Student Demographics

The first part of the questionnaire was aimed at identifying the demographics of the students who participated in the survey, as shown in Appendix A. A total of 326 students participated in the survey, of whom 134 were from primary schools, and 192 were from secondary schools. Of these students, 44.79 per cent of the students who participated in the survey were male, and 55.21 per cent were female. This indicates that the study was representative since both male students and female students were involved in the study, even though the female students participated more in the survey compared to the male students. The median age for both males and females who participated in the survey was 14–15 years. This indicates that there was a balance in the study since the age group of males and females was the same. Students starting from Primary Three and above were considered eligible to participate in the survey. This is because the students in Primary Three are eight years and above and can read, understand the questions and effectively select an answer of their choice without clarification from adult influencers. Students from senior four had the highest percentage (21 per cent) of participation in the survey compared to other classes. A majority (72.39 per cent) of the students who participated in the study lived in urban areas compared to those who lived in rural areas. Students accessed water for home use through different means. Tap water is the main method used to access water at home, followed by protected springs, boreholes and then other methods such as rainfall and dug wells.

### 3.2. Teacher Demographics

Details on the demographics and experience of teachers within the primary schools and secondary schools that participated in the survey are shown in Appendix B. A total of 41 teachers participated in the study, with male teachers making up 56.10 per cent compared to 43.90 per cent of female teachers. Youth in Uganda make up 78 per cent of the population [49]. The Uganda National Youth Policy 2016 defines 'youth' as any person who is between 18–35 years of age [50]. Due to the increasing youth population in the country and arguably the problematic definition, it is therefore not surprising that the majority of the teachers who participated in the study were in the age group of 25–34 years of age. The majority (87.81 per cent) of the teachers who participated in the survey obtained their training from teachers' training institutes. However, a minority (12.19 per cent) did

not receive any training from teachers' training institutes. In Uganda, mainly in rural areas, the main source of learning and teaching has been through methods of imitation and demonstrating, often within the workplace and guided by experienced teachers [51]) rather than through practical approaches.

### *3.3. Access to Water*

According to students' responses, tap water is the primary source of water for domestic use in urban areas, as shown in Figure 2. The use of tap water in urban areas is not surprising because NWSC currently supplies water to 263 towns [52], including the capital, Kampala. NWSC is the government organisation that was given the responsibility of treating and supplying water to the public [53]. Through four treatment plants: Ggaba I, II and III, as well as the newly built plant in Katosi [54], many areas in Kampala, such as Kanyanya, Ntinda, and Kololo, including slum areas such as Katanga, are supplied with piped water from Lake Victoria. NWSC piped water connection grew from 5073 km in 2012 and grew to 21,794 km in 2022 [52].

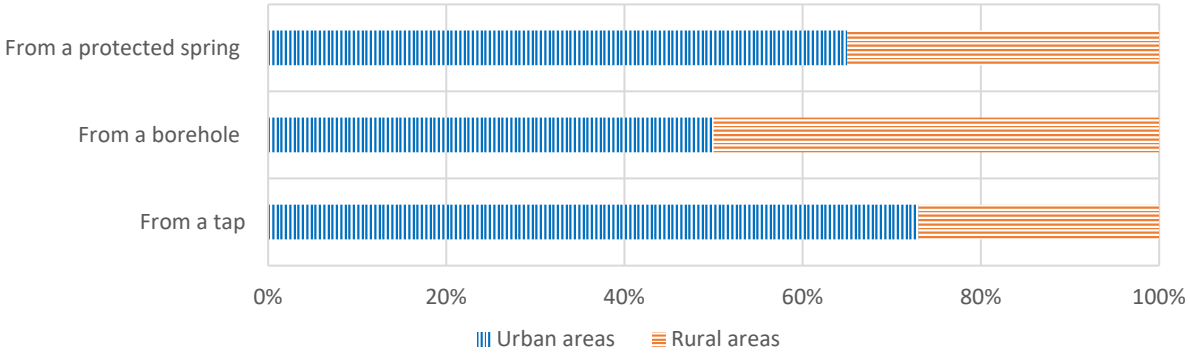


**Figure 2.** The primary source of water for domestic use.

The organisation serves over fifteen million people with piped water compared to the five hundred people it used to serve in 1990 [55]. Data collected indicated differences between students who live in urban areas and those in rural areas to access their source as shown in Figure 3. It takes 1 h and 11 min on average for citizens in rural areas to fetch water for home use, compared to 49 min in urban areas [56].

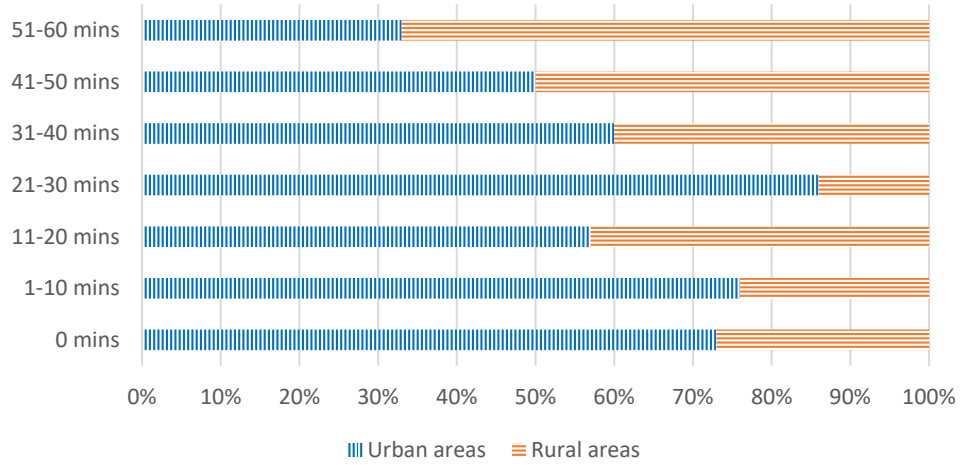


**Figure 3.** Average time required to access the source of water.

### *3.4. Domestic Water Use*

Domestic water use can be divided into two types: (i) indoor and (ii) outdoor water activities [57,58]. The indoor activities include drinking water, washing clothes, cooking, and showering, and the outdoor activities include washing cars and agriculture. Using a

Likert scale, students were asked to rate the activities which are most important and least important for their own water use. According to the data collected, most of the students responded to drinking water as the most important activity for water use compared to other activities (Figure 4). Therefore, this shows the awareness students have about drinking water. However, two per cent of the students who participated in the survey responded to drinking water as a less important activity, which shows the inadequate awareness they have about the importance of drinking water.

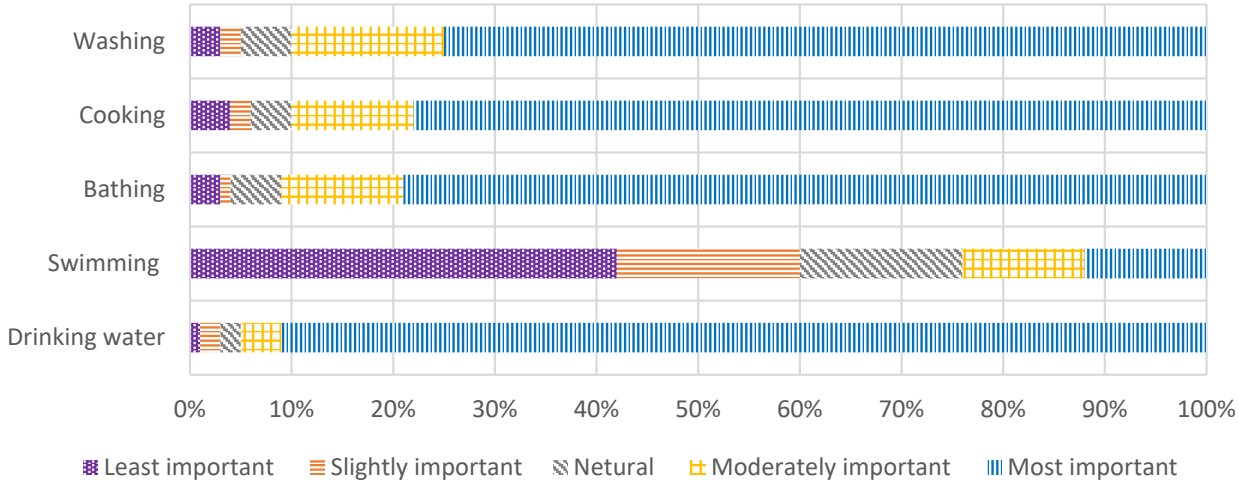


**Figure 4.** Water use activities.

### *3.5. Behaviour towards Water Usage at Home*

The behaviour towards water use can differ from one individual to another, community to community and from one point in time to another. The utilisation of water at home is rising at a significantly faster rate than any other sector [59]. Water used at home accounts for eight per cent of global water use [60]. In countries such as the USA, an average family uses more than three hundred gallons (1364 L) [61] of water every day at home, and 70 per cent of the water is used for indoor activities [61].

#### 3.5.1. Students' Behaviour towards Water Usage When Brushing Their Teeth

When an individual leaves the water running from a tap while brushing their teeth, they can use approximately four gallons (18 L) of water each time [62]. Therefore, if individuals brush their teeth twice a day as recommended by relevant organisations [63,64], about eight gallons (36 L) of water would be used per day, 240 gallons (1091 L) per month and 2880 gallons (13,092 L) annually would be wasted if water is left running from a tap while brushing teeth. Conservative use of water at home is therefore essential. Upon asking the students in Uganda to identify how they behave with water when brushing their teeth, most of the students acknowledged that they turn off the tap while brushing their teeth; however, there are students, as shown in Figure 5, who leave the water running from the tap while brushing their teeth.

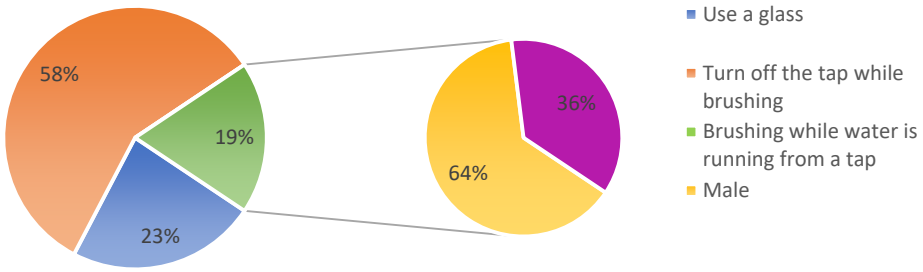


**Figure 5.** Students' behaviour towards water usage when brushing their teeth.

Students' Water Usage When Brushing Their Teeth According to Their Gender

The data collected from the students revealed that male students showed less positive behaviour towards water usage compared to female students. According to the responses from the participants, more of the male students responded positively to brushing their teeth while water was running from a tap compared to female students, as shown in Figure 2.

Studies including [65–68] have revealed that females care more for the environment compared to males, often because of gendered roles and socialization practices within home. In the domestic setup, females are said to be the regular water managers [69]. Global data indicates that most of the domestic work, such as cooking and cleaning, is performed by women [70], whereby most of the work depends on natural resources, such as water. The workload of females increases with the increasing water shortage problem. For example, females in Uganda are normally responsible for fetching water for home use, which means problems in accessing nearby water sources can increase their workload [71]. To avoid the increasing workload in their domestic activities, females have shown more water conservation practices compared to males [69].

Students' Water Usage When Brushing Their Teeth According to Their Age Group

The data was analysed according to students' age group to identify how they behave towards water usage at home. Data collected showed that students in the age group of 16–17 years responded more to leaving the water tap running as they brushed their teeth, as shown in Table 1. This indicates that this age group wastes more water at home in Uganda compared to any other age group.

**Table 1.** Age of students who leave a water tap running as they brush their teeth.

| Student Age | Frequency | Percentage |
|---|---|---|
| 8–9 | 3 | 9.38% |
| 10–11 | 8 | 25.00% |
| 12–13 | 5 | 15.62% |
| 14–15 | 6 | 18.75% |
| 16–17 | 9 | 28.13% |
| 18–19 | 1 | 3.12% |

Age is a major determinant of water consumption at home [72], and it was felt necessary, therefore, to explore the intersectionality of this group given the considerable proportion of Ugandans who reside within the 16–17 years demographic. The presence of teenagers at home increases the volume of water consumption [73]. A study by Grespan et al. [74], presented a significant effect on household water consumption due to the presence of teenagers.

Students' Behaviour towards Water Usage According to Their Place of Residence

The data collected from the students shows that more of those from urban areas leave the water running from a tap when brushing their teeth compared to those from rural areas, as shown in Figure 6. Urban areas are better supplied with improved water and sanitation compared to rural areas [75–77]. In countries such as Malawi, 37 per cent of households in rural areas spend 30 min or more fetching drinking water compared to 13 per cent of households in urban areas. The long distances in rural areas, mainly walked by women and children to collect water from boreholes and protected springs for home use, enable them to make more conservative use of the water. In urban areas, water is distributed from the source to the people's homes through piped systems. For example, in 2020, the piped water coverage in urban areas of Uganda stood at 78.6 per cent [78]. Since water is more accessible for people, some urban residents can be inefficient when using water at home.

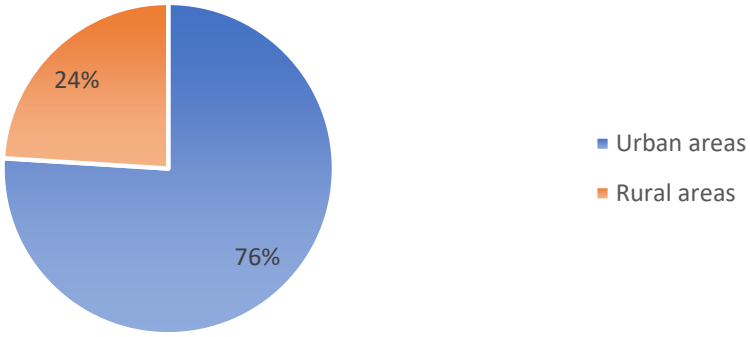


**Figure 6.** Percentage of students' using water from a running tap when brushing their teeth according to their place of residence.

3.5.2. Students' Behaviour towards Water Usage When Bathing

Showers are responsible for the highest usage of water consumption in homes, at approximately 34 per cent [79]. A traditional showerhead uses about 19 L per minute [80]. This means having a 5 min shower with a traditional shower will consume 95 L of water per person. Technology and human behaviour are the two determinants identified regarding water conservation in the shower [81]. Efficient shower heads are the main water-saving technologies [82,83]. However, it is not an assurance that efficient technology can lead to more sustainable use of water [84]. For example, a water-efficient showerhead uses about 9 L per minute [80], which means having a 5 min shower can consume 45 L of water per person. Development of good habits such as limiting shower duration [81] and turning off the shower while soaping up [85] are required regarding water conservation in shower usage. Turning off the shower while soaping up and then turning it back on to rinse off can possibly save up to half of the amount of water an individual normally uses [86].

According to the data collected from the students who participated in the survey, the majority of the students turned off the shower when soaping up. Some students, however, let the water run from the showers until they finish showering, as shown in Figure 7, hence increasing water demand in the domestic sector.

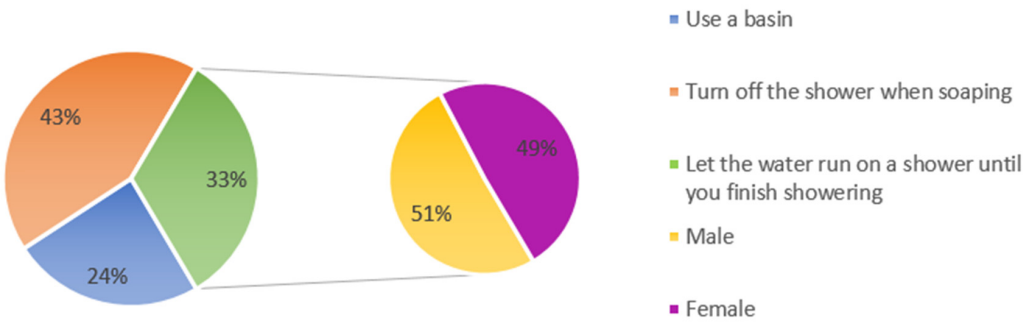


**Figure 7.** Students' behaviour towards water usage when bathing.

Students' Water Usage When Showering According to Their Gender

The data collected showed that a small majority (51 per cent) of the male students who participated in the survey left the water flowing from a shower until they finished showering, as shown in Figure 7, compared to the female students who participated in the survey (49 per cent).

Students' Water Usage When Showering According to Their Age

Students in the age groups of 14–15 years and 16–17 years old had the highest responses about leaving the water running from a shower tap until they finished showering, as shown in Table 2, compared to any other age group. This was previously noticed where there is an increase in water consumption when teenagers are at home.

**Table 2.** Students who leave water running in the shower while soaping according to their age group.

| Student Age | Frequency | Percentage |
|---|---|---|
| **8–9** | 1 | 1.56% |
| **10–11** | 14 | 21.88% |
| **12–13** | 8 | 12.50% |
| **14–15** | 18 | 28.13% |
| **16–17** | 18 | 28.13% |
| **18–19** | 5 | 7.80% |

Students' Water Usage When Showering According to Their Place of Residence

The data collected shows that a majority of the students who live in urban areas leave the water running from the shower taps when soaping compared to those who live in rural areas, as shown in Figure 8.

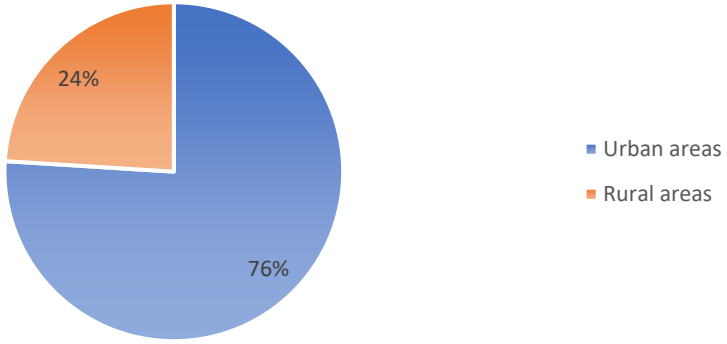


**Figure 8.** Students who leave water running from a shower while soaping according to their place of residence.

### *3.6. Water Activities Taught in the Ugandan Curriculum in Primary and Secondary Schools*

Students were asked to indicate the subjects in which they primarily study water-related topics. According to the responses for students in primary schools, the subject of Science contains more water-related topics compared to Social Studies, as shown in Figure 9. For secondary school students, Geography contains more water-related topics, as shown in Figure 10, compared to other subjects.

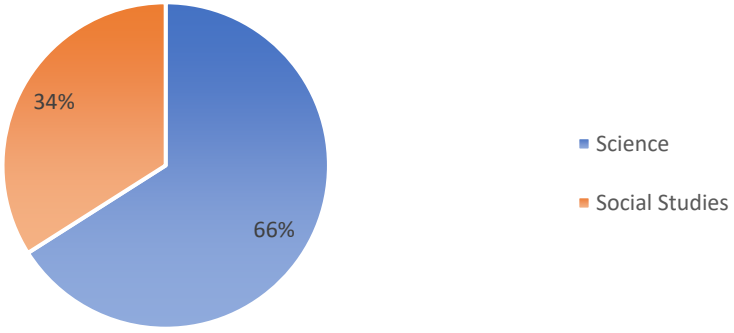


**Figure 9.** Subjects in which water topics are taught in primary schools.

In order to identify the opportunities existing in the Ugandan curricula regarding water education, a study was conducted on the Uganda school resources [87,88] to explore the water topics addressed in the curriculum, classes and subjects in which the topics occur. The National Curriculum Development Centre is an independent legal organisation under the Ministry of Education and Sports in charge of developing the education curricula for

Pre-primary, Primary, Secondary and Tertiary institutions in Uganda [88]. The organisation carries out a curriculum reform after revising the existing syllabuses, it tests and evaluates the reform, and then it updates and improves the syllabuses for schools and colleges courses. Water education topics should be part of the education curriculum in every country [30]. Therefore, one of the objectives of this study required the identification of the water education activities currently present in the Ugandan Curriculum. The water topics which are presented in the Ugandan curriculum are summarised in Appendix C for the Primary Curriculum and Appendix D for the Secondary Curriculum.

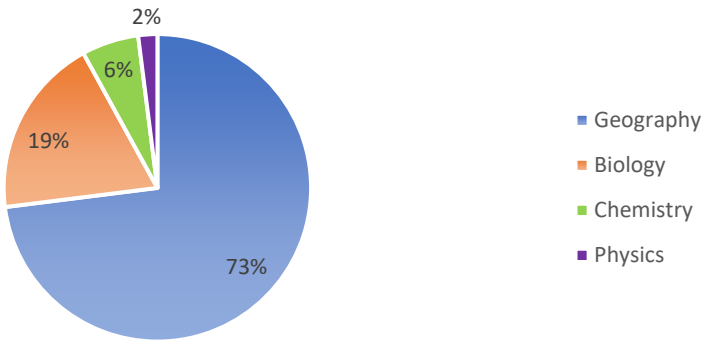


**Figure 10.** Subjects in which water topics are mainly taught in secondary schools.

An academic year for primary and secondary education in Uganda is made up of three terms. Term I runs from January to April, Term II runs from May to August, and Term III runs from September to December [89]. In primary schools, water-related topics appeared more in Term I (44.4 per cent) and Term III (44.4 per cent) compared to Term II (11.1 per cent). In Primary Three and Four, water-related topics are only taught during Term I. In Primary Five, they are only taught in Term I and Term III; in Primary Six, they are only taught in Term III; and in Primary Seven, the topics only appear in Terms II and III. According to Rosenshine [90], material that is not sufficiently practised and reviewed can easily be forgotten by an individual. Students happen to forget 80 per cent of what they have learnt within the first 24 h [91]. Therefore, students could easily forget about what they have learnt about water if they complete a full academic term without having a lesson about it.

In the secondary school curriculum, Geography has the highest occurrence (44.4 per cent) of water-related topics compared to other subjects. The time assigned to teach Geography is three periods per week, and each period is 40 min [92]. The secondary curriculum has the highest occurrence of water topics in the Geography curricula, and topics are mainly taught in Terms II and III. Students learn about the water cycle in Physics Senior I Term II and the process of water and sewage treatment in Chemistry Senior I Term X.

Water-related topics are mainly taught in Term III (39 per cent), whereby 43 per cent is taught in Geography, 29 per cent in Biology, 14 per cent in Chemistry and 14 per cent in Physics. Only 33 per cent of the water-related topics are taught in Term I and 27 per cent in Term II. This shows the imbalance of the topics within the three terms, which may lead students to forget what they might have learned.

The Sustainable Development Goals (SDGs) are one international framework currently engaged with many of the social, economic and environmental issues around water. The SDGs are a collection of 17 interlinked goals (Appendix E), which were developed by the United Nations in 2015 with the purpose of ending poverty, and protecting the earth's resources to ensure that people attain peace and prosperity by 2030 [93]. According to Hindin [94], traditional education contributes few opportunities for students to understand and solve real-world problems. Therefore, it is vital to emphasise that the SDGs (Appendix E) are closely aligned with the national curriculum. In addition, the 17 SDGs can be used as a structure for increasing and deepening the topic's engagement with world

issues [95]. For example, science and geography teachings can be deepened by discussing how climate change has affected water resources [94].

The water-related topics taught in primary and secondary schools in cover content that is aligned with the SDGs. SDG 6 (Clean Water and Sanitation) is more aligned with the primary curriculum (58.3 per cent) and secondary curriculum (54.5 per cent) compared to any other SDG. Primary Six has more lessons (39.1 per cent) in the Science subject aligned with SDG 6. Lessons such as water conservation and water demand are missing in the early stages of learning, whereby they only appear in classes starting from Primary Five to Primary Seven. This leaves students in Primary Three knowing what water is used for but having limited knowledge of how it should be managed when using it. Therefore, in order to fill this gap, water conservation lessons should also be introduced in classes in Primary Three. This could potentially facilitate the inclusion of content relating to other relevant SDGs in the curriculum (e.g. SDG 14: Life Below Water).

### *3.7. Approaches Used to Teach Water Activities in Schools*

The data collected from the teachers in Ugandan schools indicates that theoretical teaching is the method that is primarily used when delivering lessons to the students at school. Of the teachers we surveyed, 45 per cent of the teachers use theoretical teaching, 37 per cent use fieldwork, and 18 per cent use practical teaching when teaching water activities in schools. The data collected from the teachers revealed that at all levels of primary and secondary school education in Uganda, theoretical teaching is mainly used compared to other methods of teaching, as shown in Figures 11 and 12. Uganda's education system is characterised by excessive theoretical teaching and less practical teaching [96,97]. Theoretical teaching provides students with conceptual information on a subject through structured texts and written materials. For the students, however, this information can easily be forgotten, especially when delivered through traditional teaching practices which restrict critical thinking. Students' participation in practical activities is very important. Practical education offers hands-on learning experience and reduces the dependence placed on textbook and lecture-style delivery [98]. Subsequently, this enables students to actively engage with the subject matter, making the learning process more fun, memorable and effective. In one study [99], the research acknowledges the benefits of this approach to learning, suggesting that students are more, likely to master a topic when they are active participants in the implementation of it. The integration of water-related topics in practical teaching can enable students to increase awareness of managing water resources. Practical teaching centred on the environment can play a significant role in influencing students' behaviour towards the environment [100]. Students who actively participate in activities which are centred on water themes tend to practice the skills they have acquired within their own homes and communities. Furthermore, such methods for learning can be adapted in instances where language or education may be a barrier to more traditional learning.

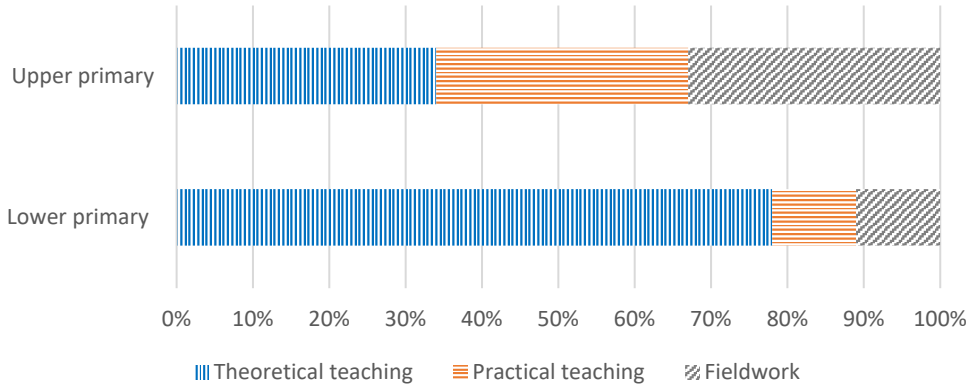


**Figure 11.** Methods used to teach students water activities at the primary level.

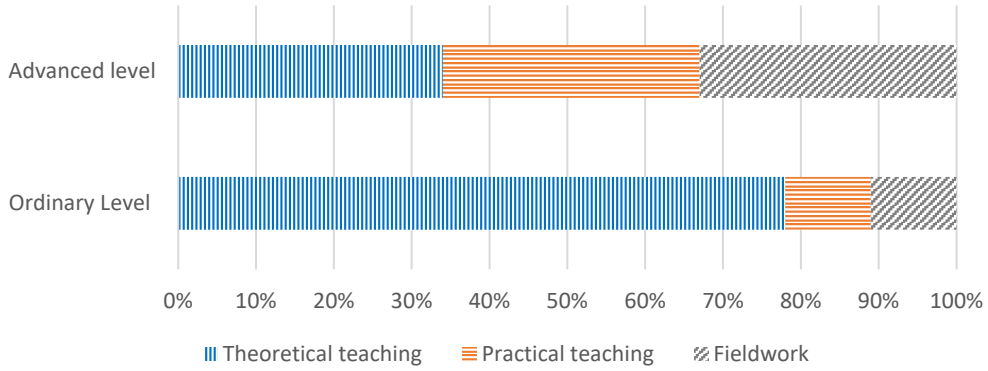


**Figure 12.** Methods used to teach students water activities at the secondary level.

### *3.8. Training of Teachers*

According to the data collected from the teachers, 88 per cent of the teachers obtained their teaching training from teaching institutes, though 12 per cent of them did not go to any teaching institute. The most persistent issue faced by the education sector in Uganda is a shortage of qualified teachers [101]. According to a report by UNESCO [102], 86 per cent of the unqualified teachers work in private schools, whereby 35 per cent are teaching in primary schools and 16 per cent in secondary schools. Uganda has approximately 400 private schools, more than double the number of publicly funded schools [103]. Subsequently, this means that the majority of Ugandan students are likely to be taught by unqualified teachers. Therefore, there is a need to increase the number of qualified teachers in schools, mainly in private schools [102].

The data collected also revealed that in some teacher training institutes, Environmental Education was not a mandatory program, as shown in Figure 13.

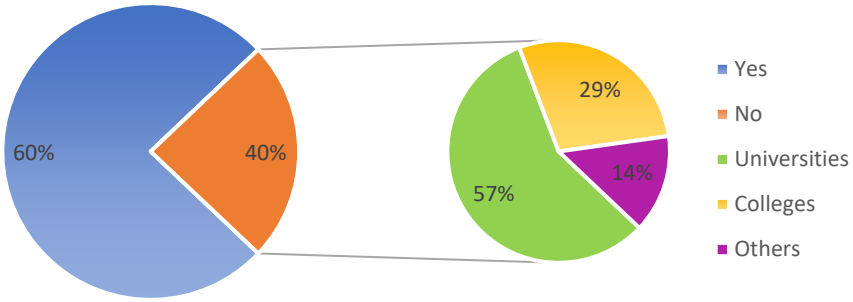


**Figure 13.** Percentage of teachers who are trained in the teaching institutes.

Environmental Education (EE) is a method that enables people to discover environmental issues, engage in solving the problem and take action to improve the environment [104]. Teachers' lack of confidence and knowledge on the topic through not enough background training and information has been found to be the main reason for not providing EE in Ugandan schools [105]. For example, a participant reported that: 'We need training as teachers to equip us with basic skills of water management'.

As an outcome, a deeper understanding of issues concerning the environment can be developed by an individual who has the ability to make responsible and informed decisions [105]. Teachers play an important role in influencing and encouraging student interest in environmental issues. A study conducted by [106] showed that EE should be a compulsory program in all pre-service teacher education. In addition, environmental-related programmes should also be compulsory for university students from different academic fields [107]. Emphasis should be placed on EE in both formal and informal systems of education in order to protect and conserve the environment [108].

## 4. Suggestions

Based on the research findings, the following recommendations are offered.

Water-related topics should be taught in all three academic terms of each class. Based on the data collected from the teachers' teaching materials, water-related topics are absent in some of the school terms, as shown in Appendices C and D. This gives room for students to forget about what they had studied in the previous terms. It is important to continuously teach water-related topics in all three academic terms of each class level. This can provide students with the opportunity to review and practice what they have previously studied, helping them to develop new knowledge and the ability to recall past learning. When students are repeatedly taught water-related topics, it becomes conducive to successful learning, and the lessons appear to be even more effective when they are spread over time [109]. The practice of quizzing and discussing the relevant material on a regular basis can help with the retention of the studied materials in the students' memory [110]. For example, a study carried out by the US Department of Education, [111], showed that students who repeatedly participated in quizzes were more likely to remember the materials they studied.

Practical teaching should arguably be integrated into water-related topics starting from the early years of primary schools upwards. China, for example, has a water conservation educational program which includes practical teaching activities, such as storytelling and picture matching. These were developed with the aim of cultivating children's action competence in conserving water [112]. Therefore, curriculums about water-related topics in Uganda should integrate activities such as designing posters, hands-on work and debating competitions among school students. The activities are expected to improve the active involvement of students in the learning process, enabling them to be aware of various water issues and understand the significance of managing and protecting water [113,114]. In addition, these activities aligned with water topics can also be organised in Ugandan schools on occasions of celebrating environmental events, such as World Environment Day [115] and World Water Day [116]. This enables students to get 'hands-on' experience within their studies, whereby they can easily practice it and pass on the knowledge within their communities.

EE needs to become a mandatory program within all the teachers' training institutes in Uganda. Although in the highest percentage of teachers' training institutes, EE is a mandatory program, there are still some institutes, as shown in Figure 13, where EE programmes are not compulsory. EE needs to be structurally developed at the beginning of teachers' training programmes and curricula rather than being an infrequent item. A teacher without knowledge and a desired awareness concerning the environment may not feel able to include Environmental Education as part of their lessons. Therefore, the teachers need to be trained well enough such that they can teach the subject effectively in schools, for which pre-existing models exist elsewhere. The pre-service teacher education for primary school teachers in India is a two-year program for example, and the teaching of EE is placed under both Science and Social studies syllabuses developed by the National Council for Educational Research and Training [107]. In addition, EE can be introduced in teachers' training by experts on environmental problems through seminars and workshops [105].

## 5. Conclusions

Education can play a significant role in training students on how to use water at home, as well as for their daily duties, hence improving water usage for the domestic sector. The use of water at home has had the effect of increasing the amount of water withdrawn from the freshwater resources. This has affected the availability of water resources in Uganda. Strategies, such as water recycling, the increase of water charges and the implementation of laws for the protection of water resources have been put in place by the Ugandan government to manage the usage of water. Technical and regulatory measures alone could not be effective for improving water usage and management. Therefore, education can

contribute to long-term changes in positive attitudes, knowledge and behaviours around water resource concerns in Uganda.

In order to identify the water-related activities that exist in the Ugandan education curriculum, a study was conducted in four schools in Uganda, and data was collected using three questionnaires for primary and secondary students and teachers. The data collected from the students and teachers were analysed, and the following were the key outcomes:

- Water-related topics in both the primary and secondary curriculums are absent in some of the academic terms.
- Theoretical teaching is the primary method used when teaching water-related topics, especially in the primary curriculum.
- EE programs are not mandatory in all teachers' training institutes.

Therefore, the study recommends that water-related topics such as increasing water-use efficiency (SDG 6 target) and reducing water pollution and contamination (SDG 3 target) should be taught throughout the three terms of the academic year in each class. Repetition has been found to facilitate students' memory, knowledge and understanding of the material. The adoption of a practical teaching approach aimed at lower primary classes arguably could be applied to other school year groups and even within adult education programs. Practical teaching and learning approaches, particularly with more interactive techniques, have been recognised as more effective for students [98]. The barriers, however, to integrating these approaches, albeit in circumstances where there may be mixed age sets and abilities, are both a lack of funding/resources and teachers' knowledge and confidence in the subject. Limited training within the field of EE could be responsible for a heavy focus [107] on the syllabus and associated textbook material. Improvements to this could allow staff to expand discussions/class exercises beyond this core material. Making EE compulsory in all teacher' training institutes will subsequently assist teachers with gaining knowledge about EE and offer experience on how to influence students' interest regarding environmental issues. Moreover, ensuring that this EE training is contextually specific to both the teachers and students is vital for ease of understanding and for fueling an emotional attachment to the issue [117].

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## Appendix A

**Table A1.** Demographics of students.

| Demographics | | Frequency | Percentage |
|---|---|---|---|
| **Gender** | Male | 146 | 44.79% |
| | Female | 180 | 55.21% |
| **Age** | 8–9 | 20 | 6.14% |
| | 10–11 | 54 | 16.56% |
| | 12–13 | 60 | 18.41% |
| | 14–15 | 85 | 26.07% |
| | 16–17 | 76 | 23.31% |
| | 18–19 | 25 | 7.67% |
| | 20+ | 6 | 1.84% |
| **Grades** | Primary Three | 19 | 5.82% |
| | Primary Four | 16 | 4.91% |
| | Primary Five | 42 | 12.88% |
| | Primary Six | 12 | 3.68% |
| | Primary Seven | 45 | 13.80% |
| | Senior One | 25 | 7.67% |
| | Senior Two | 69 | 21.17% |
| | Senior Four | 75 | 23.01% |
| | Senior Six | 23 | 7.06% |
| **Area of residence** | Urban areas | 236 | 72.39% |
| | Rural areas | 90 | 27.61% |
| **Number of family members** | 1–2 | 15 | 7.81% |
| | 3–4 | 55 | 28.65% |
| | 5–6 | 64 | 33.33% |
| | 7–8 | 31 | 16.15% |
| | 9-above | 27 | 14.06% |
| **Access to water used at home** | Tap | 293 | 83.71% |
| | Boreholes | 15 | 4.29% |
| | Protected springs | 36 | 10.29% |
| | Others | 6 | 1.71% |

## Appendix B

**Table A2.** Demographics of teachers.

| Demographics | | Frequency | Percentage |
|---|---|---|---|
| **Gender** | Male | 23 | 56.10% |
| | Female | 18 | 43.90% |
| **Age** | 18–24 | 6 | 14.63% |
| | 25–34 | 23 | 56.10% |
| | 35–44 | 6 | 14.63% |
| | 45–54 | 5 | 12.20% |
| | 55–64 | 1 | 2.44% |
| **Level of education teachers teach** | Primary level | 18 | 45.00% |
| | Secondary level | 22 | 55.00% |
| **Level of classes teachers teach in primary schools** | Lower primary classes | 9 | 50.00% |
| | Upper primary classes | 9 | 50.00% |

**Table A2.** *Cont.*

| Demographics | | Frequency | Percentage |
|---|---|---|---|
| **Level of classes teachers teach in secondary schools** | Lower secondary classes | 10 | 45.45% |
| | Upper secondary classes | 12 | 54.55% |
| **Attended teaching training institute** | Yes | 36 | 87.81% |
| | No | 5 | 12.19% |

## Appendix C

**Table A3.** Water-related teaching that currently exists in the primary curriculum.

| Class | Subjects | Topic | Content | Terms | SDGs |
|---|---|---|---|---|---|
| **Primary Three** | Science | - Environment | - Water cycle | Term I | 13 |
| | | - Water | - Uses of water<br>- Uses of water bodies<br>- Harvesting water<br>- Dangers of water | | 06<br>06<br>06<br>06 |
| | Social Studies | - Our Division | - Importance of lakes and rivers | | 06 |
| **Primary Four** | Science | - Our Environment | - Water cycle | Term I | 13 |
| | | - Human Health | - Personal Hygiene | | 06 |
| | Social Studies | - Living Together | - Piped water | | 09 |
| | | - Physical features in our district | - Ways of protecting the environment (avoid water pollution) | | 08 |
| | | - Weather | - Uses of rainfall<br>- Convectional rainfall is received around water bodies | | 13<br>13 |
| **Primary Five** | Science | - Water and Energy | - Objects sinking in water and floating on water | Term I | 12 |
| | | - Managing Changes in the Environment | - Experimenting with physical changes in water | | 09 |
| | | - Primary Health Care | - Protecting water sources | | 06 |
| | Social Studies | - Natural Resources in Uganda | - Examples of water bodies<br>- Uses of water bodies<br>- How can water bodies be misused<br>- How can water bodies be conserved | Term III | 06<br>06<br>06<br>06 |
| **Primary Six** | Science | - Science at home and in our community | - Source of water<br>- Categories of water<br>- Types of water<br>- Properties of water<br>- Preparation of drinking water<br>- Uses of water<br>- Methods of making safe water | Term III | 06<br>06<br>06<br>06<br>06<br>06<br>06 |
| | | - Human Health | - Shortage of water supply<br>- Uses of water to the body | | 06<br>06 |
| | Social Studies | - Resources in East Africa | - Water resources in East Africa | | 06 |

**Table A3.** *Cont.*

| Class | Subjects | Topic | Content | Terms | SDGs |
|---|---|---|---|---|---|
| **Primary Seven** | Science | - Environment | - Water as an energy | Term II | 07 |
| | | | - Water resources<br>- Water conservation | Term III | 06<br>06 |
| | Social Studies | - Africa as a continent | - Water bodies surrounding Africa | Term I | 06 |
| | | - Drainage system of Africa | - Rivers<br>- Lakes | | 06<br>06 |
| | | - Economic Development in Africa | - Importance of water bodies as economic resources in Africa | Term III | 08 |

## Appendix D

**Table A4.** Water-related teaching that currently exists in the secondary curriculum.

| Class | Subject | Topics | Content | Terms | SDGs |
|---|---|---|---|---|---|
| **Senior One** | Geography | - Physical features in the area around the school | - Lake and Rivers | Term I | 06 |
| | | - Weather and Climate | - Precipitation<br>- Humidity | Term II | 13<br>13 |
| | | - Formation of major landforms and drainage in East Africa | - Drainage<br>- Glaciers | Term III | 09<br>13 |
| | Physics | - Measurements in Physics | - Water density<br>- Volume of Water | Term I | 06<br>06 |
| | | - State of matter | - Rain and water cycle | Term II | 13 |
| | Chemistry | - Water | - Recycling of water by natural process<br>- Process of water and sewage treatment<br>- Role of water when extracting minerals | Term III | 12<br>06<br>11 |
| **Senior Two** | Geography | - Physical features of East Africa | - Lake Victoria, River Nile | Term II | 06 |
| | Chemistry | - Carbon in the Environment | - Origin of hard water | | 06 |
| | Biology | - Physical and chemical properties of soil | - Percentage of water in soil samples, importance of water in soil | Term I | 06 |

**Table A4.** *Cont.*

| Class | Subject | Topics | Content | Terms | SDGs |
|---|---|---|---|---|---|
| **Senior Three** | Geography | - Transport, communication, and trade in East Africa | - Water Transport | Term I | 11 |
| | | - Climate in East Africa | - Distance from the sea | Term II | 14 |
| | | - Irrigation farming in East Africa | - Source of water for irrigation | Term III | 06 |
| | Physics | - Heat quantities and vapours | - Heat capacity of water | Term III | 06 |
| | Chemistry | - Carbon in life | - Compound of water | Term I | |
| | Biology | - Growth in Plants and Animals | - Water is necessary for germination | Term III | 15 |
| **Senior Four** | Geography | - Development of urban centres in Africa | - Water supply<br>- Water demand | Term III | 06<br>06 |
| | Physics | - Swimming Techniques | - Apply the basic water movements while in water<br>- Observe safety while in water | Term I | 14<br>14 |
| | Chemistry | - Energy changes during chemical reaction | - Reaction of elements with water<br>- Dissolving substances in water | Term II | 06<br>06 |
| | Biology | - Humans and the natural environment | - Water pollution | Term III | 06 |

## Appendix E


**Figure A1.** 17 Sustainable Development Goals.

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