Part 1: Research Article
Impact of a Hand Hygiene Curriculum and Group Handwashing Station at
Two Primary Schools in East Africa

Stephanie Pasewaldt

James Madison University

Senior Honor's Thesis

Dr. Baller

May 2018
Abstract

Handwashing drastically reduces the transmission of deadly, preventable diseases. Schools, even those with limited resources, have the power to promote handwashing through simple, effective interventions. This study evaluated the impact of a school-based handwashing program consisting of two interventions: a hand-hygiene curriculum and group handwashing station. Mixed quantitative and qualitative pre/post intervention surveys were administered to students at one primary school in Kenya (n=38) and at one primary school in Uganda (n=57). Identical procedures were followed at each school. Paired t-tests for pre/post-surveys demonstrated an increase in students’ knowledge (p<0.001) and frequency of handwashing (p<0.001). After six months, students were still engaging in improved handwashing behaviors. The curriculum increased knowledge, and the handwashing station enabled students to translate their knowledge into action. The present study suggests an educational intervention combined with a built environmental intervention be used to promote handwashing behaviors and emphasizes the role of group handwashing stations.

Keywords: health promotion, intervention, handwashing, global health, school-based health, built environment
Impact of a Hand Hygiene Curriculum and Group Handwashing Station at Two Primary Schools in East Africa

Fundamental rights concerning water, sanitation, and hygiene education (WASH) are not afforded to millions of children around the world. As a result of inadequate WASH, the transmission of disease proliferates with detrimental consequences. Over 1.4 million children die of preventable diarrheal, respiratory, and intestinal diseases every year (United Children’s Defense Fund, 2016).

Schools have the power to promote health and hygiene by providing students with proper hygiene education and access to adequate sanitation facilities. However, fewer than 50% of the world’s primary schools are able to do so (UNICEF, 2012a). Improvement and change is possible though, even in schools with the most limited resources, through simple and sustainable approaches and interventions (UNICEF, 2016).

The promotion of handwashing with soap is the single most effective and cost-efficient intervention that can be implemented to improve and save children’s lives (Global Public-Private Partnership for Handwashing with Soap, 2016). Handwashing with soap can prevent the transmission of hygiene-related diseases, which can in turn improve the attendance and academic achievement of students (PPPHW, 2016; UNICEF, 2010). Through simple handwashing behavior changes, deaths attributed to diarrhea and respiratory disease, the leading causes of child mortality, could decrease by 50% and 25% respectively (Curtis & Carincross, 2003). Improving handwashing-related knowledge and behaviors is a feasible target for schools to begin improving WASH conditions because of the simplicity, cost-efficiency, and flexibility of handwashing promotion programs (PPPHW, 2016; UNICEF & Deutsche Gesellschaft für Internationale Zusammenarbeit, 2013).
Research surrounding handwashing promotion programs has highlighted numerous types of interventions used to promote healthy handwashing behaviors. Educational interventions have been shown to improve handwashing knowledge and beliefs (Galiani, Gertler, Ajzenman, & Orsola-Vidal, 2015; O’Reilly et al., 2008), which are influential in motivating handwashing behavior (Galiani, Gertler, Ajzenman, & Orsola-Vidal, 2015). Existing educational curricula provided by nonprofit and government organizations promote similar handwashing themes, but teaching methods have varied based on schools’ contexts (Sustainable Sanitation Alliance, 2015; UNICEF, 2012B). Handwashing promotion literature portrays a variety of activities that can be incorporated into such education curriculums, including handwashing competitions, songs, dramas and demonstrations (SuSanA, 2015; Zhang, et al., 2013; UNICEF, 2013; UNICEF, 2012b; Sidibe & Curtis, 2007).

Environmental interventions, such as handwashing station infrastructures, have been shown to increase handwashing behavior by eliminating physical barriers to the behavior in students’ environment (Contzen, Meili, & Mosler, 2015; Pfadenhauer & Rehfuess, 2015; Zhang, Mosa, Hayward, & Matthews, 2013). Handwashing stations and promotion programs have frequently been implemented at schools in developing countries and have ranged in design from simple tippy taps with plastic bottles (Contzen et al., 2015; Zhang et al., 2013) to elaborate PVC-piped basin systems (GIZ, 2013), depending on the school’s resources. Further, it has been suggested that handwashing stations that allow multiple students to wash their hands at the same time result in improved handwashing behaviors in the short and long-term because the behavior becomes a social activity and a social norm (SuSanA, 2015; GIZ, 2013; UNICEF & GIZ, 2013).

The literature largely supports implementing both educational and environmental interventions in handwashing promotion programs in order to generate more effective,
sustainable results than programs featuring only a single intervention (Contzen et al., 2015; Pfadenhauer & Rehfuss, 2015; Zhang et al., 2013; Aboud & Singla, 2012). Education is a vital component in encouraging handwashing behavior; however, without proper infrastructure in the environment, behavior change cannot occur (Pfadenhauer and Rehfuss, 2015; Zhang et al., 2013). In a study of handwashing and other hygiene behaviors, Pfadenhauer and Rehfuss (2015) found educational interventions create motivation for behavior change but environmental interventions are necessary to facilitate actual behavior change. Education is a vital component in encouraging handwashing behavior; however, without proper infrastructure in the environment, behavior change cannot occur (Pfadenhauer and Rehfuss, 2015; Zhang et al., 2013). The efficacy of a two-pronged approach may be explained by the integration of multiple theories to promote handwashing, since the framework is more likely to impact individual, interpersonal, societal, and contextual handwashing behavior determinants (Contzen et al., 2015; Dreibelbis, 2013; Aboud & Singla, 2012). Consequently, the present study’s interventions are built upon a framework integrating both the Health Belief Model and Integrated Behavioral Model for Water, Sanitation, and Hygiene (Dreibelbis, 2013) to target individual and contextual influences of handwashing.

More empirical research is needed to further understand the relationship between handwashing educational and environmental interventions in order to improve best practices for handwashing promotion and behavior change. The present study assesses how the implementation of a six-day hand hygiene curriculum and installation of a group handwashing impacted students at two primary schools in East Africa. Students’ knowledge, attitudes, and behaviors regarding handwashing were examined to understand the influence of each intervention.
Methods

Setting

This study took place at two separate primary schools in East Africa. The first primary school was Owimbi Academy located in Owimbi, a rural village in Nyanza Province, Kenya. The second primary school was Raising Up Hope for Uganda located in the Bulenga, an urban village in the Wakiso District of Uganda. A year prior to the present study, the researcher conducted a needs assessment, which was approved through the referent university’s institutional review board. The needs assessment identified a lack of hygiene knowledge and an absence of handwashing facilities at each school as factors that contributed to poor sanitation habits among the schools’ students.

Recruitment Strategy/ Study Population

A convenience sampling strategy was used to recruit student participants at each school. A sample of students in grades 3-8 were recruited at Owimbi Academy (n=38), and grades 4-7 were recruited at Raising Up Hope for Uganda (n=57) for a total same size of n=95. Students from each school participated in a hand hygiene educational program which was evaluated pre- and post intervention, and the schools’ principles participated in a follow-up evaluation. Table 1 describes the sample of students broken up by school and grade.
Table 1

Description of Sample

<table>
<thead>
<tr>
<th>School</th>
<th>Population of Students in Grades 3-8</th>
<th>Sample of Students in Study</th>
<th>3rd Grade</th>
<th>4th Grade</th>
<th>5th Grade</th>
<th>6th Grade</th>
<th>7th Grade</th>
<th>8th Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owimbi Academy</td>
<td>N=39</td>
<td>n=38</td>
<td>n=2</td>
<td>n=6</td>
<td>n=6</td>
<td>n=10</td>
<td>n=3</td>
<td>n=11</td>
</tr>
<tr>
<td>Raising Up Hope for Uganda</td>
<td>N=65</td>
<td>n=57</td>
<td>N/A</td>
<td>n=15</td>
<td>n=18</td>
<td>n=10</td>
<td>n=14</td>
<td>N/A</td>
</tr>
<tr>
<td>Both Schools</td>
<td>N=104</td>
<td>n=95</td>
<td>n=2</td>
<td>n=21</td>
<td>n=24</td>
<td>n=20</td>
<td>n=17</td>
<td>n=11</td>
</tr>
</tbody>
</table>

Ethics

This study was approved by University Institutional Review Board (No. 17-0537).

Written, informed consent was obtained from all participants and their legal guardians.

Study Design

This study utilized a one-group pretest-posttest experimental design. The researcher followed identical procedures at each school during a two-week time period. The researcher conducted pretest interviews, implemented educational and environmental interventions, and then conducted posttest interviews to measure the impact of the interventions on students' handwashing knowledge, attitudes, and behaviors. Additionally, a follow-up survey was conducted with each school’s principle six months after initial implementation. The timeline for pre-and post-test measurements, implementation strategies, and follow-up surveys is found in Table 2 below.
Table 2

*Timeline for evaluation and intervention implementation*

<table>
<thead>
<tr>
<th>School</th>
<th>Pretest Surveys with Students Conducted</th>
<th>Interventions Implemented</th>
<th>Posttest Surveys with Students Conducted</th>
<th>Follow-Up Survey with Principle Conducted</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Raising Up Hope for Uganda</em></td>
<td>July 12-July 14, 2017</td>
<td>July 17-July 22, 2017</td>
<td>July 24-July 26, 2018</td>
<td>January 26, 2018</td>
</tr>
</tbody>
</table>

**Pretest/Posttest Instruments for Students.** The researcher adapted outcome indicator questions from UNICEF’s Handwashing Promotion Monitoring and Evaluation Module to assemble mixed quantitative and qualitative pre-and posttest surveys (UNICEF, 2013). In person interviews were conducted with each student individually, before and after interventions were implemented. A translator was available upon student request. The surveys consisted of 13 questions within four subscales measuring students’ knowledge, attitudes, and practices (KAP) regarding handwashing. Each question yielded quantitative data, however; questions three questions included a qualitative portion to allow students to expand on their answers, if necessary. The full instrument can be found in part two of this project.

**Subscales.** The *Knowledge of the Benefits of Handwashing with Soap Subscale* assessed students’ knowledge related to illness prevention and the purpose of soap. The *Knowledge of the Critical Times for Handwashing Subscale* assessed students’ knowledge of the four most critical times to wash hands (after using the toilet, after cleaning babies, before eating, and before preparing/cooking foods), as defined by UNICEF (2013), and if students knew soap was necessary to use during each critical time. The *Attitudes and Beliefs Towards Handwashing with*
Soap Subscale assessed students’ attitudes and beliefs about handwashing with soap, including how much he/she valued and enjoyed handwashing. It also measured student’s self-efficacy to teach others how to properly wash their hands. Finally, the Self-Report of Handwashing Behavior Subscale asked students if they ever discussed handwashing with family or friends and asked students to report how many times he/she washed his/her hands the previous day.

**Intervention Strategies.** The study consisted of two interventions chosen based on best practices and strategies identified in the literature. The interventions were also chosen based on findings from formative data collected in needs assessments. Influential to planning the interventions was feasibility related to the school’s resources, the study’s $5,000.00 budget, and a time frame of 2 weeks for implementation. The researcher developed the interventions based on handwashing promotion theoretical framework and existing resources provided by organizations including UNICEF and the Global Handwashing Partnership. The two interventions were an educational intervention and an environmental infrastructure intervention, which together comprised the “Healthy Hygiene Spirit Week” program for students.

**Educational Intervention: Hand-Hygiene Curriculum.** The 6-day hand-hygiene curriculum implemented at each school educated students about handwashing and encouraged their participation in healthy handwashing behavior. Each day had a theme, which is outlined in Table 3. The researcher used pre-planned lessons and students were given workbooks to supplement lessons and activities. The curriculum consisted of various education methods including lectures, discussions, worksheets, games, role play, and other interactive activities. Examples of activities included “glo-germs” facilitations to teach students about proper handwashing technique and handwashing maps to help students observe and identify places to wash their hands. On the sixth day, students participated in an advocacy march throughout their
communities to promote handwashing. Teachers were given copies of the curriculum and encouraged to participate in all lessons. The full curriculum and its corresponding materials can be found in parts 4, 5, and 6 of this project.

Table 3

*Daily Themes of Hand-Hygiene Curriculum for Educational Intervention*

<table>
<thead>
<tr>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
<th>Day 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germ Transmission and Disease</td>
<td>Proper Handwashing Technique and Importance of Soap</td>
<td>Important Times to Wash Hands</td>
<td>Benefits of Handwashing</td>
<td>Teaching Others about Handwashing and Sustaining Healthy Behaviors</td>
<td>Promotion of Handwashing in Community</td>
</tr>
</tbody>
</table>

*Environmental Intervention: Group Handwashing Station.* Group handwashing stations were implemented at each school to enable multiple students to wash their hands at the same time. Although the stations were designed to promote group handwashing, individual handwashing could also be practiced at each station. During each day of the curriculum’s implementation, the researcher instructed students to wash their hands at the station, as a group, before eating. Each school’s station featured a different design, based on space available for the structure and access to water. At Owimbi Academy, a handwashing station for fourteen students was constructed using iron sheets, a PVC pipe with 14 holes for water to flow through, and a water tank with one tap. Four soap bars were tied in fishnet stockings to the pipe. At Raising Up Hope for Uganda, a handwashing station for three students was constructed that featured a raised cement base and platform. A water tank was cemented to the platform and connected to three taps on the side of the cement structure, which could be individually turned on and off. Two soap bars were tied in fishnet stockings around the taps. Teachers were provided instructions for
operation and maintenance of the handwashing stations. Figures 1 and 2 depict the group handwashing stations.

*Figure 1. Group Handwashing Station at Owimbi Academy, Kenya*

*Figure 2. Group handwashing Station at Raising Up Hope for Uganda, Uganda*

**Impact Evaluations for School Principles.** Six months after the interventions were implemented, each school’s principle was contacted via e-mail and asked qualitative questions to
assess potential long-term impacts of the program. The questions asked if students were still participating in group handwashing at the stations and if other activities promoting handwashing or hygiene had been implemented at the school. Principles were encouraged to elaborate on any positive or negative outcomes that they observed.

Results

Pre-and Post-Surveys

Quantitative Data. Descriptive statistics were run for each school sample individually and then descriptive statistics were run for the combined sample using Version 24 of IBM Statistical Package for the Social Sciences (SPSS) software.

All Subscales. Pre-and post-surveys' subscales were analyzed and compared using paired t-tests. Paired t-tests were run for each school's sample separately, and paired t-tests tests were run for the combined sample. Students' handwashing knowledge, attitudes, and practices improved after intervention implementation. After intervention implementation, students at both schools demonstrated statistically significant improvements between pre-and post-surveys on all subscales. Students' knowledge of the benefits of soap increased (p<0.001), and students' knowledge of the critical handwashing times increased (p<0.001). Students' attitudes and beliefs towards handwashing became more positive (p<0.001). Prior to intervention implementation, students washed their hands an average of 3.34 times a day, but after implementation, students washed their hands an average of 4.51 times a day (p<0.001). Table 4 summarizes the results of paired t-tests run on subscales, including averages of scores and p-values.
### Table 4

**Comparison of subscales by school**

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Both Schools (n=95)</th>
<th>Owimbi Academy (n=38)</th>
<th>Raising Up Hope for Uganda (n=57)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ($)</td>
<td>Sig. (two-tailed)</td>
<td>Mean ($)</td>
</tr>
<tr>
<td>Knowledge of the Benefits of Soap</td>
<td>Pre 3.00</td>
<td>p&lt;0.001**</td>
<td>2.79</td>
</tr>
<tr>
<td></td>
<td>Post 3.59</td>
<td></td>
<td>3.74</td>
</tr>
<tr>
<td>Knowledge of the Critical Times for Handwashing</td>
<td>Pre 1.55</td>
<td>p&lt;0.001**</td>
<td>1.71</td>
</tr>
<tr>
<td></td>
<td>Post 3.47</td>
<td></td>
<td>3.58</td>
</tr>
<tr>
<td>Attitudes and Beliefs Toward Handwashing</td>
<td>Pre 3.51</td>
<td>p&lt;0.001**</td>
<td>3.16</td>
</tr>
<tr>
<td></td>
<td>Post 3.95</td>
<td></td>
<td>3.95</td>
</tr>
<tr>
<td>Daily Handwashing Quantity</td>
<td>Pre 3.34</td>
<td>p&lt;0.001**</td>
<td>3.13</td>
</tr>
<tr>
<td></td>
<td>Post 4.51</td>
<td></td>
<td>4.42</td>
</tr>
</tbody>
</table>

*Note.* * indicates statistical significance at p<0.05 level and **indicates statistical significance at p<0.01

**Knowledge of the Critical Times for Handwashing.** Additional descriptive statistics were run on this subscale, considering students at both schools, to analyze students’ knowledge of the four critical times independently. The proportion of students who knew the critical time before intervention was compared to the portion of students that knew the critical time after intervention. The proportion of students who mentioned the critical times increased for each critical time before and after intervention. The greatest proportions of gains in knowledge were for the critical times of after cleaning babies and before preparing/cooking food, and smaller proportions of gains in knowledge were made for the critical times of after using the toilet and before eating. Before intervention a small proportion of students knew to wash their hands after cleaning babies (4.20%); however, this proportion increased significantly after implementation (85.30%). Before intervention, many students knew to wash their hands after using the toilet (83.20%), but, after implementation, almost all students knew to wash their hands after using the
toilet (98.9%). Table 5 summarizes the proportion of students who mentioned the critical time before and after intervention.

Table 5

Comparison of Student’s Knowledge of each Critical Handwashing Time

<table>
<thead>
<tr>
<th>Critical Handwashing Time</th>
<th>Both Schools (n=95)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes mentioned</td>
<td>Percent Increase</td>
<td></td>
</tr>
<tr>
<td>After using the toilet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>83.20%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post</td>
<td>98.90%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After cleaning babies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>4.20%</td>
<td>81.1%</td>
<td></td>
</tr>
<tr>
<td>Post</td>
<td>85.30%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before eating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>61.10%</td>
<td>20.0%</td>
<td></td>
</tr>
<tr>
<td>Post</td>
<td>81.10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before preparing/cooking food</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>6.30%</td>
<td>75.9%</td>
<td></td>
</tr>
<tr>
<td>Post</td>
<td>82.20%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Self-Report of Handwashing Behavior Subscale.** Additional descriptive statistics were run to determine the proportion of students, considering both schools, who talked to their families or friends about handwashing. Before intervention implementation, 61.10% of students talked to their families about handwashing, but after implementation this proportion of students increased to 97.9%.

**Qualitative Data**

Qualitative data from pre-and post-surveys was entered into Microsoft Excel 2012, coded by theme, and assessed for the most common responses.

**Knowledge of the Critical Times for Handwashing.** Students’ responses to the most important times to wash hands that were not listed as one of the four critical handwashing times were recorded. The most frequent response from both the pre-and post-surveys was “after
"eating". On pre-surveys, more students said hands should be washed after eating (n=60), than students who said hands should be washed before eating (n=57). However, on post-surveys more students said hands should be washed before eating (n=77), than students who said hands should be washed after eating (n=29).

**Subscale: Attitudes and Beliefs Towards Handwashing with Soap.** Students were asked to how they felt after washing their hands. On pre-surveys, students most frequently stated they felt “good” (n=45) or “well” (n=10). On post-surveys, the most frequent response was again “good” (n=32). However, on post-surveys student responses also included more descriptive adjectives including “confident” (n=5), “smart” (n=4), “healthy” (n=4). Two students also reported they were able to concentrate better in school with cleans hands because their papers were not as dirty.

**Subscale: Self-Report of Handwashing Behavior.** If students said they had talked to their family or friends about handwashing, they were asked what topics related to handwashing they discussed with them. On pre-surveys, students most frequently stated they told others to wash their hands after using the toilet (n=15) and relayed information about the importance of soap (n=8). On post surveys, students had most frequently talked with others about all four critical times to wash hands (n=21). Many students also explained to others the most common areas germs are missed when washing hands, such as in-between fingers and palms (n=15). An additional nine students reported they had witnessed someone not wash their hands after a critical time, so he/she explained the importance of handwashing to that person. Four specific quotes from students are found in figure 3. These quotes indicate students’ handwashing behaviors improved in their homes and among their families.
Figure 3. Student’s post-intervention responses regarding discussion they had with family/friends about handwashing

**Impact Evaluations**

**Owimbi Academy**

The principle at Owimbi Academy stated that students were still participating in group handwashing daily and teachers supervised the activity. He also said that Owimbi Academy participated in an activity for Global Handwashing Day and one student had built two of his neighbors handwashing stations. Finally, the principle said the handwashing station had a positive impact on the school; however, there was one unforeseen obstacle. The handwashing station required the school to spend an additional 300 KES (3.00 USD) on water per week, which the school could not afford for three of the weeks during the six-month follow-up period.

**Raising Up Hope for Uganda**

The principle at Raising Up Hope for Uganda stated students were still participating in group handwashing daily and teachers supervised the activity. He stated students were no longer eating their food with dirty hands and sanitation conditions surrounding the school’s toilets
improved. One issue he noted was the soap bars, which were attached to the handwashing station, were frequently stolen and had to be repeatedly replaced.

**Discussion**

The present study found the implementation of a hand-hygiene curriculum and group handwashing station effectively increased students’ knowledge, adjusted their attitudes to be more favorable toward handwashing, and increased their self-reported handwashing frequency. Handwashing behavior improved in terms of soap and technique, and became an important topic of discussion for students. Interestingly, prior to the interventions’ implementation more students cited “after eating” than “before eating” as an important time to wash hands. This is likely due to the students’ cultural norm of eating with their hands. Students typically washed their hands after eating to remove visible food off. However, through the curriculum, students learned it was actually more important to wash their hands before eating to avoid getting sick and/or spreading disease, even though germs may not visible at this time. With this improvement in knowledge, students were motivated to start washing their hands before meals. Six months after the interventions’ implementation, students were still acting in accordance with this knowledge and washing their hands as a group before meals at school. These results support the association between handwashing knowledge and motivation for behavior change, as discussed by Galiani and colleagues (2015).

Further, as found in other successful handwashing initiatives (Contzen et al., 2015; Zhang et al., 2013), the strategic implementation of both educational and environmental interventions was effective in promoting and facilitating healthy handwashing behaviors. Educational interventions are not likely to be as effective in achieving behavior change, if they are not simultaneously implemented with a built, environmental intervention (Contzen et al.,
2015; Pfadenhauer & Rehfuess, 2015; Zhang et al., 2013; Aboud & Singla, 2012), a relationship
the present study supports. The present study’s educational intervention, the hand hygiene
curriculum, provided students with facts and information necessary for effective handwashing,
and subsequently the handwashing station gave them the opportunity to act upon their
knowledge in the school setting. The group handwashing stations gave students access to a
sanitary place to wash their hands, because without the station, the schools’ environments were
not physically conducive to the behavior. As the curriculum was implemented, students
demonstrated enthusiasm towards the behavior. Additionally, because the group handwashing
station allowed students to wash their hands together, the behavior became a social activity,
which generated more enthusiasm and practice of handwashing. However, this enthusiasm may
have faded, never to be translated into action, if students did not have the station to continuously
practice their handwashing skills.

It is important to note that the present study’s findings, as evidenced by students’
responses in figure 3, indicate that the curriculum improved handwashing behaviors in students’
homes and among their families. Even without the handwashing station at school, students may
have engaged in handwashing behavior improvements at home. However, improving
handwashing behaviors at school is crucial, since students encounter at least two of the most
critical handwashing times, before eating and after using the toilet, while at school. If students
are to make a habit of handwashing during these times, then they need access to a handwashing
station at their school. For example, if students are not washing their hands before meals at
school, they may then forget or neglect to wash their hands before meals at home.

Since the present study resulted in improved handwashing behaviors in both school and
home settings, there is increased potential for long-term behavior changes and improved health
outcomes. Future handwashing promotion programs, implemented at schools, should include multiple interventions to motivate and enable proper handwashing behavior among students. Education interventions are important to increase individual knowledge and improve attitudes, but built, environmental interventions, like handwashing stations, are a necessary resource to empower students to take action to improve their handwashing behaviors. Handwashing stations may vary in design, but stations will likely be effective as long as students have easy access to the facility and are instructed on how and when to use it. It may be beneficial to make handwashing a supervised, social activity, as achieved through group handwashing, to generate interest and encourage consistency of the behavior through daily, planned handwashing sessions.

Limitations

The author recognizes important limitations to the present study. The study’s design did not involve a control school to determine differences between students at a school that received the interventions and students at a school that did not receive the interventions. However, since the study incorporated students from two schools and similar results were found, there is increased support for the effectiveness of the interventions on students’ knowledge, attitudes, and behaviors. Second, surveys relied on self-reported handwashing frequency, which means students could have over-reported, forgotten, or misreported the amount of times they washed their hands, thus impacting accuracy of the data. Students may have also responded untruthfully to survey questions asking about handwashing beliefs and values by providing the answers they thought the researcher desired. For example, students may have declared they felt handwashing was a fun activity, but this may not actually be the case. Finally, the study was small-scale involving time constraints with a short period of data collection. Students’ knowledge, attitudes, and behaviors could have improved from pre-to post intervention in two weeks, but the
researcher did not verify that improvements in knowledge and attitudes were sustained. However, since handwashing behaviors continued to six months after implementation, it is likely students did not forget the important information and handwashing skills the interventions provided them with.

**Suggestions for Further Research**

Future studies are needed to examine the long-term impacts of the hand-hygiene curriculum and group handwashing stations implemented to determine if handwashing behavior improvements were sustained for more than six months. Long-term research should emphasize if the interventions were effective in decreasing incidences of morbidity and mortality. Implementing the present study’s interventions at other schools, especially those with larger student populations, could provide increased insight into the effects of education and built, environmental interventions on handwashing. Other research should explore how to ensure hand hygiene education is integrated into the school’s permanent curriculum, as opposed to an isolated two-week intervention, which would help ensure future generations of students are educated about handwashing. Interventions directed at increased training for teachers and establishment of handwashing guidelines at the school would be beneficial for sustainability.

**Conclusion**

The hand hygiene curriculum improved students’ knowledge of handwashing, but the handwashing station was necessary for students to translate their knowledge into action. School-based handwashing promotion programs that include both educational and built, environmental interventions can be successful in promoting handwashing behaviors and ensuring handwashing is practiced during important times. The approach may also encourage sustainability of handwashing behaviors, which then may lead to reduced incidence of disease in the long-term.
Funding

Funds were received from the Hillcrest Scholarship, a scholarship that supports student research initiatives, from the Honor's College at James Madison University in Harrisonburg, Virginia. Funds were awarded in 2017 to the author and used to purchase curricula material and to build the group handwashing stations.

Acknowledgements

The author wishes to thank Dr. Stephanie Baller for overseeing the study and for providing quick feedback and guidance throughout every stage to ensure its success. The author also wishes to thank Ms. Lucy Bryan Malenke and Dr. Sarah Blackstone for taking time to provide edits on the article. Finally, the author wishes to thank Owimbi Academy and Raising Up Hope for Uganda for their enthusiasm and participation in the study and expresses gratitude for Nick Oketch, Patrick Ssenyonjo, and William Bukenya for assisting as translators in the schools and helping coordinate the implementation of the study's interventions.

Declaration of Conflicting Interests

The author has declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.
References


