

Sustaining effective latrine cleaning in schools to protect child health in low-income settings

Fiona Vande Velde¹, Bruno Levecke¹, Sarah Gabriel¹, Zewdie Birhanu², Zeleke Mekonnen² & Michael R. Templeton^{3*}

¹Department of Translational Physiology, Infectiology and Public Health, Ghent University, Belgium.

²Institute of Health, Jimma University, Ethiopia. ³Department of Civil and Environmental Engineering, Imperial College London, United Kingdom. *m.templeton@imperial.ac.uk; +44(0)2075946099

Globally, significant emphasis is currently being placed on improving access to and acceptance of sanitation in schools as part of the drive towards achieving Sustainable Development Goal 6. However, the importance of sustaining effective cleaning of latrines in schools remains an under-emphasised and under-researched topic, imposing serious negative consequences for the health of school-aged children in low-income settings. In this perspective article, we summarise the limited existing literature on the impacts of unclean latrines in schools on aspects of child health, and the methods that have been trialled for achieving sustainable school latrine cleaning programmes. We highlight research needs and propose a new approach to school-led total sanitation, in the aim of moving towards a world in which no child gets sick because of the unhygienic state of the toilets in their schools.

Around the world, water, sanitation, and hygiene (WASH) in school (WinS) programmes aim to achieve several simultaneous objectives, including reducing hygiene-related diseases such as diarrhoea, but also enhancing school enrolment, attendance, and performance, and encouraging children to influence their parents and communities by adopting appropriate WASH-related practices. Although WinS programmes have focused on improving access to and acceptance of toilets, there has been relatively little attention paid to the sustained, long-term cleaning of toilets, once access and acceptance have been initially achieved¹⁻³. Similarly, behaviour change interventions in schools have focused on handwashing behaviours and consistent latrine usage, rather than promoting latrine cleaning practices^{4,5}. As a result, although access to latrines in schools and their acceptability may be improving in many settings, even well-constructed toilets are found to be often unusable, unsafe, or unclean, and may even serve as a source of infections.

The poor quality of latrine facilities in schools has been strongly linked to absenteeism, as revealed in the baseline data of a cluster-randomized trial in Kenya of school-based WASH interventions⁶. However, the impact evaluation of the trial did not support the notion that constructing new latrines could reduce absenteeism, as compared to control groups⁷. In fact, students in schools that received new latrines had a higher incidence of faecal pathogens on their hands as compared to those in schools that did not receive new latrines⁸. Moreover, the condition of latrines, including the presence of urine, faeces, mud, blood, flies, and smell, was found to be a significant barrier to usage, as reported by school-aged children⁹.

To promote good quality of WinS, the World Health Organization/UNICEF Joint Monitoring Programme (JMP) for Water Supply, Sanitation and Hygiene developed a framework of service levels to support countries on their way to reaching WASH-related Sustainable Development Goal (SDG) indicators. The JMP developed service 'ladders' for WinS, which enable progress to be tracked against steps on the ladder, classified as no service, limited service, basic services, and advanced services. 'Basic' school sanitation is defined as improved facilities that are sex-segregated, accessible (i.e. doors are unlocked or a key is available at all times), functional (i.e. the toilet is not broken, the toilet hole is not blocked and water is available for flushing in the case of pour flush toilets), and private (i.e. closable doors that lock from the inside, and no large gaps in the structure, which refers to any openings or spaces that might compromise the user's privacy). While maintaining an adequate level of cleanliness of school latrines on an ongoing basis may be implied within such frameworks, in practice it may not always be evident who is responsible for latrine cleaning in schools, how it should be done safely, what tools and equipment are needed to do so (e.g. brushes, disinfectant solution), and who will finance it.

Evidence of negative health outcomes arising from unclean toilets in schools

Proper sanitation practices serve as a broad preventive measure for many diseases that have a faecal-oral route of transmission. This is because inadequate access to sanitation facilities can lead to the contamination of surfaces, food and/or water, with faecal matter, which can contain disease-causing pathogens¹⁰. Children in low- and middle-income countries are particularly vulnerable to exposure to these diseases, as they often spend a significant amount of their time in environments with poor sanitation, such as schools¹¹. The impact of inadequate sanitation on occurrence of infectious diseases, or other health-related outcomes, has been suggested by several systematic reviews¹²⁻¹⁴. Inadequate sanitation, however, has mostly been defined in studies as not having access to or use of sanitation, or to improved sanitation such as pit latrines with slabs, if mainly focused on the latrine component, and less on the hand washing component after latrine use¹² or on access to clean toilets specifically, by accounting for the cleanliness of the toilet pan, floor and walls. Even access to improved forms of sanitation can increase exposure to pathogens if the latrines are not kept clean.

As such, in this perspective article we specifically focus on the impact of unclean toilets in schools in low-income settings, rather than access to or usage of toilets, which has been studied more extensively already. Table 1 summarizes the evidence of the impacts of school sanitation cleanliness status on various child health-related outcomes in low- and middle-income countries. Seven studies were identified that measured the effect of school sanitation cleanliness status on health-related outcomes; three in Kenya¹⁵⁻¹⁷, two in Ethiopia^{18,27}, one in China¹⁹, and one in Colombia²⁰. Two studies in Kenya were nested within larger cluster-randomized trials^{16,17}, while the third study was part of an ongoing monitoring and evaluation programme led by Kenya Medical Research Institute¹⁵. Studies in Ethiopia¹⁸ and China¹⁹ evaluated the local WASH programme that was put in place by the government, using either data collected by that programme¹⁹, or data collected independently¹⁸. The study implemented in Colombia²⁰ was not linked to any local programme or intervention, which is probably due to the early date of the study (1978), since a comprehensive WASH sector policy was not introduced in Colombia until 1994²¹.

Three studies measured diarrhoea in children as their main health outcome¹⁸⁻²⁰, and all three concluded that unhygienic sanitation conditions were related to diarrhoea. One study measured *Escherichia coli* contamination on school children's hands after the construction of new sanitation facilities¹⁷. They found increased contamination on schoolgirls' hands and concluded that constructing new facilities may pose a risk to children in the absence of sufficient hygiene behaviour change¹⁸.

Other studies inspected soil-transmitted helminth (STH)-infections in general¹⁶, or *Ascaris lumbricoides* infection specifically¹⁵, in relation to unclean sanitation facilities. The study of the latter found no significant odds ratio for percent of latrines with visible faeces on floor/walls with *A. lumbricoides* infection¹⁵, while Gass and colleagues found children in schools with "worse" latrine cleanliness scores were twice as likely to be infected with STH, compared to those with "better" latrine cleanliness scores¹⁶. In an Ethiopian national mapping programme, Grimes and colleagues presented a sanitation scoring system for assessing latrine quality in schools and found links between poorly-scoring latrines and hookworm infections, though not with schistosomiasis or whipworm infections, suggesting that school sanitation facilities may be a more effective protective factor against some parasites than others²⁷.

<Insert Table 1 here>

It is not only in schools in low-income settings that sanitation facilities have been identified as a source of infection, as some case studies in high-income countries have proposed a connection between school sanitation facilities with outbreaks of infectious diseases, such as hepatitis A in the United Kingdom²² and Sonne dysentery in Canada²³. In Japan, Japanese-style toilets in schools presented schoolchildren with more *E. coli* contamination on their hands, compared to Western-style toilets²⁴. Additionally, school toilet environmental factors have been shown to have an indirect effect on schoolchildren's health, through toilet avoidance causing lower urinary tract symptoms²⁵ and more severe bladder and bowel dysfunction²⁶.

Furthermore, due to the nature of the transmission routes, 17 out of the 20 acknowledged neglected tropical diseases (NTDs) are unavoidably linked with poor access to safe WASH²⁸. Consequently, it does not come as a surprise that the WASH sector has been highlighted as needing to play an important role in the multisectoral response required to achieve the ambitious 2030 NTDs targets set by the World Health Organization (WHO)²⁸. For those NTDs for which infected/contaminated human stool is crucial for disease transmission, such as soil-transmitted helminthiasis and *Taenia solium* taeniasis, access to clean toilets/latrines and safe management of faecal waste, and promoting hygienic practices (e.g., nail clipping hand washing and prevention of open defecation) are considered

as modest/potential preventive WASH-interventions for infection^{29,30}. The attributes of the different measures separately however remain unknown, due to a lack of well-designed studies³⁰. A recent survey assessed the environmental contamination of infectious life stages of STH and *Taenia saginata* in ten governmental schools in Ethiopia (Jimma town)³¹. Their findings highlighted that life stages were ubiquitous across the school compounds, and that the level of life stages in the environment was positively associated with prevalence across the schoolchildren. Yet, it remains unclear whether schools are a source of STH infections or whether children are contributing to school contamination, or both. They also reported that the contamination in classrooms was higher than around latrines. According to the authors, this was due to extremely dirty latrines (the upper inside of the latrines was extremely contaminated with human faeces), and hence it is likely that children step into faeces when using the latrines and then step into the classroom with shoes contaminated with faeces (see also **Fig 1A**).

<Insert Figure 1 here>

In another study in Nigeria, Enogiomwan Imalele and colleagues investigated the environmental contamination of STHs on school compounds, including the playground, latrine area, and dumpsites surrounding the schools³². The study found that the dumpsites had the highest prevalence of STH contamination, indicating that they may pose a significant health risk to school-aged children. The researchers suggested that a possible reason for the high prevalence of STHs in the dumpsites was the inaccessibility of the school latrines, leading the children to defecate in these areas³². This finding further highlights the critical need for clean sanitation facilities in schools to prevent the spread of STH infections and other diseases that may be transmitted through faecal contamination. Further research is also needed into the impact of unclean toilets in schools on other potential negative health outcomes (e.g. respiratory infections) as well as social and emotional wellbeing.

To add to the limited existing published literature on this topic, and to further highlight the challenge posed by unclean latrines in schools, we also conducted our own field observations of government-funded schools in Jimma town, Ethiopia, and present them here as an illustration of the common strengths, weaknesses, opportunities, and threats to achieving sustained latrine cleaning in schools in low-income settings (Box 1).

<Insert Box 1 here>

How can we sustainably keep toilets clean in schools in low-income settings?

Against this background, attention has grown on unhygienic sanitation facilities³³, their impact on usage^{32,34}, reduced odds of school absence⁶, and negative health outcomes³⁵, as well as factors contributing to their unhygienic status such as the high ratio of students to latrines³⁶, insufficient funds allocated to maintenance^{34,37}, and the absence or malfunction of school hygiene and environmental health clubs³³. However, only a limited number of studies have explicitly included a sanitation facility cleaning intervention for improving the usability (i.e., usable, accessible, and private)^{38,39}, cleanliness³⁹⁻⁴¹, and usage⁴⁰ of sanitation in schools.

Six studies in low- and middle-income countries were identified that included a distinct sanitation cleaning/maintenance intervention in schools. They are presented in Table 2 and described below.

<Insert Table 2 here>

Two studies were implemented in Kenya^{42,40}, two in the Philippines^{38,39}, one in Mali⁴³, and one in Lao PDR⁴¹. Five of the studies were embedded in, supported, or complemented local government- or non-governmental organization-driven programmes, such as SWASH+ (School Water, Sanitation, and Hygiene Promotion Plus Community Impact) in Kenya⁴⁰, FIT Plus (Focused Implementation of Toilets for schools, including a school sanitation operation and maintenance package) in the Philippines^{38,39}, DCIM (Dubai Cares Initiative in Mali) for WASH in Mali⁴³, and WASH-HELPS (Water, Sanitation, and Hygiene for Health and Education in Laotian Primary Schools) in Lao PDR⁴¹. All studies were designed as randomized controlled trials, except for the longitudinal, matched-control trial DCIM for WASH in Mali⁴³.

Most of the studies implemented a reasonably comprehensive WASH programme, including the provision of basic WASH reusables (e.g., toilet brushes, buckets, locks, and trash bins) and consumables (e.g., toilet tissue and menstrual pads), cleaning and maintenance supplies (e.g., mops, buckets, brooms, sponges, bleach, and screwdriver), and information, education, and communication activities. The exception was one study in Kenya⁴², where the schools were allocated a budget for their own provision of materials, and the 'maintenance arm' in the trial received an additional budget for repairs of existing infrastructure and formal employment of a part-time WASH attendant. In addition, the latter was the only study that relied on an external, remunerated person to clean and maintain the sanitation facilities in the schools. The other studies relied on school children for cleaning and maintenance of the facilities through instructions by the teachers⁴⁰, or self-governance through school health clubs⁴³, or "Hygiene Action led by Pupils in Schools" (HAPIS)⁴¹. The two studies in the Philippines received tools that enabled schools to systematize WASH activities in the way that was most appropriate to each school, and therefore no particular group was appointed as responsible for cleaning and maintenance of the facilities^{38,39}. The latter promoted establishing financial, WASH governance, and material management systems at the school level, as well as the study in Mali⁴³.

Two studies included school absenteeism as primary outcome^{40,43} and WASH conditions such as the usability and cleanliness of sanitation facilities, behavioural outcomes such as sanitation usage and group cleaning, and self-reported absence or health-related incidences as secondary outcomes. The other half focused primarily on WASH conditions^{38,39,42} and included other secondary outcomes such as school sanitation satisfaction. Results were mixed but provided some support for improving latrine usability and cleanliness^{39,40,42}, and to some extent for sanitation usage⁴¹, indicating that the implementation of sanitation cleaning and maintenance interventions should be supplemented with interventions that support sustained usage. No evidence was found for reducing school absenteeism^{40,41,43}, which is to be expected, since absenteeism is a complex, multi-faceted issue.

While we commend previous research efforts for acknowledging the often-neglected aspect of toilet cleaning, we have identified certain limitations that merit future consideration. Primarily, the majority of the studies implemented comprehensive WASH programmes in the schools^{38,39,40,41} and toilet upkeep was integrated within these programmes, but not a main focus. Integrated WASH programmes (versus focusing solely on sanitation) are surely beneficial for many reasons, but however toilet upkeep may be under-emphasised within such programmes. We recommend a more comprehensive strategy within WASH programmes that focuses on sustaining latrine cleanliness and ensuring the associated necessary behaviours. Secondly, in several cases, the interventions relied on the uptake of cleaning tools that were provided by the studies, however, challenges with compliance were commonly reported^{38,40,41}. Therefore, future interventions would benefit from more participant involvement in the selection of these tools and the required training to use them, resulting in more usable and sustainable solutions. Finally, relying only on children for the upkeep of toilets, dissemination of messages and social behavioural change^{40,41,44} may burden them with

disproportionate and unsafe responsibilities. Therefore, we encourage a participant-led approach that considers the above challenges.

School-led total sanitation (SLTS) and a proposed way forward

School-led total sanitation (SLTS) is a participant-led approach to discourage open defecation and improve sanitation practices in both schools and the surrounding communities, particularly in rural areas. The approach involves creating a sense of disgust and shame around open defecation and motivating schools and community members to take collective action to construct and use latrines. It takes the dynamics of children into consideration as agents of change in triggering and monitoring good sanitation and hygiene practices in both schools and communities^{44,45}. It is based on the principles of community-led total sanitation (CLTS), which focuses on sanitation in the wider community rather than the schools⁴⁶. Over the years, CLTS has evolved to include a range of strategies, including social and behaviour change communication (SBCC), community mobilisation, and intersectoral collaboration⁴⁷. It is currently included within the WASH strategies of 50 STH-endemic countries, and within major development aid WASH programmes (UNICEF, USAID, and the World Bank's Water and Sanitation Program)⁴⁸. However, the results of such programmes have been mixed^{3,46,53}. Moreover, there has been criticism of their impact on human rights⁴⁹⁻⁵¹ and child rights⁵². Some approaches mimic colonial public health practices based on derogatory labelling and punitive routines⁵⁰. Given the controversies surrounding it, SLTS, as it stands today, requires scrutiny and optimisation.

In response to this, in Box 2, we summarize the key challenges associated with STLS and propose an adapted approach to be trialled, which we call 'SLTS-PLUS'. We call for research into improved SLTS approaches that aim to be as generalisable across cultures and countries as possible. This research should take a rigorous evaluation and monitoring approach to generate evidence of 'what works' and should consider the wider factors influencing some aspects of child health, including nutrition and housing conditions, rather than considering school sanitation cleanliness status in isolation. Studies are particularly encouraged which combine monitoring of infections alongside environmental risk assessment, including parasitological sampling of surfaces, water and soil in and around latrines in schools.

<Insert Box 2 here>

Furthermore, more emphasis should be placed on the latrine cleaning strategy during the initial engineering design of school latrines, such as in the consideration of easier-to-clean wall and flooring materials⁵³. School sanitation implementation programmes that are funded by governmental and non-governmental sources should take into account the budgets needed not just for proper latrine construction and the associated faecal sludge management services (i.e. latrine emptying and the subsequent transport, treatment, and safe disposal of faecal sludge), but also the ongoing financial support that is needed to keep school latrines clean, including for cleaning equipment and chemicals, and possibly dedicated cleaning staff, as well as the resources needed for the training programmes and effective behaviour change programmes to ensure proper ongoing latrine cleaning practices. We also advocate for the integration of sustainable sanitation programmes, including latrine cleaning planning and training, within or alongside disease prevention programmes that are aimed at school-aged children (e.g. school de-worming programmes), to maximise the benefits of these programmes.

In conclusion, deeper appreciation and understanding are needed of the range of negative effects on the wellbeing of children that arise from unclean toilets in schools in low-income settings. It is crucial

to think beyond access to and acceptance of latrines in schools and consider also the most effective ways to ensure their sustained, long-term, cleanliness. Multifaceted approaches are needed, considering local contexts, prioritising incremental changes over radical ones, and ensuring the safe, dignified, and ethical participation of children in the process.

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Author contributions

F.V.V. led the writing of all parts except the sub-section on evidence of health outcomes. B.L. and S.G. led the writing of the sub-section on evidence of health outcomes. Z.M. and Z.B. contributed to all parts except the sub-section on evidence of health outcomes. M.R.T. led the conception and contributed to and provided feedback to all parts.

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Table 1. Studies of school sanitation status and various child health-related outcomes in low- and middle-income countries. Abbreviations. Randomized controlled trial: RCT; Soil-transmitted helminth: STH

Source	Country	Study description	Health outcome studied	Findings
Koopman, 1978	Colombia	Not linked to a WASH programme or intervention	Diarrhoea	Unhygienic toilet conditions were related to diarrhoea
Greene et al., 2012	Kenya	Nested within a larger RCT	<i>Escherichia coli</i> contamination	Increased contamination on school girls' hands after building new latrines
Gass et al., 2014	Kenya	Nested within a larger RCT	STH infection	Children in schools with "worse", compared to "better" latrine cleanliness scores were twice as likely to be infected with STH
Garn et al., 2016	Kenya	Monitoring and evaluation programme led by Kenya Medical Research Institute	<i>Ascaris lumbricoides</i> infection	No established evidence from latrines with visible faeces on floor/walls with <i>Ascaris lumbricoides</i> infection
Grimes et al., 2016	Ethiopia	National mapping programme of WASH in schools and child health, via the Ethiopian Public Health Institute	STH and <i>Schistosoma</i> infection	Different forms of WASH have varying effects on different parasites
Gebrehiwot et al., 2020	Ethiopia	Evaluation of local WASH programme using self-collected data	Diarrhoea	In schools without WASH program, the odds of diarrhoea were decreased with cleaner latrines
Cha et al., 2021	China	Evaluation of local WASH programme using data obtained through that programme	Diarrhoea	Diarrhoea was more likely to affect students who attended schools with unclean and poorly maintained toilets and toilets with flies

Table 2. Identified studies with a distinct sanitation cleaning/maintenance intervention in schools in low- and middle-income countries. *Abbreviations. Randomized controlled trial: RCT; Matched case-control trial: MCT.*

Source	Country	Programme	Study design	Sanitation cleaning/maintenance intervention	Results
Alexander et al., 2013	Kenya	/	RCT	Monetary package for repairs of existing sanitation facilities and employment of a part-time WASH attendant.	Improved sanitation cleanliness
Caruso et al., 2014	Kenya	SWASH+	RCT	Received reusables and consumables. Training school staff for instructing pupils on cleaning and monitoring sanitation facilities.	Improved sanitation cleanliness, no effect on sanitation uses or absenteeism
Trinies et al., 2016	Mali	DCIM for WASH	MCT	Received reusables and consumables. Training school staff, establishing school health clubs, and establishing WASH self-governance.	Increased absenteeism, reduced self-reported infection symptoms
Chard & Freeman, 2018	Lao PDR	WASH HELPS	RCT	Not specified reusables and consumables for cleaning. Training in: Hygiene Action led by Pupils in Schools (HAPiS), with a component of group sanitation and school compound cleaning.	Improved sanitation cleanliness/maintenance, minor improvement in sanitation maintenance planning, and increased group sanitation- and school compound cleaning
Buxton et al., 2019	Philippines	FIT Plus	RCT	Received reusables and consumables. Training of school staff with a manual on sanitation maintenance, monitoring, and budgeting, as well as a video to orient school staff and parents.	No effect on sanitation improvement, children's satisfaction increased overall, and teachers' satisfaction only on the provision of sanitation materials
Duijster et al., 2022	Philippines	FIT Plus	RCT	Received reusables and consumables. Training of school staff with a manual on sanitation maintenance, monitoring and budgeting, as well as a video to orient school staff and parents.	Increased usability and cleanliness of sanitation facilities.

Figure 1. Illustration of unclean toilets and dysfunctional waste collection facilities at government-funded schools, Ethiopia. *Panel A: Full latrine with inappropriate disposal of cleansing materials, such as empty water bottles and paper. Panel B: Handwashing station on school premises without water connection. Panel C: Waste pit used for burning litter collected on school premises. Panel D: Open waste container used inappropriately so that litter is scattered around the playground.*



Box 1. Strengths, weaknesses, opportunities and threats (SWOT) analysis for latrine maintenance in schools, from observations in Jimma town, Ethiopia.

Strengths

- Cleaning service periodically sweeps floors in the school compounds and latrines
- Students periodically sweep the classrooms (every day vs. once a week)
- Waste management of litter from latrines/toilets (see **Fig 1C**, pit where litter is collected and burned)
- Designated room for menstrual hygiene and provision of sanitary pads to girls
- Handwashing stations available
- Separation of latrines for boys and girls
- Teachers trained in menstrual hygiene
- Implementation of health clubs

Weaknesses

- Schools are not easily accessible for services to empty latrines (even in an urban setting)
- Services to empty toilets/latrines are expensive/too busy
- Animals (e.g. livestock, wild) have access to school compounds
- Too few latrines/toilets per student (e.g. 1–2 buildings covering 2x3 latrines) for 1,000 - 3,000 children
- No separation of latrines for school students and staff
- Lack of access to clean water
- Lack of appropriate waste management strategy (see **Fig 1D**)

Opportunities

- Installation of waste bins
- Allocation of funds for infrastructure maintenance
- Secure water connections to handwashing stations available (see **Fig 1B**)
- Employment of a local WASH attendant for a group of schools
- Support with WASH governance and material management systems at the school level
- Seek partnerships with local NGOs and other organizations
- Integrate latrine maintenance into the existing health education program

Threats

- Waste (plastic bottles / paper) are discarded into latrines/toilets, causing rapid latrine filling and making emptying more challenging (see **Fig 1A**)
 - Floods of latrines during the rainy season
 - Potential cultural barriers coming from the communities, undermining health messaging in schools
 - Limited capacity for sustaining the maintenance activities, e.g. lack of cleaning materials or budget
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Box 2. The current challenges in school-led total sanitation (SLTS), and the ‘SLTS-PLUS’ concept.

- **The shaming approach** can be argued to violate basic human rights: shame is a volatile and often harmful emotion, particularly in conditions of poverty where the skills and resources needed to carry out the behaviour are lacking^{54,55}. Moreover, there is a significant lack of empirical causality of these emotional processes on positive behavioural outcomes⁵⁶.
- **Children as change agents:** the mechanisms through which students influence their caregivers are both ineffective and understudied³. In addition, student participation often ends up with children being burdened with disproportionate responsibilities and unsafe practices⁵².
- **Latrine access and coverage** are the main focus of sanitation efforts in schools^{1,2}, while student-focused interventions have mainly focused on handwashing behaviours, which can be affected by the unavailability of basics of hygiene resources, and latrine acceptance. Latrine upkeep in schools is an often-over-looked aspect^{4,5}.
- **Implementing parallel solutions** has been, among other things, a critical limitation of WASH interventions⁵⁷. The emphasis has been too much on radical change, rather than focusing on adaptable, but local practices. In addition, studies have evaluated intervention packages, rather than separate components, which results in a knowledge gap, as well as missed opportunities for streamlining complex interventions^{58,59}.

‘SLTS – PLUS’: a proposed way forward.

SLTS – PLUS formulates a positive, logical, usable, and sustainable response to the aforementioned challenges, to guide future school-based sanitation programs:

- **Positive:** steering clear from potentially harmful and unethical practices. The self-determination theory shows that enjoyment, interest, and a sense of value, among other things (i.e., internalized forms of motivation) are associated with a range of positive results, compared to negative emotions⁶⁰. In addition, develop an ethical code of conduct for protecting children from harm⁵⁹.
 - **Logical:** engaging children in meaningful, and safe practices by understanding the mechanisms of influence, which will lead to meaningful engagement of students as agents of change⁴⁵.
 - **Usable:** explicitly include a latrine cleaning intervention for improving the usability of school latrines (i.e., usable, accessible, acceptable, and private)³⁸⁻⁴⁰. The intervention in itself should be usable, in terms of being practical and tailored to the local context and needs (e.g., employment of a local WASH attendant for a set of schools, improving usability and emphasizing latrine use and upkeep).
 - **Sustainable:** human-Centered Design (HCD) has been proposed as a creative approach to innovation in health, owing to its methodology that prioritizes deep empathy for the local community’s desires, needs, and challenges^{61,62}. HCD includes all stakeholders and iterates through a range of possible solutions quickly, which results in a more comprehensive understanding of the problem and co-creation of the solution, rapid testing of ‘what works’, and ultimately more sustainable and inclusive solutions to address community needs⁶³.
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