

Review Paper

Water, sanitation and hygiene systems in Pacific Island schools to promote the health and education of girls and children with disability: a systematic scoping review

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ABSTRACT

Water, sanitation and hygiene (WASH) systems in schools contribute to successful education by promoting good health and supporting school attendance. Girl students and students with disability face significant challenges when there are inadequate WASH systems. Pacific Island Countries and Territories (PICTs) have some of the lowest levels of improved WASH systems on earth. The aim of this review was to document the characteristics and effectiveness of approaches to improve WASH systems that promote the health and education of girl students, and students with disability in PICTs. This systematic scoping review comprehensively searched peer-reviewed and grey literature about WASH, PICTs, schoolgirls and students with disability. At best, there are only fleeting mentions in the grey literature about WASH and disability in schools in PICTs. Inclusion and exclusion criteria resulted in 12 publications being included: 1 review; 7 original research; 4 commentaries/project reports. A holistic approach to WASH in schools in PICTs must consider how the entire school WASH system can be inclusive of girls and children with disability. Incorporating local PICT learning epistemologies (ways of knowing) and local PICT pedagogies (ways of learning) are required to ensure new WASH systems reduce existing inequalities for girls and students with disability.

Key words | children with disability, education, girl students, Pacific Island Countries and Territories (PICTs), public health, water, sanitation and hygiene

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INTRODUCTION

Pacific Island Countries and Territories (PICTs) experience some of the lowest levels of improved water, sanitation and hygiene (WASH) on Earth (WHO 2016). Yet the United Nations General Assembly has recognised that

access to safe water and sanitation are standalone universal human rights (United Nations 2015). The global community has committed to achieving 17 Sustainable Development Goals (SDGs) by 2030. This commitment includes Goal 6 which states that access to safely managed WASH should be universally available and is a global priority (United Nations 2017).

WASH are essential for life and often directly related to experiences of poverty and/or conflict. It is estimated that 844 million people globally do not have access to

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doi: 10.2166/washdev.2018.274

basic sources of drinking water (defined as originating from an improved water source within a 30-minute roundtrip), and 2.3 billion people lack access to basic sanitation facilities (defined as improved facilities that are not shared with other households) (WHO & UNICEF 2017). In PICTs, only one-third of people have access to basic sanitation facilities and half to basic water sources (WHO & UNICEF 2017). These statistics hide inequities between PICTs, with four PICTs (Kiribati, Solomon Islands, Tuvalu and Vanuatu) assessed as Least Developed Nations (as at July 2017, United Nations Committee for Development Policy 2017). For example, availability of basic water for PICTs ranges from 98% for Niue, to 37% for Papua New Guinea (PNG) (WHO & UNICEF 2017). In the Solomon Islands, only 31% of the population have access to basic sanitation (WHO & UNICEF 2017), and 66% of the population live in areas where open defecation is common (World Bank Group 2017).

For the purpose of this manuscript, we adopt the UNICEF definition of WASH:

‘WASH is the collective term for water, sanitation and hygiene. Due to their interdependent nature, these three core issues are grouped together to represent a growing sector. While each (is) a separate field of work, each is dependent on the presence of the other. For example, without toilets, water sources become contaminated; without clean water, basic hygiene practices are not possible’ (UNICEF 2017).

We also adopt the definition of a system as:

‘A set of things – people, cells, molecules, or whatever – interconnected in such a way that they produce their own pattern of behaviour over time’ (Meadows 2009, page 2).

Thus, in the case of WASH systems we include all of the products, services, stakeholders, educational initiatives, internal and external interventions and infrastructure as parts under consideration.

Adequate WASH systems contribute to successful educational experiences for students in schools by supporting good health and school attendance (Jasper et al. 2012). Conversely, inadequate WASH systems in schools contribute to

increased absenteeism, decreased academic performance and delays in academic development (Esteves Mills & Cumming 2016). Students may be reluctant to attend school when there are unsuitable or no WASH facilities (UNICEF & GIZ 2013).

Negative health outcomes resulting from poor WASH systems in schools include helminth infections, diarrhoea, and respiratory and other communicable diseases (Duijster et al. 2017). Infectious diseases, including diarrhoeal diseases, result in illness and potentially death (Water Aid 2015). In the Pacific nation of the Solomon Islands, with a population of just over half a million, an estimated 200 deaths per year are attributable to diarrhoea and other water- and sanitation-related problems (World Bank Group 2017). There are also health risks for school students who do not have access to adequate, and/or avoid using, sanitation facilities. These risks include constipation, incontinence and urinary tract infections (Jasper et al. 2012). Poor WASH conditions can result in stunting of children, which contributes not only to delayed physical development but also adverse cognitive development (Ngure et al. 2014; Barrington 2016a). Inadequate WASH systems contribute to the loss of disability-adjusted life years (DALYs) and reduce opportunities for future employment and education. Interventions that have improved access to WASH services have been found to be associated with improved growth and cognitive outcomes (Piper et al. 2017).

Girl students, and students living with disability, face the most significant challenges when there are inadequate WASH systems in schools. Girls may miss school when they are menstruating due to inadequate WASH facilities (Sommer et al. 2014). Girls in schools need adequate water and sanitation facilities, along with privacy and space for changing, cleaning, drying or discarding materials (Sommer et al. 2013). More than 90% of children with disability in developing countries do not attend school, with inadequate WASH facilities contributing to their exclusion (FSG 2016). Improving WASH systems in schools is a key intervention to increase all children’s prospects for healthy development (Duijster et al. 2017) and can foster social inclusion and individual self-respect (Sommer et al. 2014). An integrated approach to WASH systems that is gender sensitive and disability inclusive is required (Water Aid Australia 2017).

There is a small, but growing, body of research literature emerging about WASH systems in the PICTs, as they relate to girls in schools. At best, there are only fleeting mentions about WASH systems and disability in schools in PICTs. Calls to improve WASH systems in PICTs are being made, including to improve the physical and cognitive health and wellbeing of children (Barrington 2016a). There have also been a number of recent literature reviews that report on WASH systems both globally, and in the Pacific region (Vindigni *et al.* 2011; Jasper *et al.* 2012; Parker Fiebelkorn *et al.* 2012; Willetts *et al.* 2012; Taylor *et al.* 2015; Esteves Mills & Cumming 2016; Rosenqvist *et al.* 2016; Water Aid *et al.* 2016; MacDonald *et al.* 2017; McGinnis *et al.* 2017). However, to the knowledge of the authors, there has not been a review conducted about WASH systems in PICT schools, particularly focusing on girls and students living with disability. To this end, the authors conducted a review of the WASH literature from PICTs relating to schools, girls and students with disability. The aim of the review was to evaluate the existing evidence to document the characteristics and effectiveness of approaches to improve WASH systems that promote the health and education of girl students, and students with disability, for children (aged 3–19 years). The objectives included the following:

1. Identify the quantity and nature of available evidence, and its quality.
2. Understand the facilitating environments, strategies, and outcomes of WASH systems in schools.
3. Explore the interface between theoretical knowledge and practice that informs WASH systems to promote the health and education of female students and students with disability in the PICTs.

Because all of the authors are from PICTs, or have worked for many years in PICTs, we are acutely aware that knowledge documented in the literature is not universal, nor does it represent all knowledge systems. We therefore critically engaged with the review to propose how local epistemologies and pedagogies could be incorporated to improve WASH systems in schools in the region.

METHODS

Identification of publications

The peer-reviewed literature was searched 27–30 June and 3 July 2017 by an accredited librarian working at an Australian university. The accredited librarian assisted in design of the search strategy and search strings for the peer-reviewed literature. An exploratory search was carried out in Scopus/Elsevier and selected references were downloaded. Following a discussion with authors about key terms, refinements were made to key terms and the nature of literature to be searched. The librarian then completed a comprehensive search in: Medline (including Epub Ahead of Print, In-Process & Other Non-Indexed Citations)/Ovid; Embase/Ovid; PsycINFO/Ovid; EBM Reviews – Cochrane Database of Systematic Reviews/Ovid; Global Health/ Ovid; ERIC/Proquest; EconLit/Proquest; CAB Abstracts/Ovid; Environment Complete/Ebsco; Geobase/Elsevier; and the Campbell Collaboration databases, and all references were downloaded.

Search strategy

The databases were searched with the terms below (and their corresponding subject headings in each database where specialised thesauri existed):

1. Hygiene OR sanitation OR environmental sanitation OR sewage OR sewerage OR water supply OR water quality OR water resource management OR WASH OR 'water, sanitation and hygiene'
2. Public policy OR health care policy OR health care planning OR health program OR public health practice OR government regulation
3. Pacific Islands OR Pacific Island Countries and Territories OR Pacific OR Pacific Island Countries OR Melanesia OR Polynesia OR Micronesia OR American Samoa OR Cook Islands OR Federated States of Micronesia OR Fiji OR French Polynesia OR Guam OR Kiribati OR Marshall Islands OR Nauru OR New Caledonia OR Niue OR Northern Mariana Islands OR Palau OR Papua New Guinea OR Pitcairn Islands OR Samoa OR Solomon Islands OR Tokelau OR Tonga OR Tuvalu OR Vanuatu OR Wallis OR Futuna

4. Children OR child development OR child health OR adolescent OR young people OR young adult* OR teenage* OR juvenile* OR schools OR school hygiene OR preschool education OR primary schools OR primary education OR high schools OR secondary education OR preschool children OR school child* OR student OR pupil OR scholar OR school attendance OR school enrolment OR educational status OR educational measurement OR academic performance OR achievement OR mental ability OR learning OR female OR schoolgirl OR disabled children OR disabled persons OR disability OR developmental disabilities OR intellectual disability OR health status disparities OR social determinants of health
5. And/1–4

The results were limited to human studies published in English from 1990 to the present (2017). As shown in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram (Figure 1), 267 records were identified.

Grey literature search

Grey literature (Schöpfel 2011) was searched from 28 June to 19 July 2017 by an author (MRM). Twenty-three websites and three clearinghouses that included documents related to WASH and schools in the Pacific were scanned. Resource lists were scanned for smaller collections. For larger sites, including Google, the search criteria were applied as per the peer-reviewed search outlined above. If string limitations

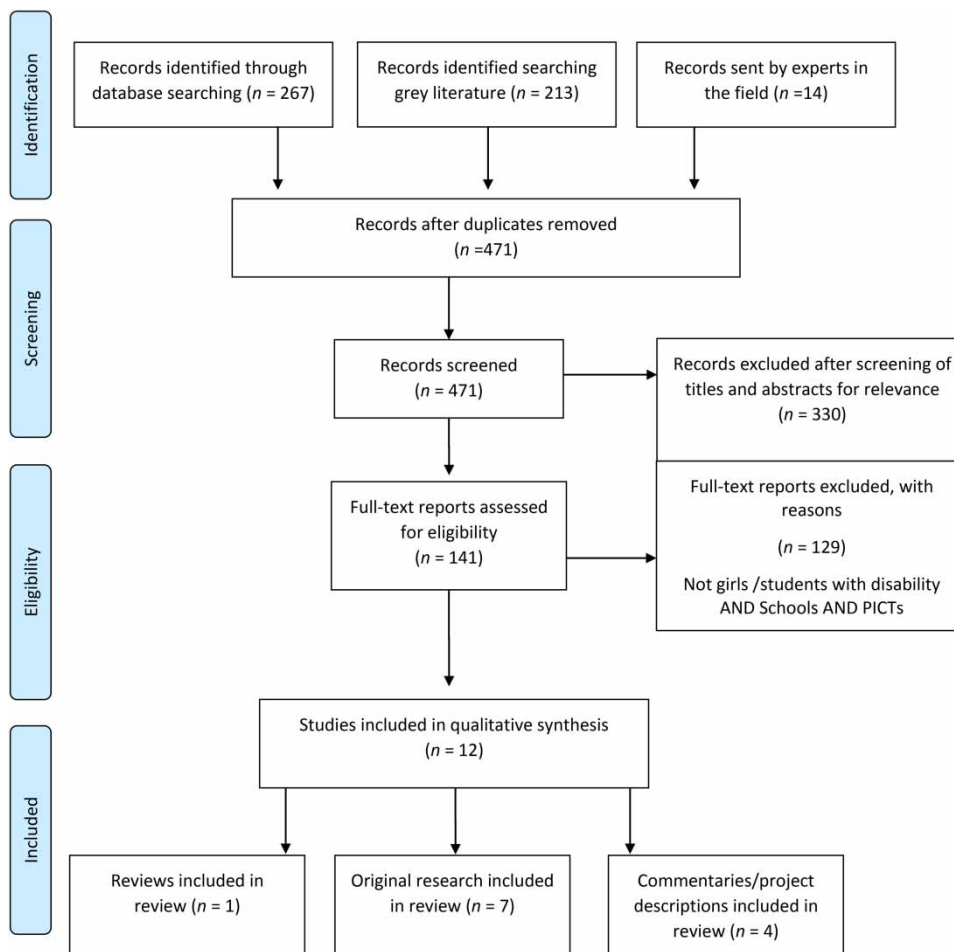


Figure 1 | The PRISMA statement (Moher et al. 2009).

applied (e.g. Google only accepts 32 search terms (ignoring connectors such as AND and OR)), then combinations of the above strings were searched to ensure a comprehensive search of available literature. While authors are aware of the limitations of such an approach (Haddaway *et al.* 2015), time and resource constraints meant a decision was made to assess the first 100 hits per search. If search strings could not be accommodated by the search function of the website (usually due to size of website), minimum search terms included 'Pacific AND WASH AND schools AND girls'. In addition, reference lists from peer-reviewed and grey literature were scanned, and relevant resources downloaded. Relevant grey literature was downloaded from 26 search engines, clearinghouses, alliances and organisation websites. As shown in the PRISMA diagram (Figure 1), 213 grey literature publications were identified.

Expert search strategy

The authors also contacted several experts working in the field for additional references; 14 additional publications were collected and screened.

Inclusion and exclusion criteria

The following inclusion and exclusion criteria were applied for consistent reviewing and checking.

Inclusion criteria:

- Published between 1990 and June 2017 – to reflect the November 1989 Convention on the Rights of the Child. The Convention points to water, environmental sanitation and hygiene in Article 24(2) (United Nations Human Rights Office of the High Commissioner 1989). Additionally, there is very little likelihood that there are functioning WASH technologies that pre-date 1990, and there is evidence that there is very little published pre-1990 about WASH in PICTs.
- Published in English.
- Target population between 3 and 19 years.
- Peer-reviewed literature and grey literature.
- Any study that referred to WASH in schools AND girls/young women in PICTs; WASH in schools AND students with disability in PICTs.

- Any study that focused on improving the capacity of school environments, teachers or other staff to promote WASH facilities.
- Any study that referred to WASH and health outcomes for schoolchildren in PICTs.
- Any study that referred to WASH and education outcomes for schoolchildren in PICTs.

Exclusion criteria:

- Pre-1990.
- WASH in schools that did not include girls and/or children with disability.
- Languages other than English.

Screening

The titles and abstracts of the 471 publications were screened by one author (MRM) applying the inclusion and exclusion criteria. If it was unclear whether a publication should be included in the review, the authors reviewed the full text of the publication before a decision was made; those publications which did not meet inclusion criteria were excluded. To ensure quality of the selection process, other authors (DJB and DM) independently reviewed the titles and abstracts of the peer-reviewed and grey literature which MRM was unclear about including, reading the full texts as required. Authors then conferred on included publications and consensus was reached.

Types of publication

The type of publication included in the literature review was determined using the Sanson-Fisher classification of publications: original research; reviews; program descriptions; discussion papers or commentaries; or case reports. Research publications were further classified as either measurement, descriptive or intervention. Intervention studies were then classified as either experimental or non-experimental (Sanson-Fisher *et al.* 2006).

Quality assessment

Assessment of the quality of articles was undertaken using the Canadian hierarchy of promising practices evidence

(Figure 2) (Canadian Homelessness Research Network 2013). The hierarchy outlines three categories (and four levels) of evidence ranging from best practices, promising practices through to emerging practices, with Levels 1 and 2 representing a best practice intervention, method or technique that has consistently been proven effective through the most rigorous scientific research.

An intervention is considered to be a promising practice (Level 3) when there is sufficient evidence to claim that the practice is proven effective at achieving a specific aim or outcome, consistent with the goals and objectives of the activity or programme. Ideally, promising practices demonstrate their effectiveness through the most rigorous scientific research; however, there is not enough generalisable evidence to label them 'best practices'. They do, however, hold promise for other organisations and entities that wish to adapt the approaches based on the soundness of the evidence.

Emerging practices (Level 4) are interventions that are new, innovative and which hold promise based on some level of evidence of effectiveness or change that is not research-based and/or sufficient to be deemed 'promising' or 'best' practice. In some cases, this is because an intervention is new and there has not been sufficient time to generate convincing results. Nevertheless, information about such interventions is important because it highlights innovation and emerging practices worthy of more rigorous research.

Systemic considerations

In order to evaluate the various interventions, the WASH systems in each publication were assessed to determine whether they had considered six of the core elements of WASH planning and decision making: sensory design; socio-cultural concerns; current policy; technical matters; financial aspects; and public health (Barrington 2016b), and how the inclusion or exclusion of some elements may have impacted on the reported outcomes.

RESULTS

There were 12 research studies that met the inclusion criteria for this review. There was one review (Water Aid et al. 2016); seven descriptions of original research (Hughes et al. 2007; Johnson et al. 2010; Ministry of Health and Medical Services et al. 2014; Tran et al. 2006; Huggett & Natoli 2017; Mohamed & Natoli 2017; Natoli & Huggett 2017) and four commentaries/project descriptions (Layton & Layton 2010; Nielsen 2010; Barrington 2016a; Selep et al. 2016); see Table 1. The limited amount of literature that met the inclusion criteria demonstrates a paucity of research about WASH systems in schools in PICTs that is focused on girls and students living with disability.



Figure 2 | Hierarchy of evidence (Canadian Homelessness Research Network 2013).

Table 1 | Publications which synthesised evidence, evaluated or measured WASH interventions in PICTs

Author, year	Country and population	Setting	Classification of publication	WASH evidence/ intervention relating to school girls/students with disability	WASH-related outcome for health and/or education	Systemic considerations of intervention (assessed against 6 elements: sensory design, socio-cultural, policy, technical, financial, public health)	Hierarchy of evidence
Barrington (2016a)	PICTs; children	Community settings, including schools	Discussion paper or commentary	Poor WASH outcomes impact physical, mental and social wellbeing of children, including school absenteeism specifically relating to girls	N/A (not intervention research)	N/A (not intervention research/project)	Emerging practices
Huggett & Natoli (2017)	Fiji; 22 adolescent girls, women and some men	Schools at two sites: urban setting – Viti Levu and rural setting – Vanua Levu	Original descriptive research; qualitative design	Evidence for how women and girls in Fiji manage menstruation; including impact of these practices on participation in work and school and opportunities to improve MHM	N/A (not intervention research)	N/A (not intervention research/project)	Emerging practices
Hughes et al. (2007)	13 PICTs; 3,683 school-aged children	Primary schools (n = 27)	Original descriptive research; quantitative design	Severity of helminth infection determined; nutritional status assessed; WASH environmental data collected/measured; capacity to deliver helminth control programmes assessed. Intervention: treatment; handwashing demonstrations; included schoolgirls and boys; no specific mention of students with disability	N/A (not intervention research)	N/A (not intervention research/project)	Promising practices

Johnson <i>et al.</i> (2010)	Pohnpei State, Federated States of Micronesia; school-aged children	Elementary schools	Original descriptive research; quantitative design	Public awareness messages for personal hygiene of girls; bucket handwashing system; hygiene supplies for girls distributed	Hepatitis A is mostly a self-limiting disease; outbreak brought under control by the end of the school year; definitive attribution of impact of WASH interventions not possible	Sensory design (water and infrastructure quality); policy (required days absent from work/school); public health (mitigation strategies such as use of bleach)	Promising practices
Layton & Layton (2010)	Papua New Guinea; schoolgirls, teachers and community members	10 schools (including a primary school)	Programme description	Knowledge sharing workshops; participatory design of local WASH facilitates; included schoolgirls and boys; no specific mention of students with disability	Students designed appropriate solution to assist in MHM	Sensory design (toilet cubicle new and clean); socio-cultural (locally sourced materials in local style architecture); technical (local knowledge to develop and maintain WASH infrastructure); financial (donated goods/affordable); public health (increased knowledge of WASH, infrastructure reduces risk of transmission of disease)	Emerging practices
Mohamed & Natoli (2017)	Papua New Guinea; 110 adolescent girls, women and some men	Community, including schools (urban and rural sites)	Original descriptive research; qualitative design	Evidence for how women and girls in PNG manage menstruation; including impact of these practices on participation in work and school and opportunities to improve MHM	N/A (not intervention research)	N/A (not intervention research/project)	Emerging practices

(continued)

Table 1 | continued

Author, year	Country and population	Setting	Classification of publication	WASH evidence/ intervention relating to school girls/students with disability	WASH-related outcome for health and/or education	Systemic considerations of intervention (assessed against 6 elements: sensory design, socio-cultural, policy, technical, financial, public health)	Hierarchy of evidence
Natoli & Huggett (2017)	Solomon Islands; Guadalcanal (urban setting) and Malaita (rural setting); 23 adolescent girls, women	Community, including schools (urban and rural sites)	Original descriptive research; qualitative design	Evidence for how women and girls in Solomon Islands manage menstruation; including impact of these practices on participation in work and school and opportunities to improve MHM	N/A (not intervention research)	N/A (not intervention research/project)	Emerging practices
Nielsen (2010)	Fiji, Vanuatu, Solomon Islands; schoolgirls and boys	Rural schools in the Western Pacific	Programme description	Student-led hygiene promotion and empowerment for schoolgirls; no specific mention of students with disability	Students lead schools-based hygiene projects; increased student confidence to extend and apply their knowledge; measures not reported.	Socio-cultural, (mapping of acceptable WASH solutions in village settings), technical (building of hand basins, water quality testing), financial (fundraising through soap sales), public health (public awareness on global handwashing day)	Emerging practices
Selep et al. (2016)	Papua New Guinea; schoolgirls	Schools and communities	Programme description	Capacity building health practitioners in schools and communities, particularly with girls; gender sensitisation; WASH infrastructure; School Health Clubs	Women in leadership roles through School Health Clubs; increased attendance by girls in schools; improved hygiene and sanitation	Socio-cultural (school health clubs, improved rates of girls' attendance at school), technical (access to clean water, use of toilet facilities), public health (improved hygiene and sanitation reduced risk of disease)	Emerging practices

Ministry of Health and Medical Services <i>et al.</i> 2014	Solomon Islands; school girls	Secondary schools	Original descriptive research; qualitative design	Case study of MHM in schools for girls in Honiara and Guadalcanal Province; no intervention	N/A (not intervention research)	N/A (not intervention research/project)	Promising practices
Tran <i>et al.</i> (2006)	Vanuatu, Tonga and Pohnpei in the Federal States of Micronesia; schoolgirls and boys	Primary and secondary schools	Original descriptive research; quantitative design	Determine relationship between hygiene practices for girls, psycho-social and economic factors for effective interventions	N/A (not intervention research)	N/A (not intervention research/project)	Promising practices
Water Aid Burnet Institute and IWDA (2016)	PICTs; school students and community members	Schools and communities	Review	Determinants and impacts of MHM for girls, interventions to improve MHM, gaps in evidence; no specific mention of students with disability	N/A (not intervention research)	N/A (not intervention research/project)	Emerging practices

MHM, menstrual hygiene management.

Characteristics of improved WASH systems in schools to improve girls health

The review identified two studies in which WASH activities were conducted alongside research data collection processes in formal disease transmission studies (Hughes *et al.* 2007; Johnson *et al.* 2010). Assessment showed that the studies included schoolgirls; however, the WASH activities themselves were not evaluated in the studies. In a multi-country soil transmitted helminth survey of schoolchildren, Hughes *et al.* (2007) conducted hand washing demonstrations, and administered helminth treatment. WASH activities were described as being led by researchers and research partners, with hand washing demonstrations conducted as time permitted (Hughes *et al.* 2007). In the Federated States of Micronesia, Johnson *et al.* (2010) reported WASH-related action alongside an epidemiologic investigation at a school that included public awareness messaging, bucket hand hygiene and the distribution of hygiene supplies.

The review identified three programme descriptions that detailed 'emerging practices' or 'promising practices' for WASH systems in schools to improve girl's health and/or education in PICTs. All three programme descriptions were from the grey literature and by civil society organisations. The first, from Appropriate Technologies Projects in Papua New Guinea (PNG) (Layton & Layton 2010), described important characteristics of their WASH systems that included female students directing the project, identifying the required action and designing appropriate sanitation facilities. The second, from World Vision in PNG, described a participatory approach to incorporate menstrual hygiene management (MHM) training with a group of female students (Selep *et al.* 2016). The World Vision team also sought to build the capacity of teachers who taught personal development topics including health and puberty, to increase gender sensitisation, improve WASH infrastructure for MHM and form school health clubs. These activities enhanced female student leadership through the school health clubs, increased female student attendance at schools (by 23%) and enabled improved access to water and access to toilets. The third programme operated by Live and Learn in Fiji, Vanuatu and Solomon Islands explicitly showed the involvement of girls in the WASH programme and utilised

photo story methodology (Nielsen 2010). The description described a Rapid Assessment of Perception (RAP), a participatory tool that sought to understand how students perceive hygiene in their own village. The intervention was the creation of 'new knowledge, attitudes and practices through participation and thinking' (Nielsen 2010, p.71). Plans resulted and action ensued, with examples such as the building of hand washing basins and use of student-designed hand washing resources.

The intervention studies/programme descriptions that reported improved WASH outcomes included socio-cultural and public health elements, highlighting their importance in WASH systems. Other WASH elements identified included sensory design (Johnson *et al.* 2010; Layton & Layton 2010), policy (Johnson *et al.* 2010) and financial considerations (Layton & Layton 2010) (Table 1). Rather than focusing primarily on technical approaches to improving WASH services, the emerging and promising practices described in this review show the potential of supporting a student-centred approach to WASH at schools that reflect local socio-cultural, local policy and local financial contexts.

Effectiveness of WASH systems

The effectiveness of an improved WASH system is measured by its success in producing a desired change in WASH-related activity or behaviour (Dubé *et al.* 2012). This desired change in WASH-related activity is assessed by conducting intervention studies (Sanson-Fisher *et al.* 2006). No intervention studies that systematically assessed the effectiveness of improved WASH systems in schools in the PICTs to improve girls' health and/or education were identified through this literature review. Intervention studies can measure the effectiveness of WASH interventions (e.g. pre-, post- or measurement studies) such as: improvement to a water supply or distribution; a sanitation intervention (e.g. installation or promotion of a technique for disposal of excreta); and/or a hygiene intervention (e.g. hygiene facilities, health education or promotion of related behaviours such as hand washing) (Fewtrell & Colford 2005). There were WASH activities reported in the grey literature including WASH education for students, building of WASH facilities (toilets and hand basins) and the selling of soap by a school-based cooperative, but there were no

formal intervention studies that systematically investigated improved WASH systems in schools to improve the health and education of girl students and students with disability in PICTs.

DISCUSSION

WASH intervention activities are considered relevant when consistent with the needs of the girl students, or students with disability, their schools and wider community, and are aligned with local or national and/or international goals. In all three programme descriptions (Layton & Layton 2010; Nielsen 2010; Selep *et al.* 2016), the WASH Intervention activities were student driven and supported by school teachers and leaders. Resources were mobilised and emphasis embedded in WASH action (such as school health clubs). The cultural and social needs of the students were taken into account and technology was adopted and adapted to be appropriate for the contexts. Layton & Layton (2010) described how making student needs central to the WASH response produced important changes for the students themselves and the direct involvement of teaching staff. Washing facilities were built from local materials and a donated sewing machine was used to make clothes to sell and the income used to purchase sanitary products. Selep *et al.* (2016) reported changes to female attendance at school (an increase of 23%) and Nielsen (2010) reported outcomes such as the building of hand washing basins. These promising outcomes show the potential of student-centred participatory approaches for local WASH solutions in PICTs.

The evidence gathered through this systematic scoping review shows that there is great opportunity to expand the growing evidence base about improved WASH systems with girls in PICTs (Ministry of Health and Medical Services 2014; Huggett & Natoli 2017; Mohamed & Natoli 2017; Natoli & Huggett 2017). As a result of the recent investment of the Australian Department of Foreign Affairs and Trade (DFAT) in menstrual health through 'The Last Taboo: Menstrual hygiene interventions in the Pacific' research project, there is now a growing body of knowledge to help WASH practitioners respond to the needs of girls in schools (Ministry of Health and Medical Services 2014; Huggett & Natoli

2017; Mohamed & Natoli 2017; Natoli & Huggett 2017). Many girls manage the onset of menarche with limited knowledge; schoolgirls report menstruation is not discussed in detail at school, and what is discussed is highly dependent upon the teacher (Natoli & Huggett 2017). The WASH facilities in schools are often described as inadequate and the conditions often lead girls to experience high levels of absenteeism (Mohamed & Natoli 2017), thus expanding the inequity in educational participation and achievement between boys and girls. Specific information about improved WASH systems that addresses the specialised needs of students with disability in PICTs is sparse. A number of the papers in the review referred to WASH responses that should meet the needs of people living with disability as a 'cross cutting issue', however there was little evidence of significant direct action. Although disability is emphasised as an important dimension to ensure equality in international WASH studies (Institute for Sustainable Futures 2016), there is little evidence of disability being emphasised in improved WASH systems in schools in PICTs.

The global WASH in Schools literature does not, for the most part, reflect the 'social and cultural lens' that is so important in PICTs (e.g. <https://www.washinschools.info/>). PICTs are characterised by extreme diversity where contexts can differ not only at country level, but between and within adjacent provinces, islands and villages (Thaman 2009). Creative and contextualised responses through interconnected systems are essential to develop WASH systems that meet the needs of girls and students with disability. Although WASH in Schools material from non-PICT contexts is useful to developing school WASH systems in PICTs, it is essential that it is not transposed to PICTs without critique for the sake of uniformity or minimising the cost of improved WASH systems.

A systemic approach must consider how the entire school WASH system can be more inclusive of girls and children with disability, from education to infrastructure. This requires integrating the epistemologies (ways of knowing) and pedagogies (ways of learning) that are embedded within cultural and environmental contexts in partnership with technical aspects of WASH science. To be truly inclusive, local cultural and social contexts need to be considered alongside Western educational ideals so that change can

occur from the 'bottom up' involving girls and children with disability in designing programmes (e.g. MHM educational programming) and infrastructure (e.g. disability friendly toilet complexes). Implementing high-level policy changes is unlikely to result in the necessary improvements in inclusive education (Sharma *et al.* 2016). Traditional knowledge also shows promise when it comes to both teaching WASH and designing suitable WASH services within schools and communities (McCarter & Gavin 2011; Harrington *et al.* 2015) and should not be summarily discounted in favour of Western methods or technologies (Brohman 1996).

Development programmes in the PICTs have been described as too high level, focusing predominantly on economics, export industries and urban areas (Gegeo & Watson-Gegeo 2002). This is despite large proportions of PICT populations living in rural locations. In the Solomon Islands, for example, over 80% of the population live in rural areas and in PNG over 85% of the population live in rural areas (Secretariat of the Pacific Community 2015). Development programmes are also considered too 'simplistic', with many focusing on the obvious, or surface, issues.

Development programmes, including in WASH, often neglect the time and resources to incorporate the deeper sociocultural context within which PICT development occurs. Using a local metaphor of a tree, with its obvious branches and hidden roots, can help understanding. The obvious or surface issues that development programmes can see (often physical and technical aspects of WASH systems) can be conceptualised as branches of a tree. The branches can be observed, measured and trimmed back if needed. However, the deeper context needs to be understood. This is where the less obvious (but extremely important) socio-cultural, epistemological and pedagogical issues exist. This deeper context could be conceptualised as the tree's root system. The branches can only grow when they are sustained by a healthy root system. Such local metaphors can help us understand how we can create a world where '*physical, mental and social well-being are assured*' (United Nations 2015, p. 3) for everyone, always.

A holistic approach to improving school WASH systems for girls and children with disability will need to develop an understanding of local ways of knowing and learning. A province-, nation- or PICT-wide programme or policy is unlikely

to be effective unless the programme is designed to encourage local design and implementation suited to girls and students with disability. The promising student-led WASH design process, as described by [Layton & Layton \(2010\)](#), highlights the potential for student-centred WASH interventions in PICT schools. There are a growing number of resources being developed, for example by Live and Learn, which has developed school-specific flip charts ([Live and Learn Education 2011](#)). Value could be added to these project activities by having community-based researchers systematically collect data while the actions are taking place to inform evidence-based WASH systems in other PICT schools ([MacLaren *et al.* 2015](#)).

Some studies report links to the effectiveness of the social determinants of children's health as they relate to WASH outcomes. The predominantly patriarchal social and cultural conditions that students in PICTs experience is an important determining factor for many girls managing WASH outcomes, with girls often not having access to the same opportunities as boys. [Tran *et al.* \(2006\)](#) reported research showing a relationship between the social status of a child and their hygiene practices for students in Vanuatu, Tonga and Pohnpei in the Federated States of Micronesia; specifically, they reported a significant association between gender, parental occupations and high levels of school affiliation with hygiene behaviours.

All original research in this review was descriptive, with no measurement or intervention research found. This is consistent with health research across PICTs, including a previous review conducted of health research in the Solomon Islands ([Redman-MacLaren *et al.* 2010](#)). There is a significant opportunity to centralise PICT researchers in conducting WASH research that reflects PICT social and cultural worldviews ([Note *et al.* 2009](#)). As unequivocally demonstrated by the work of [Clarke *et al.* \(2014\)](#), undertaking WASH initiatives that are not relevant or appropriate to the local context can have dire consequences. Of 27 WASH projects re-visited in Papua New Guinea, Solomon Islands and Vanuatu, 'there was only one site where the project outputs were clearly recognisable as being the same as (or better than) they were at the end of the project' ([Clarke *et al.* 2014](#), p. 696). The lack of 'benefit persistence' demonstrates an urgent need for local responses to local WASH issues.

Limitations

This literature review was initially conducted to inform a non-government organisation about actions to support girls in school and students with disability. As such, the review was time bound. This did not compromise the quality of the search of peer-reviewed and grey literature. However, the nature and purpose of the review did increase the number of contacts the authors were able to make with leaders in the field and access to grey literature.

The literature search was conducted from an Australian university and thus access to grey literature was limited to what could be found on the World Wide Web or be emailed to authors from individuals and organisations in PICTs and internationally.

CONCLUSIONS

The SDGs aim for universal WASH by 2030 and evidence from this review shows that WASH are critical for the successful participation in school for girls and students with disability. However, there is limited evidence about what works and under what conditions. The locally generated descriptive literature points to the type of effective evidence that can be generated. Linking local epistemologies (ways of knowing) and pedagogies (ways of learning) within cultural and environmental contexts, in partnership with technical aspects of WASH science, have shown great promise. Application of such approaches is now urgently required to improve WASH systems for girls and students with disability in PICTs.

COMPETING INTERESTS

The authors declare they have no competing interests.

FUNDING

The initial review was funded by Adventist Development and Relief Agency.

AUTHOR CONTRIBUTIONS

MRM: Led the design of the literature review, acquired and analysed the literature, drafted the majority of the manuscript and edited the manuscript.

DJB: Co-designed the literature review, assessed literature for inclusion or exclusion, drafted the Discussion section, revised the manuscript for important intellectual content and reviewed the final manuscript.

HH: Provided important intellectual content, revised the manuscript and reviewed the final manuscript.

DC: Provided important intellectual content, revised the manuscript and reviewed the final manuscript.

JS: Provided important intellectual content, revised the manuscript and reviewed the final manuscript.

DM: Co-designed the literature review, assessed literature for inclusion or exclusion, revised the manuscript for important intellectual content and reviewed the final manuscript.

ACKNOWLEDGEMENTS

We thank Ms Mary Kumvaj, Librarian, for searching the peer-review literature within such a short period of time, and Associate Professor Janya McCalman, Senior Research Fellow, for reviewing the original literature review report. We also thank the two anonymous reviewers for their constructive comments that helped improve the final version of the paper.

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First received 20 December 2017; accepted in revised form 18 May 2018. Available online 28 June 2018