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Kennedy Files Date

Implementation of School-Based WASH Education Programs and their Association with Elementary Student Knowledge, Health, and Attendance

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Implementation of School-Based WASH Education Programs and their Association with Elementary Student Knowledge, Health, and Attendance

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B.S.
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2020

Thesis Committee Chair: Dana Boyd Barr, PhD

An abstract of
a thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
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Abstract

Implementation of School-Based WASH Education Programs and their Association with Elementary Student Knowledge, Health, and Attendance.
By Kennedy Files

WASH education programs can provide students with valuable information on proper WASH techniques and practices. This can influence their behavior and health, as they may choose to use what they have learned in their daily WASH practices. There are a variety of factors that can play a part in how knowledge from the education program is adopted and utilized by students, such as availability of resources, and engaging education lessons. In this thesis, I will be analyzing existing WASH education programs conducted by large and small public health and non-profit organizations. I will also be examining existing literature. The research goal of this thesis is to determine if and how the implementation of school-based WASH education programs can be successful, and how they can influence elementary students' health, knowledge, and attendance. I will also be performing data analysis to create a baseline percentage of existing student WASH knowledge, using pre-program survey data from the Kaleidoscope Child Foundation WASH program.

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Introduction

Experiencing a lack of water, sanitation, and hygiene (WASH) can significantly affect the health of communities in low-and middle-income countries (LMIC). Improvements in WASH infrastructure are considered "key public health measures" in a variety of areas around the world (Black and Walker, 2020). One important group that is affected by inadequate WASH is school children. In schools with inadequate WASH, there can be an increased spread of WASH-related diseases like diarrhea. Diarrhea is a big issue because, in unsanitary conditions, the microbes can thrive because they "rely on fecal-oral transmission from infected to susceptible individuals" (Black and Walker, 2020). By improving sanitation conditions, there is a large potential to "reduce the risk of diarrheal disease" because there would be less fecal-oral transmission occurring (Wolf, et al. 2018). Inadequate WASH in schools can also affect menstrual hygiene in female students. Not having a private and clean area to clean and dispose of menstrual products can cause female students to be absent from school due to a "lack of disposal system, broken lock/doors of toilets, lack of water tap, bucket, and poor water supply" (Kaur, et al. 2018). Improving WASH infrastructure in schools can improve "child health, educational outcomes, and improved teacher satisfaction" (Cronk, R, et al. 2020).

Educating students on WASH techniques is important so they can learn how to keep themselves and their families healthy. Various WASH (education and/or infrastructure) programs in LMIC schools have been implemented by multiple public health and non-profits. However, there is a gap in the existing literature about WASH education programs in general, specifically programs that have taken place in Bihar, India. Kaleidoscope Child Foundation (KCF) is a non-profit organization with which I interned this past summer. I helped finalize a WASH education program for the school they built in Lakhanpur, a village in Bihar, India. This

location was chosen because Bihar has the “third highest rate of death from diarrhea in India” and many students in this state are unaware of WASH topics (Kaleidoscope Child Foundation (KCF), 2022.). It’s important to add that this school has mostly middle school aged students (ranging from 11 - 16 years old), and that there is access to clean toilets, handwashing stations with soap and clean water in this school. KCF built the school with these amenities so students could get access to clean water and sanitation units while in school as soon as the school opened. It was less for the non-profit to worry about if they had the amenities ready from the start. This project started in January 2023. It’s aims are to increase WASH awareness by having weekly lessons teaching students and parents about WASH-related techniques, menstrual hygiene, female empowerment, and how to improve sanitation practices.

My main research question is to find out if WASH education programs are effective at teaching students, and if this new knowledge can improve health and increase student attendance, through disease prevention. I’m also interested in the types of topics that are common between different programs, and types of WASH programs conducted in existing literature. I will also be looking at how to develop strategies based off successfully completed WASH education programs, to improve the retention and execution of what students have learned. By looking at existing WASH resources, conducting literature reviews, and performing baseline survey analysis for the KCF program, I hope to learn more about WASH programs and answer my research question.

Methods

Existing WASH Education Programs in Organizations

To get an idea of existing WASH education programs, I did a Google Search to look at programs conducted by large public health organizations, smaller public health organizations,

and non-profits. I identified five WASH education programs from larger public health organizations. These programs were conducted by the Center for Disease Control and Prevention (CDC), United Nations International Children's Emergency Fund (UNICEF), United States Agency for International Development (USAID), World Health Organization (WHO), and a joint UNICEF/WHO program. I also found five WASH education programs from smaller public health and/or non-profit organizations. They were: Clean the World Foundation, PAC Nepal, Pencils of Promise, Project Wet and WASH United.

I analyzed each program from the information available via the program and the organization's websites. Then I created two tables that focus on the types of topics that were covered, and the key points and data collected from each program. One table was for the large public health WASH programs and the other was for the smaller public health and non-profit WASH programs. I also took the types of topics covered and compared them to topics in the KCF WASH education program, in their own table. I did this to see if there were any overlapping topics between the programs.

Literature Review

I conducted a literature review in October-December 2022, to gain more insight into WASH education programs by other entities (like non-profits and teams of researchers). I used three different databases for my initial search: PubMed, Science Direct, and Google Scholar. I used a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline to help me focus on relevant articles. A PRISMA guideline “focuses on reporting of reviews evaluating the effects of interventions”, to help find relevant articles (PRISMA, 2023). I used an inclusion criterion to make sure I was looking at only peer-reviewed articles, and that they were published in the past five years (2017-2022). I also used the following keywords to

help refine the results; WASH, water, hygiene, hand wash, sanitation, health, child, education, primary school, school, attendance, low income, developing country, India, and South Asia. I chose to try and find studies that were done in India or South Asia, as the KCF program is being done in Bihar, India. I did this because I thought it would be easier to analyze certain contexts and ideas covered if studies were taken place in similar areas, so there wouldn't be as much variation between studies.

With the 41 articles, I read each one and created a table that highlighted the types of topics each paper covered, and key points/statistics. I also categorized each article on the main themes they cover. The categories I created are WASH SDG ideas/current policies, menstruation, school WASH program, community-based WASH program, behavior and adoption of WASH program theory, student health and attendance, and effectiveness of WASH programs/impacts. I chose to look at some papers that had menstruation lessons as a part of the WASH program, because that is similar to the KCF program as they have a menstruation lesson towards the end of the program. I also looked at the WASH SDG ideas/current policies papers to get an idea of current rules and policies on improving WASH in schools and the community, either through education and/or construction of handwashing stations, tippy taps, and toilets.

Using the information from the existing organization analysis and sources from the literature review, I determined two topics that could be added to the KCF WASH program in future years. I also looked at the literature and some papers about teaching strategies to make two suggestions on how students who complete the program can retain what they have learned. I will be giving this information to my contact at KCF so they will be able to use it if they choose to. I also think this step helps me really learn to recognize how the literature review programs were

and were not successful, and how they can be improved for future years. The completed literature review table can be found in the results section of this paper.

KCF Student Pre-Program Survey Analysis

I received the pre-program surveys at the end of January of 2023. There were 25 students who completed the pre-program survey. Each student was given the same survey, which had the same 38 questions. survey had the same questions, and each student was given the same survey. The first 18 questions asked students about their current WASH habits, and how important they think certain habits are (eg washing their hands before eating). The last 20 questions were a mixture of single choice, multiple choice, and true and false questions about WASH topics that will be covered in the education program (eg how to purify water). There were no questions that addressed the topic of menstruation or disposal methods, but that will be the main topic of one of the last lessons in the KCF education program.

I decided to use pre-program data to create a baseline of student knowledge. KCF can use this data at the end of the program when they have post-surveys to see if students' knowledge increased or not. While the KCF program has separate surveys and information for parents of the students at the school, I will be focusing on just the student surveys - as this translates closer to the other existing WASH programs. Using Excel and SAS programs, I evaluated the students' results to the pre-program survey questions. I looked at the number of students who answered each survey question correctly. I also looked at the number of students who answered each option of muti-choice questions. A few questions from the pre-program survey are shown below.

17. How often do you or someone in your household treat your water in any way to make it safe?

1. Always
2. Often
3. Sometimes
4. Sometimes
5. Never

18. If you treat water, what do you usually do to make the water safe?

a. Boil the water
b. Adding bleach/chlorine
c. Sun disinfection
d. Sift through
e. Allow water to stagnate and impurities to settle to the bottom
f. Don't know
g. Others

Figure 1: Pre-survey questions example

Results

Existing WASH Education Programs - Large Public Health Organizations

CDC's Global WASH Program is a community-based WASH program. It takes place in LMICs in Latin America, the Caribbean and Africa. This program covers topics like water treatment, improving existing latrines and water sources, investigating causes of illness from WASH-related diseases, and developing models and materials for public health staff. The WASH program found that there is inadequate hand hygiene access and behavioral adherence across LMIC contexts and settings. There is also a need to improve personal and community capacity to follow guidelines for COVID-19 mitigation.

UNICEF's Country Program in India goals were to prevent malnutrition and preventable diseases (like diarrhea and waterborne diseases) by improving education in schools. It covers WASH topics like supporting planning and implementation, incorporating behavior change into state and national guidelines, and creating costed plans for district-wide WASH interventions. This program reinforced in schools that the risk of spreading diarrhea and waterborne disease can get stopped by handwashing with soap and having clean water available. While reviewing schools where program took place, "22% did not have appropriate toilets for girls, 58% of preschools had no toilet at all, and 56% had no water on the school premise" (UNICEF, 2022).

USAID's Partnership for WASH (India) program goals were to improve water and waste management quality and increase health awareness. USDAID partners with the Government of India (GoI) for this program. This is a community-based WASH program and works in slum communities in 15 different cities. In 2020, USDAID helped more than 178,000 people get access to safe drinking water, and 573,000 people get access to basic sanitation services. This program also works on creating pins in Google Maps to map public toilets in the cities. Currently more than 60,000 public toilets have been mapped in over 2,900 cities.

WHO's WASH work in India program covers many topics, with its main goal to promote health and wellness through WASH programs and working with leadership teams in healthcare settings. This is a community-based program. WHO partners with the Ministry of Health and Family Welfare (MoHFW), which is a part of the GoI. While many topics are covered in the program, the WHO hopes to expand its project so they can collaborate with a larger number of government sectors and companies in India, as well as globally. This project continues to be monitored by the MoHFW, and any future expansion ideas will need to go through them first.

WHO and UNICEF's Joint Monitoring Program (JMP) for WASH expanded to cover WASH in schools in August 2018. Their main goals are WASH education and monitoring basic drinking water and sanitation services in pre-primary, primary and secondary schools. They also check in with school periodically to make sure the services are still working well and if they have been used by students and/or facility. In 2021, this program found that nearly 546 million children lacked basic drinking water in school. More information on topics covered and key data from the programs can be seen in Table 1 below.

Table 1: Existing WASH programs from large public health organizations

Organization	Program name	Topics covered	Data collected/Key points
CDC	Global Water, Sanitation and Hygiene (WASH) Program	• Water treatment (boiling, chlorination, solar disinfection, and slow sand filtration). • Improving existing latrines and water sources and creating new ones if needed. • Identifying WASH-related factors needed to control or eliminate Neglected Tropical Diseases (NTDs). • Investigating the causes of illness, to provide critical health data for decision-making. • Developing model programs and materials for public health staff training.	• This program looks at WASH interventions in low-and middle-income countries in Latin America and the Caribbean and Africa, focusing on healthcare, community institution, household settings, and hand hygiene. • Adapted common WASH tools for COVID-19 mitigation via rapid, mixed-methods assessments and adapted WASH guidance for settings without existing WASH standards. • We found inadequate hand hygiene access and behavioral adherence across LMIC contexts and settings, and a need to improve personal and community capacity to follow guidelines for COVID-19 mitigation.
UNICEF	Country Program in India	• Goals are to prevent malnutrition and preventable diseases, reduce neonatal mortality, and improve education outcomes. • Supporting planning and implementation, incorporating behavior change into state and national guidelines, and creating costed plans for district-wide WASH interventions.	• The number of people defecating in the open in India has reduced significantly by an estimated 450 million people. • The risk of spreading diarrhea and other waterborne diseases gets compounded by the lack of regular handwashing and microbial contamination of water in their homes and communities. • In India's schools, reports show that 22% did not have appropriate toilets for girls, 58% of preschools had no toilet at all, and 56% of preschools had no water on the premises.
USAID	Partnership for WASH (India)	• Partners with the Government of India (GoI) to improve safe water services. • Leveraging the private sector to solve urban India's water supply challenges. • Working with slum communities in 15 cities to improve waste management, increase health awareness, and improve the delivery of water and sanitation facilities among the underserved.	• In collaboration with the Government of India's flagship programs, USAID has helped more than 178,000 people gain access to safe drinking water in 2020. • More than 573,000 people gained access to a basic sanitation service in 2020. • USAID partnered with the Government of India and Google to map public toilets on Google Maps. • To date, more than 60,000 public toilets have been mapped in over 2,900 cities.
WHO	WASH work in India	Accelerate progress on UHC. • Implementing Ayushman Bharat: Health and Wellness Centers. • Monitoring and evaluation of health sector performance. • Improving access to priority health services such as immunizations,	• The WHO India Country Cooperation Strategy 2019–2023: A Time of Transition' has been jointly developed by the Ministry of Health and Family Welfare (MoHFW) of the Government of India (GoI) and the WHO Country Office for India. • The Country Cooperation Strategy (CCS),

		maternal and child health, tuberculosis, and hepatitis Promote health and wellness by addressing determinants of health. ● Noncommunicable diseases (NCDs) action plan roll-out ● Environmental health ● Mental health promotion ● Suicide prevention ● Nutrition and food safety ● Road safety ● Tobacco control Better protect the population against health emergencies. ● Roll-out of the integrated disease surveillance program. ● Preparedness and response to emergencies). Enhance leadership in health. ● Improving access to medical products ● Development and information sharing of innovations in health practices.	provides a strategic roadmap for WHO to work with the GoI towards achieving its health sector goals, improving the health of its population, and bringing in transformative changes in the health sector. ● This CCS not only builds upon the work that WHO has been supporting in the last several years, but also expands to address complex challenges, such as the prevention of NCDs, the control of antimicrobial resistance (AMR), the reduction of air pollution, and the prevention and treatment of mental illnesses. ● WHO will further expand its collaboration with a broader set of government sectors and other stakeholders beyond health, under the overall guidance of the MoHFW,
WHO and UNICEF	WHO and UNICEF Joint Monitoring Program (JMP) for Water Supply, Sanitation and Hygiene (WASH) in schools	● Tracking 'basic' drinking water, sanitation and hygiene services in pre-primary, primary and secondary schools. ● Produces estimates for a total of nine primary indicators related to drinking water, sanitation, and hygiene in schools. ● Tracking these services in schools to see if any improvements are made. ● All indicator estimates are produced at the country, regional, and global levels. ● All estimates are expressed as the proportion of schools with a type of drinking water, sanitation, and hygiene technology or level of service.	● WHO/UNICEF Joint Monitoring Program (JMP) for Water Supply, Sanitation and Hygiene expanded its global databases to include WASH in schools in August 2018. ● In 2021, nearly 546 million children worldwide (29%) lacked basic drinking water service at their school, and among them over 288 million children (15%) had no drinking water service at their school. ● Global coverage of basic drinking water services in schools increased by 0.25 percentage points per year from 2015 to 2021. ● Coverage of basic drinking water service was lower in primary schools (67%) compared to secondary schools (76%).

Existing WASH Education Programs - Smaller Public Health and Non-Profit Organizations

Clean the World Foundation's WASH in Schools program aims to educate students on a variety of WASH topics, such as correct handwashing. They partner with four schools to provide

handwashing stations and soap for students and stuff to use. They also do their education program at these schools. The goal is that students will be able to use what they have learned and will more frequently wash their hands. This can prevent them from getting sick from WASH-related diseases. Another goal is that students will share what they have learned from the program at home with their families, which will increase WASH awareness. So far, Clean the World Foundation has worked with 1,500 students and is hoping to expand to six more additional schools by the end of 2023.

PAC Nepal's WASH Public Awareness Campaign main goals are to increase student knowledge on different WASH topics. They also create student clubs and orientate the teachers and parents about WASH topics as well. Therefore, I think this program is a combination of student-based and community-based learning. So far, PAC Nepal has facilitated the construction of more than 45,000 toilets in 2 years. The organization also works with multiple donors and partners to broaden their reach to more schools and community and help expand their program topics.

Pencils of Promise's WASH program main goals are to educate students, teachers, and school administrators in Ghanian, Guatemalan, and Lao schools on health WASH behaviors. They will also hold workshops based on community needs and create student-led WASH clubs in schools to promote using healthy WASH behaviors. They will also monitor the use of WASH infrastructure, activities, and behaviors of students throughout the school year. This organization has worked with around 31,500 students in 169 schools. They have also built 1,796 bathrooms and 940 handwashing stations since the program started in 2009.

Project Wet's Healthy Water, Healthy Habits, Healthy People program is an online school-based education program. It covers WASH topics like preventing the spread of germs,

how germs spread, handwashing, how to purify water and how to find healthy water sources. This program was developed to educate students on WASH topics and to reduce the spread of waterborne preventable diseases in Africa. Project Wet worked with local partners and the USAID to develop the materials of the program. They also used these partners to add more context to the lessons to make it more relevant in the schools in Africa.

WASH United's MHM Education Program goals are to educate students on WASH topics, with a focus on female empowerment and menstruation hygiene. It is an online program that can be accessed for free via the Internet and is a combination of story-based education and activities to help guide in-person school lessons. Because it is available for free, it can be implemented in any part of the world that can access the program. This program has reached more than 2.5 million students in schools. More information on topics covered and key data from all the programs can be seen in Table 2 below.

Table 2: Existing WASH programs from smaller public health and non-profit organizations

Organization	Program name	Topics covered	Data collected/Key points
Clean the World Foundation	WASH in Schools	● Provides education to school-age children on hygiene and sanitation through proper handwashing. ● Students then share this with their families at home.	● Partner with four schools to provide handwashing stations, education, and soap. ● Have reached 1,500 students in the community and plan to enter six more schools by the end of 2023.
PAC Nepal	WASH: Public Awareness Campaign	● Promote safe drinking water, sanitation, and hygiene (WASH). ● Orientation to teachers, parents, and child clubs for total sanitation. ● Orientation to the community women to utilize the wastage of plastics, paper, plastic, and glass bottles.	● PAC Nepal has facilitated the construction of more than 45,000 toilets in a 2-year time span. ● Works in collaboration with multiple donors and partners, including SNV, DFID, Australian Aid, Department of Water Supply, and Sewerage Management (DWSSM).
Pencils of Promise	Water, Sanitation, and Hygiene (WASH) Program	● Provides WASH lessons to educate teachers and school administrators on healthy behaviors. ● Workshops based on community	● Long-term vision is that the holistic model will be fully adopted and incrementally scaled by Ghanaian, Guatemalan, and Lao education systems beyond their partnership

		needs and school knowledge. ● Student-led WASH clubs to enforce healthy behavior practices. ● Interventions are conducted throughout the school year to monitor the use of WASH infrastructure, activities, and behavior over time.	with Pencils of Promise. ● Have worked with 31,475 students in 169 schools. ● Have built 1,796 bathrooms and 940 handwashing stations and have installed 1,046 water filters in the schools since the programs start in 2009.
Project Wet	Healthy Water, Healthy Habits, Healthy People program	● Healthy habits (germs, preventing the spread of germs, disease information). ● Don't pass it along (how illness spreading germs spread between people, how healthy habits stop germ spread). ● Hand washing for health (how handwashing kills germs, types of soap, tippy taps). ● Healthy drinking water (water contamination, how to purify water). ● Finding healthy water sources.	● Developed as a part of a project with USAID to reduce the spread of preventable waterborne diseases in Africa. ● A series of WASH education materials, originally designed for countries in East Africa. ● Developed with local education, water, and health experts, the materials have since been adapted to other regions of the world and for more specific locations in Africa.
WASH United	MHM Education Program	● Story-based education guide and activities to facilitate school lessons on menstrual hygiene management (MHM). ● Development and creation of low-cost, scalable solutions for menstrual hygiene education for Sub-Saharan Africa and South Asia that can be accessed online for free.	● Reached more than 2.5 million girls and boys with MHM and WASH education programs in school.

Comparing Existing Programs to the KCF Program

Many of the existing programs had similarities in the topics and techniques they chose to use. Several were monitoring sanitation and hygiene services in the schools they were working with. Others worked with partners such as governmental agencies to expand the reach of their programs, and it incorporated behavior change into state and national guidelines. Some of the programs created student WASH clubs in schools to help reinforce behavior changes and WASH techniques taught by the education programs. There were also some organizations who had free

online resources as a part of their WASH programs. This makes it more accessible and low-cost for teachers to use these resources in their own classrooms.

Some topics in the existing WASH programs were also seen in the KCF program. Examples include WASH education topics like handwashing, purifying water, and how to prevent the spread of disease. There were also similarities in having community outreach, specifically through educating the parents of students and teachers at the school. There was also a menstruation hygiene management lesson that is like the one KCF will be doing. More information on topics covered in the programs can be seen in Table 3 below.

Table 3: Topics covered in existing WASH programs and the KCF program

Topics in KCF program	Topics in big public health programs	Topics in smaller public health/non-profit programs
Advanced Hygiene ● Effective and ineffective hygiene and body care practices. ● Importance of wearing clean clothes. ● Tippy taps in-class activity.	**CDC** ● Water treatment (boiling, chlorination, solar disinfection, and slow sand filtration). ● Improving existing latrines and water sources and creating new ones if needed. ● Identifying WASH-related factors needed to control or eliminate Neglected Tropical Diseases (NTDs). ● Investigating the causes of illness, to provide critical health data for decision-making. ● Developing model programs and materials for public health staff training. <u>Similarities to KCF</u> ● Water treatment ● Model programs/materials for training (KCF does teacher training before the WASH program starts).	**Clean the World Foundation** ● Provides education to school-age children on hygiene and sanitation through proper handwashing. ● Students then share this with their families at home. <u>Similarities to KCF</u> ● Education sessions in school on WASH topics.
Environmental Sanitation ● Places where mosquitoes breed around the home and and school. ● How to keep surroundings clean and healthy.	**UNICEF** ● Goals are to prevent malnutrition and preventable diseases and reduce neonatal mortality, and improve education outcomes. ● Supporting planning and implementation, incorporating behavior change into state and national guidelines, and creating costed plans for district-wide WASH interventions. <u>Similarities to KCF</u>	**PAC Nepal** ● Promote safe drinking water, sanitation, and hygiene (WASH). ● Orientation to teachers, parents, child clubs for total sanitation. ● Orientation to the community women to utilize the wastage of plastics, paper, and glass bottles. <u>Similarities to KCF</u>

	● Education session planning and implementation.	● WASH topics ● Orientations for teachers and students.
Illness Prevention ● Causes, prevention, symptoms, and treatment of diarrhea.	**USAID** ● Partners with the Government of India (GoI) to improve safe water services. ● Leveraging the private sector to solve urban India's water supply challenges. ● Working with slum communities in 15 cities to improve waste management, increase health awareness, and improve delivery of water and sanitation facilities among the underserved. <u>Similarities to KCF</u> ● Increase health awareness about safe water.	**Pencils of Promise** ● Provides WASH lessons to educate teachers and school administrators on healthy behaviors. ● Workshops based on community needs and school knowledge. ● Student-led WASH clubs to enforce healthy behavior practices. ● Interventions are conducted throughout the school year to monitor the use of WASH infrastructure, activities, and behavior over time. <u>Similarities to KCF</u> ● Education lessons to teachers on healthy WASH behaviors. ● These lessons are then taught to students by the teachers.
Menstrual Hygiene ● What is menstruation? ● Types of menstrual products and how to dispose of menstrual products.	**WHO** Accelerate progress on UHC. ● Implementing Ayushman Bharat: Health and Wellness Centers. ● Monitoring and evaluation of health sector performance. ● Improving access to priority health services such as immunizations, maternal and child health, tuberculosis, and hepatitis. Promote health and wellness by addressing determinants of health. ● Noncommunicable diseases (NCDs) action plan roll-out ● Environmental health ● Mental health promotion ● Suicide prevention ● Nutrition and food safety ● Road safety ● Tobacco control Better protect the population against health emergencies. ● Roll-out of the integrated disease surveillance program. ● Preparedness and response to emergencies. Enhance India's global leadership in health. ● Development and information sharing of innovations in health practices. <u>Similarities to KCF</u> ● Environmental health/food safety ● Information sharing of health practices	**Project Wet** ● Healthy habits (germs, preventing the spread of germs, disease information). ● Don't pass it along (how illness spreading germs spread between people, how healthy habits can stop germ from spreading). ● Hand washing for health (how handwashing kills germs, types of soap, tippy taps). ● Healthy drinking water (water contamination, how to purify water). ● Finding healthy water sources. <u>Similarities to KCF</u> ● Germs ● How germs spread ● Handwashing ● Tippy taps ● Water contamination ● Purifying water

	(WASH-related topics during the education sessions	
WASH Basics ● Germs. ● How, when, and why a person should wash their hands. ● Effective ways of cleaning and protecting the body ● Identify safe and unsafe sources of drinking water and food.	**WHO and UNICEF** ● Tracking 'basic' drinking water, sanitation and hygiene services in pre-primary, primary, and secondary schools. ● Produces estimates for a total of nine primary indicators related to drinking water, sanitation, and hygiene in schools. ● Tracking these services in schools to see if any improvements are made. ● All indicator estimates are produced at the country, regional, and global levels. ● All estimates are expressed as the proportion of schools with a type of drinking water, sanitation, and hygiene technology or level of service. <u>Similarities to KCF</u> ● Monitoring drinking water quality ● Teaching students about safe drinking water	**WASH United** ● Story-based education guide and activities to facilitate school lessons on menstrual hygiene management (MHM). ● Development and creation of low-cost, scalable solutions for menstrual hygiene education for Sub-Saharan Africa and South Asia that can be accessed online for free. <u>Similarities to KCF</u> ● Education on menstrual hygiene and female empowerment through an all-girls lesson.

Literature Review

From the database searches and using my PRISMA guidelines, I found 442 articles from PubMed, 364 articles from Science Direct, and 5,200 articles from Google Scholar, for a total of 6,006 articles. Using my PRISMA guidelines, I screened the 6,006 initial articles and removed any articles that were not relevant to WASH education programs after looking at the title and abstract. This left me with a total of 88 articles to go through. I then did a second screening, where I removed any duplicate and articles that were no longer available, not in English, or not accessible from PubMed, Science Direct or Google Scholar sites. This left me with the final 41 articles to read in depth and analyze. The selection and screening process is summarized below.

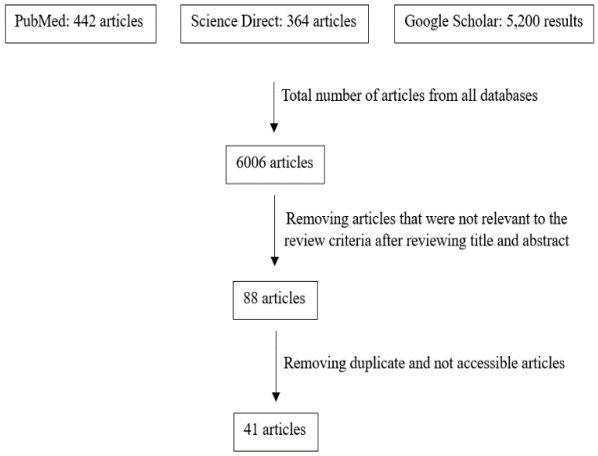


Figure 2: PRISMA guidelines for literature review

Of the 41 articles I screened, the papers could fall into multiple categories of key themes or ideas they addressed. There were 13 papers that were in the WASH SDG ideas/current policies category. There were 8 papers that were in the menstruation category. There were 32 papers that were in the school WASH program category. There were 19 papers that were in the community-based WASH program category. There were 22 papers that were in the behavior and adoption of WASH program theory category. There were 6 papers that were in the student health and attendance category.

I then looked at how many of the programs were effective. Of the 32 papers in the school WASH category, 12 (37.5%) were successful in improving student knowledge. Some common topics that were seen in the successful school WASH category were: having resources available (handwashing station, latrines) where students could practice what they learned. It also helped to have teachers who were enthusiastic about the WASH program, which helped the students to feel empowered. It was also helpful for students to be able to teach their family about what they had learned from the WASH program.

Of the 19 papers in the community WASH category, 7 (36.8%) were successful in improving community knowledge. Some common topics that were seen in the successful community WASH category were: creating and monitoring the use of community toilets, menstruation waste bins, and hand washing stations. Educating people on how to maintain

cleanliness of the facilities can help keep them clean. Teaching about keeping methods to keep the home clean is also important to prevent the spread of germs among family members.

Of the 22 papers in the behavior and theory category, 11 (50%) were successful at increasing students' behavior, and 9 (40.1%) were successful at increasing community behavior by using WASH practices and theories that they learned in the programs. Some common topics that were seen in the successful behavior and theory category were: creating student clubs to keep students accountable and enforcing handwashing in school bathrooms via communication methods like flyers. It's also important to educate people about the negative health impacts (like WASH-related diseases), as that can lead to more adoption of correct WASH techniques to prevent them from getting sick.

Finally, of the 6 papers in the student health and attendance category, 4 (66.6%) were successful at improving student health and attendance. Some common topics that were seen in the successful behavior and theory category were: promoting health activities towards students even after the program has finished and educating students on negative health impacts (like WASH-related diseases). Having accessibility of hand washing materials and facilities in school or at home can also improve health as it can help students to practice the WASH techniques they had learned from the program. The average success rate of the programs reviewed was 43% (43 successful / 100 total papers (this includes the menstruation and SDG papers even though none were successful)).

Table 4: Literature Review Table

Authors	Title	Category	Topics Covered	Key Points/Quotes
Al-Ansary, L, et al	Physical interventions to interrupt or reduce the spread of respiratory viruses.	School WASH program Community-based WASH program	• Hand hygiene • Disease transmission. • COVID-19	• The use of hand hygiene is an essential component of the WHO recommendations for epidemic and pandemic respiratory virus infections

	Part 2 - Hand hygiene and other hygiene measures	Behavior and adoption of WASH program theory	transmission and hand hygiene in schools and communities.	transmitted predominantly by the droplet and contact route. • The benefits of hand hygiene found in our study have important implications for policymakers and support the recommendations for hand hygiene in the current WHO recommendations for COVID-19. • The combined effect of the trials is small but highly statistically significant.
Anthony, C, et al	Do health risk perceptions motivate water - and health-related behavior?	Community-based WASH program Behavior and adoption of WASH program theory	• Existing WASH knowledge. • Behavior changes using WASH knowledge. • Health risk perceptions.	• Education is a key mitigation strategy to influence WASH-related risk perception and choices and must focus on teaching simple strategies, demonstrating concepts, and providing feedback. • The efficacy of behavior change interventions depends on how health risk messages are tailored to current behaviors, knowledge, and perceptions of the target population, as well as their cultural context
Barrington, D.J, and Robinson, H.J.	Drivers of menstrual material disposal and washing practices: A systematic review	Menstruation School WASH program Community-based WASH program Behavior and adoption of WASH program theory	• Education on menstruation and WASH. • Use of menstruation and WASH practices. • Behavior changes. • Creating new menstrual disposal and washing facilities.	• Behaviors are often not solely reliant on one factor but on several interrelated considerations. • WASH professionals and other implementers of menstrual disposal and washing facilities and services need to ensure that disposal and washing options are appropriate for their context. • Educational policy needs to allow for the teaching of menstruation in a scientific, judgment-free zone, where those who menstruate feel comfortable learning without the fear of embarrassment.
Biran, A, et al	Effect of a behavior-change intervention on handwashing with soap in India (Super Amma)	Community-based WASH program Behavior and adoption of WASH program theory	• Hand washing with soap. • Surveys to gain baseline data. • Frequency of hand washing in households' post-program.	• The most common occasion observed was "handwash at other time" (hand washing not associated with key events). • Hand washing with soap at key events was rare at baseline in both the intervention and control groups. • At 6 weeks' follow-up, hand washing with soap at key events was more common in the intervention group than in the control group.
Cairncross, S	The public health benefits of urban sanitation in low and middle-income countries	WASH SDG ideas/current policies	• Importance of sanitation programs in LMICs. • Ways to improve	• In LMICs, sanitation can transform people's lives – it can save people's lives and make them worth living. • Many approaches have been proposed and endorsed but it is more useful to see

			sanitation in the future.	them as options, suitable for different conditions.
Caruso, B, et al	Water, sanitation, and women's empowerment: A systematic review and qualitative meta-synthesis	WASH SDG ideas/current policies Menstruation	• Barriers in sanitation access. • Access to menstruation products in LMICs.	• Integration of a gender lens into WASH research, program, policy planning, and evaluation, can enable the identification of inequities and potential harms and benefits. • WASH researchers should also integrate gender-transformative approaches that challenge and reduce systemic constraints of women's and girls' resources and agency.
Chatterjee, P	Improving menstrual hygiene among adolescent girls in India	Menstruation School WASH program	• Knowledge of MHM topics. • Availability and affordability of sanitary products	• Much more needs to be done to make adolescent girls more aware of menstrual hygiene. Girls can't talk about this at home. • In government schools, teachers don't spend time talking about the subject or clarifying doubts.
Dery, F, et al	Understanding empowerment in water, sanitation, and hygiene (WASH): a scoping review.	School WASH program Community-based WASH program	• Empowerment in a school and community setting when using WASH resources. • Cultural context.	• This study identified multiple but related dimensions of empowerment as well as multiple levels for analyzing or promoting empowerment. • Empowerment can be both a cause and an outcome of successful gender-sensitive WASH programs.
Divya, M, and Maheswari, J	Issues and Challenges of Hand Washing with Particular Reference to Prevention of COVID-19.	WASH SDG ideas/current policies School WASH program Community-based WASH program Student health and attendance	• Hand washing at school and at home. • Accessibility to hand washing materials and facilities. • Using hand washing to stop disease spread.	• Millions of people have no ready access to a place to wash their hands. Only 3 out of 5 people worldwide have access to basic hand washing facilities. • Hand washing facilities may be fixed or mobile and include a sink with tap water, buckets with taps, tippy-taps, and jugs or basins designated for hand washing. • Limited access to water and the absence of hygiene could pose significant challenges to COVID-19 spread.
Drinkwater, K, and Schmidtke, K	A cross-sectional survey assessing the influence of theoretically informed behavioral factors on hand hygiene across seven countries during COVID-19.	School WASH program Community-based WASH program Behavior and adoption of WASH program theory	• Children's handwashing in school and at home. • Adult surface cleaning at home. • Future expansion the program	• The current study used the COM-B model to inform the design of future interventions to increase children's hand washing and adult surface cleaning. • While small differences between teachers and parents emerged, differences between countries were much larger. • For both behaviors, India had the lowest levels for each COM-B component, and therefore, likely requires more support than the other countries.

Dulluri, A, and Ram Mohan, M.P.	Constitutional mandate and judicial initiatives influencing WASH programs in India	WASH SDG ideas/current policies	• Access to water • Health differences from drinking clean water. • How WASH programs are created and constructed in LMICS.	• The changes in policy that resulted from the MDGs, and the WASH programs are sorely lacking in any scope to recognize the fundamental rights of citizens to access drinking water and sanitation, in the absence of an explicit Constitutional right to water.
Evans, B, and Mara, D	The sanitation and hygiene targets of the sustainable development goals: scope and challenges	WASH SDG ideas/current policies	• Sanitation for all • SDG goals • Ways to improve hygiene access in future years	• SDGs #6.2 and #6.3 shows that achieving this goal represents an extraordinarily great Sanitation and Hygiene Challenge, as it requires ~2½ times the number who received improved sanitation per day during the 15-year period 2001–2015 to be served with basic sanitation.
Freeman, M, and Haque, S	The Applications of Implementation Science in Water, Sanitation, and Hygiene (WASH) Research and Practice	WASH SDG ideas/current policies School WASH program Community-based WASH program	• Creating new WASH programs with implementation science. • How implementation science works in a WASH program.	• The WASH sector operating in these lower resource settings is not yet ready for the tools of implementation science to document, adapt, and scale proven interventions. • There is evidence to suggest that WASH technologies in LMICs have the potential to provide health and social benefits when they are used and well-maintained.
Garg, A, et al	Impact of school-based handwashing promotion program on knowledge and hand washing behavior of girl students in a middle school in Delhi	School WASH program Behavior and adoption of WASH program theory Student health and attendance	• Hand washing knowledge in students. • Students share WASH knowledge with families. • Pre-and-post-program surveys.	• There was a significant improvement in the knowledge regarding hand washing and the frequency of hand-washing practices after the intervention. • 42% of children shared the information they had learned with their parents. • The intervention proved effective in improving awareness and highlights the potential of schools for hand washing promotion activities
Garn, J.V, et al	The impact of sanitation interventions on latrine coverage and latrine use: A systematic review and meta-analysis	School WASH program Community-based WASH program Behavior and adoption of WASH program theory	• Behavior changes and adaptation of WASH knowledge. • School sanitation interventions. • Community and household sanitation interventions.	• We found that many different types of household-based sanitation interventions increased latrine use, including TSC, latrine subsidy/provision interventions, and other latrine subsidies/provision interventions that also incorporated education components, sewerage interventions, sanitation education interventions, and CLTS interventions. • The school-based WASH studies that included latrine provisions showed improvements in pupil-to-latrine ratios.

Ginja, S, et al	Water, sanitation, and hygiene (WASH) behavior change research: why an analysis of contingencies of reinforcement is needed	School WASH program Community-based WASH program Behavior and adoption of WASH program theory	• Behavior changes to put new WASH knowledge to use. • How WASH behavior changes can affect health. • Education in the classroom. • Education at home and in a community setting.	• This article is an attempt to shift the discussion toward more pragmatic issues. What, and whose behaviors need to be targeted, how to measure them, and what activities need to be undertaken to change them, are the key questions for researchers. • In this perspective, both antecedents and consequences of behavior need to be considered, including those that maintain inadequate practices as well as those that can help sustain the desirable practices.
Jain, Y.K, et al	Health-promoting school in India: Approaches and challenges	School WASH program Behavior and adoption of WASH program theory Student health and attendance	• Promote health activities for students. • Staff willingness to teach WASH programs. • Creating consistent frameworks that can be adapted for cultural or area-specific needs.	• The willingness of the staff to participate in the school health promotional activities along with their routine work must be reinforced, thus ensuring sustainability, and making them a part of everyday school activities. • The newly emerging public health schools in the country might be the apt solution for the collaborations needed to create models of school health promotions.
Jordan, E, and Kaminsky, J	Qualitative comparative analysis (QCA) for WASH research and practice	School WASH program Community-based WASH program	• What is QCA? • Future use of QCA in new and existing WASH programs.	• QCA has not been used frequently in studies of water, sanitation, and hygiene interventions to date. • Given its ability to account for configurational complexity, it is a promising method for WASH researchers that strongly complement more commonly used methods.
Igaki, S, et al	Effectiveness of community and school-based sanitation interventions in improving latrine coverage: a systematic review and meta-analysis of randomized controlled interventions.	School WASH program Community-based WASH program Behavior and adoption of WASH program theory	• Education on WASH practices related to latrine use and fecal disposal. • Building new latrines for communities and schools. • Open defecation rates and reasons that cause it to occur.	• This study provided evidence of community- and school-based sanitation interventions in improving latrine use and coverage along with the increase in the number of latrine constructions. • This study also provided information about the effectiveness of sanitation interventions on safe fecal disposal which in turn reduces the incidence/prevalence of diarrheal diseases in the communities. • Problems from open defecation could be solved by using subsidies, providing education, and building latrines.
Lange, S, et al	A scoping review to identify the type and	School WASH program	• Hand washing in school and home.	• The analysis shows that interventions led to decreases in diarrheal diseases,

	effect of hand hygiene interventions on the reduction of infectious diseases (including COVID-19) in preschool children	Behavior and adoption of WASH program theory Student health and attendance	• Access to hand washing supplies and facilities. • Health impacts from regular hand washing at school and at home.	respiratory infections, and absenteeism although there was no definitive 'one-size-fits-all' intervention. • Using innovative, entertaining methods of educating children has shown to be successful in improving hand-washing techniques and decreasing microbial growth on children's hands.
Lewis, H.E, et al	Effect of a School-Based Hygiene Behavior Change Campaign on Handwashing with Soap in Bihar, India: Cluster-Randomized Trial	School WASH program Community-based WASH program	• Hand washing knowledge before eating in mothers. • Hand washing knowledge before eating in school children. • Hand washing to maintain hygiene.	• Children within the intervention arm more frequently mentioned hand washing before eating and defecation as a way of maintaining hygiene compared with those from the control arm. • There was some indication for intervention mothers to mention soap use and hand washing more often before eating as ways to be hygienic.
Levine, D, et al	Rapid prototyping of a school-based health program in the developing world	School WASH program Behavior and adoption of WASH program theory	• School sanitation interventions. • Developing a curriculum for a WASH program.	• Focusing only on hand washing, this intervention is much improved compared to the version at the start of this pilot. • Each expansion of the program (from classroom to school to multiple schools and then more broadly) will require cycles of testing and improvement. • Our goal is to have a curriculum worthy of a randomized trial and then dissemination to tens of millions of students.
Mbakaya, B.C, et al	Use, adoption, and effectiveness of tippy-tap handwashing station in promoting hand hygiene practices in resource-limited settings.	School WASH program Behavior and adoption of WASH program theory	• Types of tippy taps. • Hand washing practices at school or home using tippy taps. • Evaluating past tippy-tap studies.	• The use of tippy-taps for hand washing by school children ranged from 2.7 to 80%. • The availability of tippy taps increased hand washing and the use of soap among participants. • Most people who were oriented to tippy-taps or recruited to tippy-tap studies built their tippy-tap stations even after the promotional activities or programs had ended.
Mchenga, J, et al	Do sanitation facilities in primary and secondary schools address Menstrual Hygiene needs? A study from Mzuzu City, Malawi	Menstruation School WASH program	• Evaluating existing sanitation facilities in schools. • Suggestions for future improvements. • Teaching female	• Existing sanitation facilities in most schools do not sufficiently address the needs of adolescent girls. • Key gaps in schools' sanitation facilities are inadequate sanitation facilities, unreliable access to water, lack of proper disposal/drying mechanisms for menstrual materials, unclean facilities, lack of privacy, and insufficient

			students about MHHM topics.	lighting.
Mushota, O, et al	Effect of school-based educational water, sanitation, and hygiene intervention on students' knowledge in a resource-limited setting	School WASH program Behavior and adoption of WASH program theory Student health and attendance	• Increasing student knowledge on WASH topics (specifically diarrhea).	• WASH and diarrhea-related knowledge among higher secondary school students increased after the educational intervention. • The proportions of students possessing knowledge on the treatment of diarrhea, the use of zinc tablets during an episode of diarrhea, and the symptoms and signs of severe pediatric diarrhea were 28%, 27%, and 27%, before intervention. • These proportions increased after the educational intervention to 72%, 73%, and 74%, respectively.
Orgill-Meyer, J, and Pattanayak, S.K.	Improved sanitation increases long-term cognitive test scores	Community-based WASH program Behavior and adoption of WASH program theory	• Latrine coverage in the community. • Use of latrines vs open defecation. • Cognitive tests. • Access to latrines.	• We show that higher rates of village-level latrine coverage in one's childhood have large long-term positive impacts on cognitive development. • This finding is particularly important given the literature linking cognitive development to labor market outcomes.
Pacheco, E.M, et al	Integrating psychosocial and WASH school interventions to build disaster resilience	WASH SDG ideas/current policies	• ACFCSS and Sustainable Development Goals. • Behavioral buildings in schools. • Disaster risk management.	• Our guidance would allow the ACFCSS to be brought into better alignment with the major international disaster risk recovery and management frameworks. • A holistic framework would allow schools to become potential hubs for building resilience in the preparedness and recovery phases. • This would support resilient recovery and delivery of the UN Sustainable Development Goals by improving the physical and psychosocial well-being of children.
Psaki, S, et al	Policies and interventions to remove gender-related barriers to girls' school participation and learning in low- and middle-income countries: A systematic review of the evidence	WASH SDG ideas/current policies Menstruation School WASH program Community-based WASH program Behavior and adoption of WASH program theory	• Barriers to female students going to school. • Menstruation knowledge and practices by female students. • WASH knowledge and practices (used during and not during menstruation). • Barriers that need more	• More research is needed for the following barriers: ○ Lack of support for girls' education ○ Child marriage ○ School-related gender-based violence (SRGBV) ○ Lack of safe spaces and social connections ○ Inadequate sports programs for girls ○ Inadequate health and childcare services ○ Inadequate menstrual hygiene management (MHM)

			research.	○ Gender-insensitive school environment.
Ramaiya, A, et al	How does a Social and Behavioral Change Communication Intervention Predict Menstrual Health and Hygiene Management: A Cross-Sectional Study	Menstruation School WASH program Behavior and adoption of WASH program theory	• Existing student knowledge on MHHM. • Educating female students on MHHM topics.	• The results showed that adolescent girls in the 'high' encoded exposure group had higher knowledge about puberty and reproductive parts, positive attitudes towards gender, and significantly higher levels of discussion and dialogue. • The intervention was not successful in addressing knowledge about absorbent use, attitudes towards absorbent use, attitudes towards social/religious restrictions, personal restrictions, and structural restrictions.
Sangalang, S, et al	Protocol for a Trial Assessing the Impacts of School-Based WaSH Interventions on Children's Health Literacy, Handwashing, and Nutrition Status in LMICs	School WASH program Behavior and adoption of WASH program theory	• Impact of school WASH on student health (malnutrition and WASH-related diseases). • Food and water insecurity in LMICs.	• Our findings will enable health practitioners, educators, and other researchers to better promote adherence to proper hand washing. • Our study will show how children's physical growth could be improved by school-based WASH interventions, providing key information for malnutrition prevention programs.
Sclara, G.D, et al	Effects of sanitation on cognitive development and school absence: A systematic review	School WASH program Community-based WASH program Student health and attendance	• Existing student knowledge of WASH topics. • Existing adult knowledge of WASH topics. • Health and attendance from the adoption of topics learned from the WASH program.	• While some studies found sanitation was associated with lower school absence, others found no effects or even higher school absence. • It is possible that the differences in effects are due to very substantial differences in the studies themselves, not only in terms of settings, but also the point of intervention (household vs. community vs. school levels), type of sanitation delivered or assessed, and whether the sanitation intervention was delivered alone or in combination with other WASH interventions.
Shankar, P, et al	Evaluating the Impact of a School-Based Youth-Led Health Education Program for Adolescent Females in Mumbai, India	School WASH program Behavior and adoption of WASH program theory	• Peer-led education programs. • Pre- and post-program surveys to measure knowledge learned during the WASH program.	• Following the education sessions, participants demonstrated favorable health attitudes at a rate of 66% (42% improvement). • There were significant gains across all three standards and for both Champions (student leaders) and non-Champions (students who were not leaders). • The post-test results show that immediately following the peer-led education sessions, average knowledge scores for participants were nearly 1.5 times the baseline average, with statistically significant gains across all

				three standards. • Average scores for both Champions (+65%) and non-Champions (+46%) significantly improved.
Sommer, M, et al	Attention to menstrual hygiene management in schools: An analysis of education policy documents in low- and middle-income countries	WASH SDG ideas/current policies Menstruation School WASH program	• MHM in school education programs. • WASH education program in schools. • Ways to improve MHM education.	• The review highlighted the absence of explicit or proxy mentions of MHM in 19 out of 21 countries' education and/or gender and education policies. • Implicit references to MHM, as seen when policies include reference to WASH infrastructural needs without mentioning how these interventions address the menstrual needs of girls and women and risk further stigmatizing menstruation as taboo.
Thakur, R, et al	The Clean India Mission: Public and animal health benefits	WASH SDG ideas/current policies	• Toilet construction in households (rural and urban). • Usage of toilets once they have been built and are ready to use.	• The clean India mission is one of the biggest programs initiated by the Government of India. Around 71,277,000 toilets have been constructed and a 44.68% increase in households with toilets being reported in rural settings. • The aim of an open defecation-free world could only be achieved through government support, policy development, health education, and sustained collaborations between multiple stakeholders.
Tidwell, T.B, et al	Impact of a teacher-led school handwashing program on children's handwashing with soap at school and home in Bihar, India	School WASH program Behavior and adoption of WASH program theory	• Washing hands with soap. • Hand washing practices at school. • Hand washing practices at home.	• Strong evidence that hand washing with soap was greater in the treatment than in the control before eating, though it occurred less often than after defecation in both treatments and control. • We find evidence that it succeeded in changing behavior overall, with large impacts before eating (very low to begin with) and both in schools and at home among children. The impact was greater in the school setting than in the home.
Vishwanath, R, et al	Detection of bacterial pathogens in the hands of rural school children across different age groups and emphasize the importance of hand wash.	School WASH program	• Common types of bacteria are found in rural school children's hands. • Reasons for lack of hand washing.	• Simple hand washing practices can efficiently reduce the transmission of pathogenic bacteria from our hands and greatly reduce the transmission of infection. • Male children were colonized with a relatively higher bacterial population when compared to female children. • Lack of a proper hand washing model, and hand washing materials like clean water, soap, and wiping material were a few of the reasons for the failure of

				hand washing practice in schools.
Vogel, W, et al	Gender and Sanitation: Women's Experiences in Rural Regions and Urban Slums in India.	Menstruation School WASH program	• Access to toilets in rural and urban areas. • Access to sanitary products in rural and urban areas. • Improving existing knowledge on menstruation topics in female and male students.	• Misconceptions need to be addressed by increasing the level of education boys and girls receive in schools and within their households. • Properly educating males on menstruation will increase the social mobility of females, which would prevent them from being set behind educationally or socially. • A well-rounded framework such as the sanitation insecurity measure supports a holistic perspective as it examines not only the availability of sanitary facilities, but also the effect that gender, social structures, community awareness, and culture have on the quality of sanitation within an area.
Waddington, H, et al	Evidence and Gap Map Protocol: Interventions promoting safe water, sanitation, and hygiene for households, communities, schools, and health facilities in low- and middle-income countries	WASH SDG ideas/current policies School WASH program Community-based WASH program	• How to create a WASH program to cover gaps in knowledge. • How to use gap maps. • Using cultural context/practices to adjust or add to existing educational materials.	• There is evidence to suggest that poor WASH conditions are associated with high levels of diarrheal disease, respiratory infections, parasitic worm infections, and trachoma. • Mechanisms for providing WASH technologies can be classified into four main groups: direct provision, health messaging, psychosocial 'triggering', and systems-based interventions. • An important dimension of any intervention is how, or where, participants interact with it in terms of both their social and physical environments.
Wolf, J, et al	Effectiveness of interventions to improve drinking water, sanitation, and handwashing with soap on the risk of diarrheal disease in children in low-income and middle-income settings: a systematic review and meta-analysis.	School WASH program Behavior and adoption of WASH program theory	• Risk of diarrhea from untreated water. • Risk of diarrhea by treating water. • Treatment methods to purify untreated water. • Hand washing promotion in school and at home.	• Compared with untreated water from an unimproved source, diarrhea risk was reduced by 52%, with the provision of an improved drinking water supply on premises with higher water quality and by up to 50% with water treated by: filtration, solar treatment, and chlorination. • Basic sanitation services without sewer connection resulted in a 21% reduction in diarrhea risk and basic sanitation services with sewer connection resulted in a 47% reduction, compared with unimproved or limited sanitation. • Hand washing promotion with or without broader hygiene education reduced diarrhea by 30%.

Wolf, J, et al	Impact of drinking water, sanitation, and handwashing with soap on childhood diarrheal disease: an updated meta-analysis and meta-regression.	School WASH program Community-based WASH program	• Water treatment methods. • Systematic review. • Risk of diarrhea in children who use untreated and treated water sources.	• Our review found that point-of-use (POU) water quality interventions reduced diarrhea by an average of 23% for chlorination, 31% for flocculation and disinfection, 38% for solar water treatment, 53% for bio-sand filters, and 61% for ceramic filters, all prior to adjustment for non-blinding. • 75% of the diarrhea reduction was attributed to the indirect or community effect that adequate sanitation has on members of other households in the community,
Yates, T, et al	Efficacy and effectiveness of water, sanitation, and hygiene interventions in emergencies in low- and middle-income countries: a systematic review.	WASH SDG ideas/current policies Community-based WASH program Behavior and adoption of WASH program theory	• How communities use WASH interventions. • Accessibility to WASH interventions in emergency scenarios. • Types of WASH interventions.	• Small-scale source water treatment, HWT, latrines, latrine alternatives, and hygiene promotion, effectiveness varied, and outcomes were conditional based on the emergency context, beneficiary knowledge, or cultural and social preferences. • Disease reduction was not regularly evaluated and remains a gap in the literature; however, the evidence from this review validates the causal chain for emergency WASH intervention. • Interventions with access to WASH services and measured high use also had large and significant reductions in diarrhea.

Future strategies and topics for the KCF program

Using information from the existing WASH programs and the literature reviews, I was able to come up with two strategies that the KCF program may want to add to in future years to help with knowledge retention of WASH topics. The first strategy is to create a student WASH club. This could benefit students because it would hold them accountable to use correct WASH techniques and can improve behavior change and adoption of these techniques (like washing their hands with soap and water after using the bathroom). The second strategy is having students who have completed the program help teach it to younger students and/or community members as the program expands. This can help reinforce the WASH techniques that the older students have already learned. This may make behavior and adaptation easier for the younger students

(especially if they look up to the older students). A similar teaching technique was used in one of the articles I reviewed and was proven to be very effective on learning and knowledge retention.

The first topic recommendation for the program expansion is to expand on the germs lesson by adding in some common types of bacteria that are found in the region where the education program is taking place. Right now, the KCF program only overviews what germs are and how to kill them with handwashing. By adding common types found in the area, it could tailor the lessons more to students, which may motivate them to use the correct WASH techniques. The second topic is to make menstruation lessons for boys in the class. There is lots of stigma and cultural views of menstruation in India, and this can cause girls to not want to come to school (due to shaming by fellow students, no safe places to discard menstruation products etc). By educating male students about menstruation, it could help reduce the stigma behind this natural process.

KCF Student Pre-Program Survey Analysis

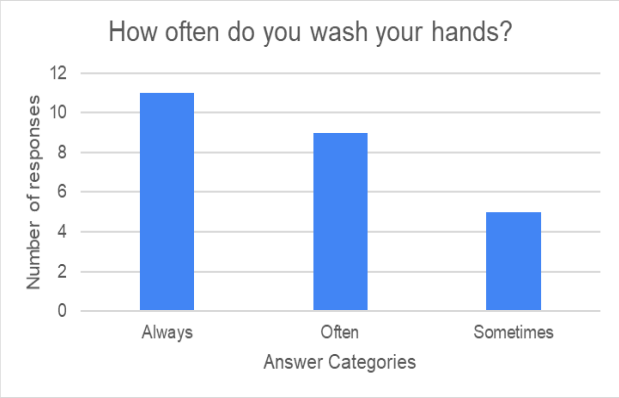
. The average age of the students who completed the survey was 14 years old. Of the first 18 questions on the pre-program survey that measured current WASH habits, here are some of the highlights. The students who took the survey reported an average of 3 days of missing school in the past 30 days, due to not being in good physical health. There were 60% of students who found handwashing to be very important, followed by 24% selecting important, and 12% selecting moderately important. There were 44% of students who reported ‘always’ washing their hands, followed by 32% saying they ‘often’ and 20% saying they ‘sometimes’ wash their hands. Most students said that they do not wash their hands because there is no soap available (44%). 92% of students said that they do use the toilet when they need to go to the bathroom. Around 80% of students said that they get their drinking water from hand pumps, followed by

12% saying they get water from ‘other sources’ (like rainwater collection, wells etc). 88% of students said that they boil their water to make it clean, followed by 4% saying they use a sift to remove particles.

Of the final 20 questions that covered WASH topics that will be mentioned in the KCF program, here are some of the highlights. 80% of students said that washing hands with soap and water will stop the spread of germs. 8% of students said that using hand sanitizer stops the spread of germs (both answers were correct). Most students (84%) chose that washing hands before preparing food will make food safe to eat, followed by washing fruits and vegetables with clean water (8%), and then do not mix raw meat and vegetables together (4%). These options were all correct answers to those questions. 100% of students selected the right answer on a true and false question that was: True or False: Using toilets provides more privacy and is better for security. All the students chose true, which was the correct answer. Similarly, 100% of students also selected the right answer on another true/false question that was: True or False: Using toilets helps keep the environment clean. All the students chose true, which was the correct answer! Below are some of the graphs I created while doing the data analysis, I used a combination of SAS and Microsoft Excel to do my analysis. (Figures 3, 4 and 5).

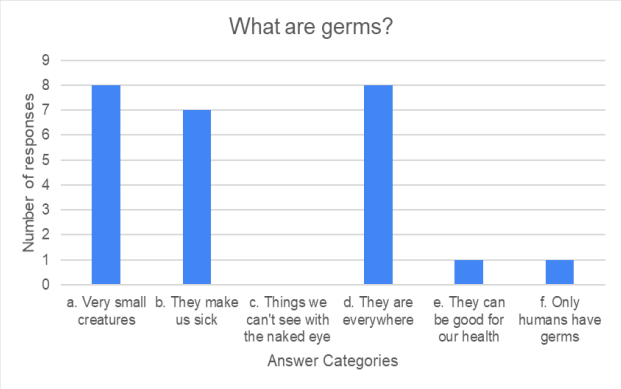
By looking at the number of students who answered at least one part of the questions correctly in the WASH topics in the program section (part 2), I was able to calculate a baseline of student knowledge over the WASH topics. The baseline was 82.4%. This is a high baseline percentage, which suggests that the students already know quite a bit about WASH before even starting the KCF program. To see if students learn anything from the program, I will have to go through the post-program surveys and do a similar calculation as the baseline calculation.

- Baseline = 412 correct answers/500 possible answers from students = 0.824 = 82.4%



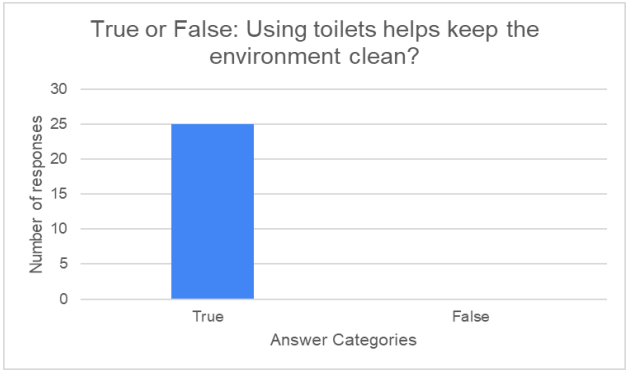
Obs	Answer	Responses
1	Always	11
2	Often	9
3	Sometime	5

Figure 3: Survey Result 1



Obs	Answer	Responses
1	a	8
2	b	7
3	c	0
4	d	8
5	e	1
6	f	1

Figure 4: Survey Result 2



Obs	Answer	Responses
1	true	25
2	false	0

Figure 5: Survey Result 3

Discussion

Main Findings

From my analysis, I was able to answer my research question, that WASH education programs can be successful at improving student knowledge and health. I found these programs were successful if they had at least one of the five main ideas. The first idea is to make lessons interactive and exciting. This will keep students interested in the lessons. If the facility teaching the program are excited, it could also help keep students engaged during lessons. The second idea is to let students lead others. This can be done via small groups in class, creating WASH clubs in schools or leading community groups. Teaching others can help reinforce what students have learned from the WASH program and remind them of correct WASH practices and techniques.

The third idea is adding to existing resources. This can be done by partnering with WASH infrastructure programs to create and/or update latrines, handwashing stations etc where the WASH education program is taking place. If you are teaching students about how to wash their hands, it would be beneficial to have a place where they are able to wash their hands in school. This can lead to more behavior changes in students using what they have learned from the education program. The fourth idea is keeping supplies maintained after the program. If you only have a single stock of items, when they run out there is no more left for people to use (eg soap or menstruation products). If there is a continuous supply of items available, it can make students and community members more likely to use correct WASH practices they learned from the WASH education program (thus changing behavior which can lead to more positive health outcomes).

The fifth idea is that program creators need to be checking in on resources after the education program has finished. This can monitor that WASH resources (like toilets and water

pumps) are being used correctly and holds students/community members accountable to use what they have learned from the education program. It also helps because repairs can be made to the infrastructure as needed. For example, it would be difficult to wash your hands if the sink was broken and no water was coming out. So, you would be less likely to wash your hands. By fixing infrastructure, you are helping promote correct WASH practices by making resources available for use. From my analysis, I was also able to get a baseline percentage on student WASH knowledge before the KCF program was put in place.

From my literature review results, the success rate of the programs was lower than what I was anticipating. I was hoping for a success rate between 50-70%. In actuality, the success rate was around 43%. One reason why the average success rate is lower is because many of the papers I evaluated did not have efficacy metrics. However, many gave suggestions of different ways to make school and community-based WASH programs successful in the future. Another reason the rate was low could have been because I didn't look at menstruation and the SDG WASH ideas/policy articles to see if they were successful. I chose to exclude the articles that looked at menstruation because all of them either talked about future plans to include menstruation into WASH curriculum, gaps in student knowledge in menstruation and how sanitation facilities need to be improved for menstruating students at school. I chose to exclude the articles that looked at SDG WASH ideas and policies because they looked at ways that WASH programs should be run and current standards for infrastructure building in communities.

Limitations

To determine if the KCF program was successful, I would have to analyze the post-program survey results. A limitation is that I was not able to get the post-program results before my deadlines. I feel confident that the program will be successful but wish I could have the data

to back it up. The initial start date was supposed to be in November 2022, but ended up starting January 2023. Therefore, this pushed the end date back from March 2023 to May 2023.

Another limitation is that I could have spent a longer time and used more websites when searching for articles in my literature review. I looked at 41 articles from three main websites. If I could have increased the number of articles, perhaps it would have given me a higher percentage of studies that were successful. However, many of the studies weren't not successful. Many said that they could be successful in the future with more work and research done. Having more websites to look at could have also reduced the number of articles I was cutting out.

Future Suggestions

I think future development on WASH education programs is important because you can have more of an impact on the community. For example, expanding a current school-based education into a community-based education program can reach more people. By broadening the reach of education programs, it can help expose more people to WASH education - which can improve their health. This would improve health because it can reduce spread among the community, as people would be adopting correct WASH techniques like handwashing with soap. Therefore, less people will be getting sick from WASH-related diseases. In my analysis, I also provided KCF with suggestions on how to expand their program. I think these ideas could be applied to several of the WASH programs I reviewed that would be able to become successful in future years with more research.

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References

Al-Ansary, L, et al. 2020. *Physical interventions to interrupt or reduce the spread of respiratory viruses. Part 2 - Hand hygiene and other hygiene measures: systematic review and meta-analysis.* Google Scholar Website. Retrieved from: https://www.medrxiv.org/content/10.1101/2020.04.14.20065250v1

Anthony, C, et al. 2022. *Do health risk perceptions motivate water - and health-related behavior? A systematic literature review.* ScienceDirect Website. Retrieved from: https://www.sciencedirect.com/science/article/pii/S004896972107981X

Barrington, D.J, and Robinson, H.J. 2021. *Drivers of menstrual material disposal and washing practices: A systematic review.* Google Scholar Website. Retrieved from: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0260472

Berendes, D, et al. 2022. *Improving water, sanitation, and hygiene (WASH), with a focus on hand hygiene, globally for community mitigation of COVID-19.* PLOS Water Website. Retrieved from: https://journals.plos.org/water/article?id=10.1371/journal.pwat.0000027

Biran, A, et al. 2014. *Effect of a behavior-change intervention on handwashing with soap in India (SuperAmma): a cluster-randomized trial.* PubMed Website. Retrieved from: https://pubmed.ncbi.nlm.nih.gov/25102847/

Black, R and Walker, C. 2020. *Do Water, Sanitation, and Hygiene Interventions Prevent Childhood Diarrhea?* PubMed Website. Retrieved from: https://pubmed.ncbi.nlm.nih.gov/31049582/

Cairncross, S. 2018. *The public health benefits of urban sanitation in low and middle-income countries.* ScienceDirect Website. Retrieved from: https://www.sciencedirect.com/science/article/pii/S0957178717302886

Caruso, B, et al. 2022. *Water, sanitation, and women's empowerment: A systematic review and qualitative meta-synthesis.* Google Scholar Website. Retrieved from: https://journals.plos.org/water/article?id=10.1371/journal.pwat.0000026

Center for Disease Control and Prevention (CDC). 2020. *CDC at Work: Global Water, Sanitation and Hygiene (WASH).* CDC Website. Retrieved from: https://www.cdc.gov/healthywater/global/programs/index.html

Chatterjee, P. 2020. *Improving menstrual hygiene among adolescent girls in India.* ScienceDirect Website. Retrieved from: https://protsahan.co.in/wp-content/uploads/2020/09/The-Lancet_PIIS2352464220301425.pdf

Clean the World Foundation. 2022. *WASH in Schools Program.* Clean the World Website. Retrieved from:https://cleantheworldfoundation.org/wash-in-schools/

Cronk, R, et al. 2020. *Factors associated with water quality, sanitation, and hygiene in rural schools in 14 low- and middle-income countries.* PubMed Website. Retrieved from: https://pubmed.ncbi.nlm.nih.gov/33360548/

Dery, F et al. 2020. *Understanding empowerment in water, sanitation, and hygiene (WASH): a scoping review.* Google Scholar Website. Retrieved from: https://iwaponline.com/washdev/article/10/1/5/71150/Understanding-empowerment-in-water-sanitation-and

Divya, M, and Maheswari, J. 2020. *Issues and Challenges of Hand Washing with Particular Reference to Prevention of COVID-19.* Google Scholar Website. Retrieved from: https://digitalcommons.du.edu/irbe/vol4/iss2/33/

Drinkwater, K, and Schmidtke, K. 2021. *A cross-sectional survey assessing the influence of theoretically informed behavioral factors on hand hygiene across seven countries during COVID-19.* PubMed Website. Retrieved from: https://pubmed.ncbi.nlm.nih.gov/34289816/

Dulluri, A, Ram-Mohan, MP. 2017. *Constitutional mandate and judicial initiatives influencing Water, Sanitation, and Hygiene (WASH) programs in India.* Google Scholar Website. Retrieved from: https://iwaponline.com/washdev/article/7/4/630/38052/Constitutional-mandate-and-judicial-initiatives

Evans, B, and Mara, D. 2018. *The sanitation and hygiene targets of the sustainable development goals: scope and challenges.* Google Scholar Website. Retrieved from: https://iwaponline.com/washdev/article/8/1/1/38061/The-sanitation-and-hygiene-targets-of-the

Freeman, M, and Haque, S. 2021. *The Applications of Implementation Science in Water, Sanitation, and Hygiene (WASH) Research and Practice.* Google Scholar Website. Retrieved from: https://ehp.niehs.nih.gov/doi/full/10.1289/EHP7762

Garg, A, et al. 2013. *Impact of school-based handwashing promotion program on knowledge and hand washing behavior of girl students in a middle school in Delhi.* PubMed Website. Retrieved from: https://pubmed.ncbi.nlm.nih.gov/23873200/

Garn, J.V, et al. 2017. *The impact of sanitation interventions on latrine coverage and latrine use: A systematic review and meta-analysis.* ScienceDirect Website. Retrieved from: https://www.sciencedirect.com/science/article/pii/S1438463916302619

Ginja, S, et al. 2019. *Water, sanitation, and hygiene (WASH) behavior change research: why an analysis of contingencies of reinforcement is needed.* Google Scholar Website. Retrieved from: https://www.tandfonline.com/doi/full/10.1080/09603123.2019.1682127

Jain, Y.K, et al. 2019. *Health-promoting school in India: Approaches and challenges.* Google Scholar Website. Retrieved from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6857387/

Jordan, E, and Kaminsky, J. 2017. Qualitative comparative analysis (QCA) for WASH research and practice. Google Scholar Website. Retrieved from: https://iwaponline.com/washdev/article/7/2/196/30193/Qualitative-comparative-analysis-for-WASH-research

Igaki, S, et al. 2021. *Effectiveness of community and school-based sanitation interventions in improving latrine coverage: a systematic review and meta-analysis of randomized controlled interventions.* Google Scholar Website. Retrieved from: https://link.springer.com/article/10.1186/s12199-021-00934-4

Kaleidoscope Child Foundation (KCF). 2022. *India – WASH program.* Kaleidoscope Child Foundation Website. Retrieved from: https://kaleidoscopechildfoundation.org/?page_id=260

Kaur, et al. 2018. *Menstrual Hygiene, Management, and Waste Disposal: Practices and Challenges Faced by Girls/Women of Developing Countries.* PubMed Website. Retrieved from: https://pubmed.ncbi.nlm.nih.gov/29675047/

Lange, S, et al. 2021. *A scoping review to identify the type and effect of hand hygiene interventions on the reduction of infectious diseases (including COVID-19) in preschool children.* Google Scholar Website. Retrieved from: http://www.scielo.org.za/scielo.php?script=sci_arttext&pid=S1999-76712021000400009

Lewis, H.E, et al. 2018. *Effect of a School-Based Hygiene Behavior Change Campaign on Handwashing with Soap in Bihar, India: Cluster-Randomized Trial.* PubMed Website. Retrieved from: https://pubmed.ncbi.nlm.nih.gov/30105966/

Levine, D, et al. 2017. *Rapid prototyping of a school-based health program in the developing world.* ScienceDirect Website. Retrieved from: https://www.sciencedirect.com/science/article/pii/S2352728516300100

Mbakaya, B.C, et al. 2020. *Use, adoption, and effectiveness of tippy-tap handwashing station in promoting hand hygiene practices in resource-limited settings: a systematic review*. Google Scholar Website. Retrieved from: https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-020-09101-w

Mchenga, J, et al. 2020. *Do sanitation facilities in primary and secondary schools address Menstrual Hygiene needs? A study from Mzuzu City, Malawi.* ScienceDirect Website. Retrieved from: https://www.sciencedirect.com/science/article/pii/S147470651930097X

Mushota, O, et al. 2021. *Effect of school-based educational water, sanitation, and hygiene intervention on student's knowledge in a resource-limited setting.* PubMed Website. Retrieved from: https://pubmed.ncbi.nlm.nih.gov/34895193/

Orgill-Meyer, J, and S. K. Pattanayak, S.K, 2020. *Improved sanitation increases long-term cognitive test scores.* ScienceDirect Website. Retrieved from: https://www.sciencedirect.com/science/article/pii/S0305750X20301017

PAC Nepal. *WASH Program – Public Awareness Campaign.* PAC Nepal Website. Retrieved from: https://pacnepal.org/program/wash/#

Pacheco, E.M, et al. 2021. *Integrating psychosocial and WASH school interventions to build disaster resilience.* ScienceDirect Website. Retrieved from: https://www.sciencedirect.com/science/article/pii/S2212420921004817

Pencils of Promise. 2022. *Water, Sanitation, and Hygiene Program (WASH).* Pencils of Promise Website. Retrieved from: https://pencilsofpromise.org/our-work/wash/

Pencils of Promise. 2022. *WASH Program Outputs*. Pencils of Promise Website. Retrieved from: https://public.tableau.com/app/profile/pencilsofpromise/viz/ProgramOutputsWASH/Dashboard1

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). 2023. *The Role of PRISMA.* PRISMA Website. Retrieved from: http://prisma-statement.org/

Project Wet. 2022. *Healthy Water, Healthy Habits, Healthy People program.* Project Wet Website. Retrieved from: https://www.projectwet.org/programs/wash

Psaki, S, et al. 2022. *Policies and interventions to remove gender-related barriers to girls' school participation and learning in low- and middle-income countries: A systematic review of the evidence.* Google Scholar Website. Retrieved from: https://onlinelibrary.wiley.com/doi/full/10.1002/cl2.1207

Ramaiya, A, et al. 2019. *How does a Social and Behavioral Change Communication Intervention Predict Menstrual Health and Hygiene Management: A Cross-Sectional Study.* PubMed Website. Retrieved from: https://pubmed.ncbi.nlm.nih.gov/31375074/

Sangalang, S, et al. 2021. *Protocol for a Trial Assessing the Impacts of School-Based WaSH Interventions on Children's Health Literacy, Handwashing, and Nutrition Status in Low- and Middle-Income Countries.* PubMed Website. Retrieved from: https://pubmed.ncbi.nlm.nih.gov/33561075/

Sclara, G.D, et al. 2017. *Effects of sanitation on cognitive development and school absence: A systematic review.* ScienceDirect Website. Retrieved from: https://www.sciencedirect.com/science/article/pii/S1438463917302262

Shankar, P, et al. 2020. *Evaluating the Impact of a School-Based Youth-Led Health Education Program for Adolescent Females in Mumbai, India.* PubMed Website. Retrieved from: https://pubmed.ncbi.nlm.nih.gov/32566485/

Sommer, M, et al. 2017. *Attention to menstrual hygiene management in schools: An analysis of education policy documents in low- and middle-income countries.* ScienceDirect Website. Retrieved from: https://www.sciencedirect.com/science/article/pii/S0738059317302316

Thakur, R, et al. 2018. *The Clean India Mission: Public and animal health benefits.* ScienceDirect Website. Retrieved from: https://www.sciencedirect.com/science/article/pii/S0001706X1830305X

Tidwell, TB, et al. 2020. *Impact of a teacher-led school handwashing program on children's handwashing with soap at school and home in Bihar, India.* PubMed Website. Retrieved from: https://pubmed.ncbi.nlm.nih.gov/32106240/

United Nations International Children's Emergency Fund (UNICEF). 2021. *Water, sanitation, and hygiene*. UNICEF Website. Retrieved from: https://www.unicef.org/india/what-we-do/water-sanitation-hygiene

United Nations International Children's Emergency Fund (UNICEF). 2022. *WASH in schools.* UNICEF Website. Retrieved from: https://data.unicef.org/topic/water-and-sanitation/wash-in-schools/

United States Agency for International Development (USAID). 2021. *Partnership for Water, Sanitation, and Hygiene (WASH).* UNICEF Website. Retrieved from: https://www.usaid.gov/india/water-and-sanitation

Vishwanath, R, et al. 2019. *Detection of bacterial pathogens in the hands of rural school children across different age groups and emphasizing the importance of hand wash.* PubMed Website. Retrieved from: https://pubmed.ncbi.nlm.nih.gov/31312739/

Vogel, W, et al. 2022. *Gender and Sanitation: Women's Experiences in Rural Regions and Urban Slums in India.* Google Scholar Website. Retrieved from: https://www.mdpi.com/2075-4698/12/1/18

Waddington, H, et al. 2018. *Evidence and Gap Map Protocol: Interventions promoting safe water, sanitation, and hygiene for households, communities, schools, and health facilities in low- and middle-income countries.* Google Scholar Website. Retrieved from: https://www.proquest.com/openview/3a140320287f7bc99b3cfd98dc088e97/1?pq-origsite=gscholar&cbl=2040247

WASH United. 2021. *MHM Education Program.* WASH United Website. Retrieved from: https://wash-united.org/

Wolf, J, et al. 2018. *Impact of drinking water, sanitation and handwashing with soap on childhood diarrheal disease: an updated meta-analysis and meta-regression.* Google Scholar Website. Retrieved from: https://ueaeprints.uea.ac.uk/id/eprint/66458/

Wolf, J, et al. 2022. *Effectiveness of interventions to improve drinking water, sanitation, and handwashing with soap on the risk of diarrheal disease in children in low-income and middle-income settings: a systematic review and meta-analysis.* ScienceDirect Website. Retrieved from: https://www.sciencedirect.com/science/article/pii/S0140673622009370

World Health Organization (WHO). 2022. *Our work in India.* WHO Website. Retrieve from: https://www.who.int/india/our-work

Yates, T, et al. 2018. *Efficacy and effectiveness of water, sanitation, and hygiene interventions in emergencies in low- and middle-income countries: a systematic review.* Google Scholar Website. Retrieved from: https://www.jstor.org/stable/26600890#metadata_info_tab_contents