Mehran University Research Journal of Engineering and Technology
Vol. 40, No. 2, 383 - 391, April 2021
p-ISSN: 0254-7821, e-ISSN: 2413-7219
DOI: 10.22581/muet1982.2102.12

Water, Sanitation and Hygiene Resources Available at Higher Education Institutes of Sindh and Students' Satisfaction

Ubed Ur Rehman[1a], Jamil Ahmed[1b], Rasool Bux Maher[1c], Aneela Yasmeen[2]

RECEIVED ON 13.02.2019, ACCEPTED ON 03.05.2019

ABSTRACT

The present study was focused on the available Water, Sanitation and Hygiene (WASH) facilities and students' satisfaction in three public and two private Higher Education Institutes (HEIs) of Hyderabad and Jamshoro city. This cross-sectional study recorded WASH facilities in 21 departments of 5-HEIs and satisfaction appraisal of 630 students in total. The survey was also supplemented with quality analysis of Point of Use (PoU) drinking water. The results revealed that the overall 85.7 and 47.6% contamination of the drinking water samples were recorded due to total and thermo-tolerant coliforms, respectively. Further, physiochemical parameters were found in the permissible limits as provided by the World Health Organization (WHO) and arsenic was not detected in any of the water samples. In total 25% of the toilet facilities were found non-functional. All monitored HEIs were found having sufficient quantity of water however, 95% hand-washing stations did not supply soap/ detergent for hand-washing. Moreover, this study divulges that there is a significant relationship between WASH facilities like water quality (χ^2= 7.55*; p=0.023), toilets functioning (χ^2= 45.39; p=0.002), and washing facilities (χ^2= 37.29**; p=0.000) in HEIs and student's satisfaction in HEIs. Thus, it can be concluded that the poor WASH facilities in HEIs could affect the students' satisfaction leading to affect their performance in the studies, negatively.**

Keywords: Higher Education Institutes, Water, Sanitation and Hygiene, Students' Satisfaction Appraisal, Point of Use.

1. INTRODUCTION

The Sustainable Development Goals (SDGs) of the United Nation (UN) include a target SDG 6.2 to ensure the access to water and sanitation for all by 2030 [1]. Though, UN had expanded improved drinking water sources to 2.6 billion people since 1990; yet 0.66 billion people still lack access to potable water. Globally, fecally contaminated sources of drinking water are being used by at least 1.8 billion people, and 2.4 billion people even do not have access to basic sanitation services, such as toilets or latrines [1]. Monitoring of WASH on a national and international level is crucial to inform policymakers about benchmark service quality, investment strategies and define the ways to measure, compare and report progress among nations in WASH areas. Nevertheless, there is limited knowledge about the status of WASH facilities and equipment in non-household settings, such as educational institutes, healthcare facilities, and workplaces. Inadequate WASH facilities/resources in such settings impact efficiency, well-being, health and educational outcomes [2]. Despite the importance of WASH in non-household settings, it was not included

[1] U.S Pakistan Center for Advanced Studies in Water, Mehran University of Engineering and Technology Jamshoro Sindh, Pakistan. Email: [a]urmemon0@gmail.com (Corresponding Author), [b]jamilahmed.uspcasw@faculty.muet.edu.pk, [c]dd.uspcasw@admin.muet.edu.pk
[2] Sindh Agriculture University, Tando Jam, Sindh, Pakistan. Email: aneelayasmin@yahoo.com

in international WASH monitoring until 2008 [3] however, it is gaining importance during these days.

According to a report of the UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) in a biannual survey during 2014, less than a third of reporting countries have policies, plans, and targets that were placed for educational institutes and healthcare facilities [4]. Fortunately, the need to provide safe drinking water and other WASH resources in non-household settings has been recognized by the UN Special Rapporteur on human rights, as a primary means of advancing the human rights [5]. Education plays a vital role in nurturing children and can be employed as a tool to create awareness regarding good sanitation practices among children [6]. Student's knowledge has a significant influence on the practices associated to hygiene and sanitation, as they may do not know the things and practices harmful for them, while the provision of the safer sanitation kept aside [7]. Besides the fact that improved WASH facilities effects health and educational outcomes and gender disparities, the HEIs are places where students study, receive training, establish networks and interact with many people. It is a platform from where the best practices can be taught, and healthy WASH behaviors can be developed and experienced throughout their lives and even multiply the effect [8, 9]. However, considering the benefits and limitations of the existing WASH-specific models and frameworks, the Integrated Behavior Model (IBM) WASH model has proven to be one of the best cores to provide both a hypothetical and also a useful tool [10]. The model is valid for increasing understanding and appraisal of the multi-level, multi-dimensional factors, influencing WASH practices in settings with constrained infrastructure [10, 11]

In this century, HEIs become business entities where stakeholders consider students as customers and provide distinction services ensuring customers' satisfaction; conversely, the unsatisfied students may drop out or cut on the courses [12]. According to Pakistan Education Statistics (2015-2016), there are 163 universities in the country out of which 91 (56%) are public universities whereas 72 (44%) are private sector universities. The increase in the number of universities also demands the high-quality service to attract and retain students. Although there are many reports available demonstrating the impact of service quality and student satisfaction globally, very few researchers have investigated the WASH indicators as determinants of service quality. On the other hand, literature is scarce for the Pakistani HEIs, WASH resources and students' satisfaction perspective. In present study 5-HEIs situated in Hyderabad and Jamshoro districts of Sindh Pakistan were selected, due to their uniqueness in a sense that these are highly reputed educational institutions and students throughout the Pakistan approach these for admissions thus the obtained data may infer the whole HEIs of Pakistan.

Additionally, it is the need of time to study and monitor the WASH-related satisfaction-intention-retention association of students in HEI. Consequently, monitoring of WASH facilities in HEIs and other non-household settings, on a national and international level, is an important activity. It will help form equal quality policy and venture plans; by reporting these assessments, it will be easier to measure and compare the progress amongst the nations [13].

2. MATERIALS AND METHODS

2.1 Study area

Five HEIs of Jamshoro and Hyderabad, Sindh, Pakistan were selected for the present study. Jamshoro is located 18 kilometers from Hyderabad on the right bank of the River Indus. It is known as the Educational City due to encompassing three public-sector HEIs which were included in our study namely Mehran University of Engineering and Technology (MUET), University of Sindh (UOS) and Liaquat University of Medical and Health Sciences (LUMHS). Additionally, two private universities of Hyderabad, *i.e.*, Isra University (IU) and Shaheed Zulifqar Ali Bhutto Institute of Science & Technology (SZABIST) (Fig. 1) were also part of this study. The stratified random sampling was used to select different departments from each HEI and students within each department. The 21-departments of 5-HEIs were included in the present study and coded as MUET1-5, UoS1-5,

Fig. 1: Google Map representing the 5-HEIs of Jamshoro and Hyderabad, Sindh Pakistan included in the Study

LUMHS1-5, IS1-5 and SZABIST1 due to ethical concerns.

2.2 Sampling, Analysis, and Survey

A cross-sectional study design was applied to evaluate the quality of drinking water at PoU in selected study areas. PoU drinking water samples, 500 ml each, were collected from 21 departments of the selected HEIs in the sterilized sample bottles and transported to the water quality laboratory of US-Pakistan Center for Advanced Studies in Water (USPCAS-W), MUET, Jamshoro, Pakistan in an ice box (at 4^0C) and tested within 2 hours of the sample collection. The collected samples were analyzed for physicochemical, microbial and arsenic analysis. Physicochemical parameters include pH, turbidity, and Total Dissolved Solids (TDS) that were measured using a multi-meters of Hanna Instruments (HI991001; HI99301 and HI93703). Microbial analysis was carried out using the method described by [8-9]. Briefly, 100 ml of drinking water was filtered through membrane filters of 0.45 micron. The filter papers were inoculated on Petri dishes containing selective media (Eosin Methylene Blue Agar; mFC Agar Oxoid, USA) for the detection of Total Coliforms (TT) and Thermo-Tolerant Faecal Coliforms (TTC) respectively. The Petri dishes with filters were incubated for 24-48 hours at 37 or 45^0C. After incubation, the Colony Forming Units (CFU) were counted for microbial analysis. Arsenic detection was performed using KIT MQuant™ test strips (Catalogue No. 117917, Merk International).

Secondly, an observational WASH assessment regarding the toilet and hand-washing facilities was conducted using a structured questionnaire. The questionnaire was consists of five sections and was developed using IBM for WASH [10]. The first section contains information about socio-demographics of the HEIs. In the second section, access to safe water was recorded by observing the chief source of water. Its treatment methods and physical appearance of the drinking water in the institutes, Section three represents sanitation access related observations by recording the number of toilets, segregation for male/female and students/visitors, availability of commode facilities for the persons unable to use the existing squatting or cultural latrines. Water availability and sanitation functionality of toilets were documented in the fourth section. In section five, hygiene facilities were observed. Thus the data were recorded for the drinking water sources, presence of any treatment facility for drinking water, toilet facility, and functionality, hygiene facilities including soap and detergent availability.

Lastly, the structured questionnaire was developed to measure students' satisfaction. There were ten items measured on a three-point Likert-type scale [12]. The items include the availability and quality of potable water, sanitation access and its functionality, hand

washing and hygiene facilities. The data collected from the 2nd year to the final year students at the selected HEI's (Fig. 1). Thirty WASH satisfaction appraisal questionnaires were get filled by the students from each of the department/ building, and the total number of participants was 630 (n= 630). Participation in the questionnaire filling was voluntary.

2.3 Data Analysis

To analyze the collected data like direct observations, self-administered questionnaires and drinking water quality analysis from HEIs MS-Excel was used. Additionally, Pearson Chi-Squared Test was performed through SPSS v 17 (Statistical Program for Social Sciences) to determine the students' satisfaction level regarding available WASH-related resources in HEIs, Chi-squared and the associations between education and sanitation to satisfaction levels.

2.4 Ethical Considerations

The study was approved by MUET, Jamshoro to be carried out during the year 2016-2017. The concerned staff and management of the different HEIs and selected departments were assured that none of the appraisal data would be published with the name of the departments. Moreover, the drinking water samples collected for the analysis were coded before taking them to the laboratory. Student's participation in the student satisfaction appraisal questionnaire was also a voluntary act. None of the students was forced to fill out the survey if s/ he felt uncomfortable. Further, students were allowed to ask questions in case of any confusion before filling the student satisfaction appraisal questionnaire.

3. RESULTS AND DISCUSSION

3.1 Quality of Drinking Water at PoU

According to the structured observations for the present investigation, the drinking water facilities were found available in all 21-departments of the selected 5-HEIs. The main source of drinking water for all HEIs was surface water except for IU, Hyderabad; they were collecting ground water through electrical motors and mixing it with surface water and further storing it for future use in a cemented water storage tank. All departments have sufficient water quantities in storage tanks and were using this water for drinking and toilet purposes. Nonetheless, MUET4 were using the stored water for drinking purposes only. Importantly, all 21-departments included in the present study have installed some type of water treatment filter system at the PoU. However, the drinking water samples were found bacteriologically contaminated.

Irrespective of the sources of drinking water all PoU drinking water samples from HEIs were contaminated with total coliforms (85.7%) and TT Coliforms (47.6%). The SZABIST (HEIs) is excluded from this discussion here for the time being because only one department of that institute was analyzed in the present study. However, based on the recorded data the highest TT coliforms (80%) were found in LUMHS followed by IU (60%), UoS (40%) and MUET (20%). Interesting the highest average CFUs were detected in the water samples of UoS = 16, followed by LUMHS = 12.4, IU = 2.8 and MUET = 0.2 as presented in Table 1. In case of TC, all the selected departments of UoS and IU exhibited some level of bacterial contamination whereas the highest TC contamination was detected in the water samples of LUMHS and MUET, i.e., 80 and 60%, respectively. The data for the coliform contaminations of the water samples (PoU) collected from selected HEIs is given in Table 1. The sampled water is being used for drinking and toilet purposes and physically was found clean. It is important to notify that the only three departments out of 21 departments revealed no TC count on selective media which include MUET4, MUET5, and LUMHS5. MUET5 owns a functional RO plant within their department. According to the WHO (2008) and Pakistani (2008) guidelines, no coliform should be detected in 100 ml of the drinking water sample.

Regardless of the detected microbial contamination of drinking water samples, the values for other physicochemical parameters, i.e. turbidity, pH, TDS, EC and arsenic were found in the permissible limits provided by WHO [14] and Pakistan Environmental Protection Agency (PEPA) 2008 and arsenic was not detected in any of the collected PoU water samples (Table 2).

Table 1: Bacteriological Contamination of POU Drinking Water in HEIs			
HEIs	Source of Drinking Water	Thermo-Tolerant Coliforms (CFU)	Total Coliforms (CFU)
UoS (n=5)	Surface water	16(40%)	38.2(100%)
MUET (n=5)	Surface water	0.2(20%)	11.2(60%)
LUMHS (n=5)	Surface water	12.4(80%)	20.4(80%)
IU (n=5)	Surface + Ground water	2.8(60%)	28.6(100%)
SZABIST (n=1)	Surface water	2(100%)	5(100%)

Table 2: The Analysis of POU Drinking Water Samples for the Physicochemical Properties					
HEIs (Department)	Turbidity/NTU	pH	TDS (g/l)	E (mS/cm)	Arsenic (mg/L)
Permissible Limits WHO Pakistan	<5 NTU	6.5 – 8.5	<1.0		<0.01 <0.05
UoS1	5	7.8	0.27	0.54	ND
UoS2	4.5	8.1	0.49	0.98	
UoS3	3.4	8.2	0.54	1.08	
UoS4	4	8.2	0.52	1.09	
UoS5	4.3	7.9	0.55	1.11	
MUET1	4.1	8	0.64	0.94	ND
MUET2	2.2	8	0.64	0.98	
MUET3	2.4	8.1	0.60	0.93	
MUET4	1.2	8	0.75	1.16	
MUET5	2	8	0.18	0.27	
LUMHS1	4.4	7.8	0.89	1.72	ND
LUMHS2	4	8	0.76	1.53	
LUMHS3	4.9	7.9	0.99	1.73	
LUMHS4	5.3	7.9	0.56	1.24	
LUMHS5	2	8	0.18	0.29	
IU1	4.3	8.1	0.5	0.91	ND
IU2	5.4	7.9	0.56	1.11	
IU3	3.6	8.7	0.89	1.52	
IU4	4.6	8.5	0.79	1.65	
IU5	3.9	8.7	0.98	1.79	
SZABIST1	3	7.9	0.2	0.56	ND

3.2 Sanitation Assessment of Selected HEIs

The analysis of sanitation of the selected 21-departments of 5 HEIs was carried out. Data revealed that the on average each department has at least 9 toilets in total and out of those functional toilets were at least 7; however, the highest total number of toilets recorded were 24 in MUET5 and as low as 3 toilets in MUET4. All the monitored toilets of MUET5 (24) and LUMHS1 (7) were functional at the time of assessment. The toilets without door, not maintained, having no access to water or other facilities were considered as non-functional toilets. The Fig. 2 shows the percentages of the functional toilets in each HEIs. 95% HEIs have western commode type toilets whereas the separate toilets for males and females were found in all departments except MUET4 and UoS5 for which

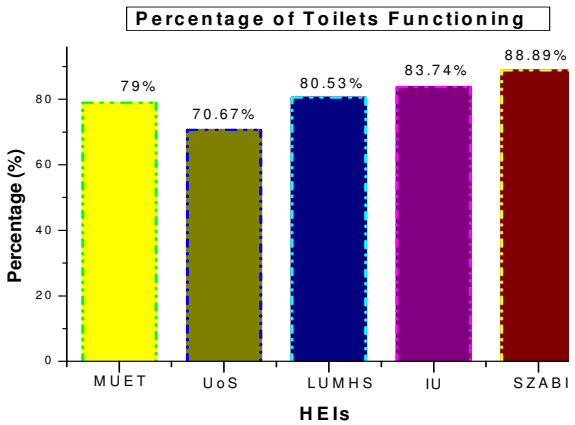

Fig. 2: Percentage of the Functional Toilets in 5-HEIs of Hyderabad and Jamshoro

information could not be obtained. Sufficient water was available in the storage tanks of all the HEIs which

were found equipped with the piped facility to distribute water inside the toilets. The hand washing facilities were present in all departments with plenty of water conversely the resources for hands washing like soap was only found at MUET5 and none of the department had tissues or drying machine or dustbins for the waste disposal in toilets.

3.3 Students' Satisfaction Appraisal

For the assessment of students' satisfaction appraisal, a questionnaire with three-point Likert scale was filled by the students of each HEI, randomly and voluntary. In students' satisfaction appraisal questionnaire, they were asked about their satisfaction level regarding the availability of sufficient quantity of water, quality of potable water, adequacy of toilet facilities like separate toilet facilities for male and female, western commode for the person unable to use squatting toilet, sufficient toilet facilities in terms of functionality, proper ventilation, cleanliness of toilets, adequacy of hand washing and drainage facilities. Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity were conducted for the entire data which resulted from KMO, the measure of sampling adequacy, as 0.823 followed by a Chi-square value of 1366.8 (df: 46) and statistically highly significant at $p< 0.05$; thus indicating the enough grouping of items into distinct factors of satisfaction appraisal [15]. Furthermore, the association between the available WASH resources and students' satisfaction was evaluated by Chi-square testing (Table 3). The association between the available water quality and the student satisfaction regarding it was found significant showing the significant Chi-Square value 7.55 at $p < 0.05$. Moreover, the functionality of toilet facilities was found associated with the students' satisfaction, and the analysis revealed a Chi-Square value of 45.39 that is highly significant at $p < 0.05$. Nevertheless, the available hand washing facilities like water and soap were also found significantly associated with the satisfaction level of students at the Chi-Square value 37.29** that is highly significant hence it can be concluded that there is a significant relationship between student satisfaction and water quality, toilets functioning and hand washing facilities.

Table 3: Association among Students' Satisfaction and Wash Indicators

Students' Satisfaction	χ^2	p-Value
Water quality and TTC (CFU<20 & CFU>20)	7.55	0.023*
Toilet facilities & toilets functioning (50-75% and 76-100%)	45.39	0.002**
Hand washing facilities and resources (water only or water and soap)	37.29	0.000**

One of the studies done by Water Aid revealed that one out of every three schools has no availability of clean drinking water and two out of every five schools do not have a toilet [16]. Our study found that the WASH facilities are available in the selected HEIs. However, they were inadequate. Sufficient water quantity is available in all monitored HEIs, whereas the drinking water samples were highly contaminated with TC (85.7%) and TT coliforms (47.6%) and one department out of every seven departments have clean drinking water. This reveals an alarming situation in HEIs of Sindh.

Furthermore, sufficient toilet facilities were available; every department on average has nine toilets, and seven out of these nine toilets were recorded functional. A study conducted in six rural regions of Sub-Saharan Africa revealed that up to 23% of rural schools had improved water sources on the premises with improved sanitation, water, and soap for hand washing whereas the schools meeting WHO guidelines of the student to latrine ratios were less than 23% [17]. Nonetheless, this study reveals that there are sufficient sanitation facilities available in all the HEI's. However 95% of HEIs did not have soap or detergent available for hand washing. Out of 21 departments/ buildings, only one department had hand washing facilities supplied with soap/ detergent. The difference may be owed to variation in the socio-demographic status or the change in the level of academia, *i.e.*, School and University.

Moreover, this study divulges that there is a significant relationship between WASH facilities and student's satisfaction in HEIs. Poor WASH facilities in HEI affect the students' satisfaction leading to affect their performance negatively, in studies. The questionnaire for the assessment of students' satisfaction was

prepared following IBM-WASH. It is an integrated behavioral framework that describes social and behavioral factors affecting the adoption of water and sanitation behaviors, such as hand-washing with soap, treatment of drinking water and construction, maintenance and use of latrines [10]. The IBM-WASH framework is being used to identify factors to examine qualitative research by describing reasons for WASH behaviors, promotion of WASH behaviors through intervention designs, and design of data collection tools to measure the effect of the interventions [18]. One of the studies conducted in the government schools of Lahore and Islamabad regarding the status of WASH facilities concluded that there is a significant relationship between the WASH factors and children's performance at the school. They revealed that poor sanitation practices affect the overall performance of the students in the studied school setting [19].

During a large-scale trial in China, the children who received handwashing intervention showed a decline in the absence of median episodes up to 48%, compared to the control group [20]. Further, an intensive hand hygiene campaign contributed to a significant reduction in influenza-related absence by 40% and diarrhea-related absence by 30%. Almost similar trial based study in Cairo, Egypt showed that the point-of-use water treatment and handwashing promotion intervention could reduce school absenteeism up to 35% and 26% respectively [21, 22]. Therefore, taking our study as a baseline, further research may be initiated, and interventions should be made to avoid any health and education related emergency at HEIs.

4. CONCLUSION

The current study was aimed to assess the quality of available WASH facilities in HEI's and their impact on students' satisfaction. Based on the results of the current study, it can be comprehended that there is dire need to improve the WASH infrastructure for the betterment of water quality and hand washing facilities at HEIs. The drinking water assessment revealed that almost 85% of the drinking water samples are contaminated with fecal contamination, 95% hand washing stations hadn't supplied with soap/ detergent, which could be one of the main cause of diarrhea and other water-borne and water-washed diseases, affecting student's satisfaction leading to their performance in education as well.

5. RECOMMENDATIONS

Based on the above study results and findings, the following recommendations can be made:

(i) There is an urgent and dire need of improvement in water, sanitation and hygiene infrastructure in HEIs
(ii) Despite the use of PoU filter systems and clean visibility of water samples; fecal contamination was observed. Therefore, regular monitoring mechanism should be established to timely detection of any contamination.
(iii) Hand washing with soap or detergent is an important factor to avoid diarrheal disease and influenza virus. The soap or detergent must be provided at hand washing stations to clean the hand to avoid any disease emergency.
(iv) The interventions should be made in those HEIs, where WASH facilities are not meeting the baseline, and further comparison can be planned to see the impact of WASH focused interventions on student satisfaction and performance.
(v) WASH should be included in the curriculum as a subject thus students can have a better understanding of WASH.

ACKNOWLEDGMENTS

Present work was done at the Pakistan Centre for Advance Studies in Water, Mehran University of Engineering & Technology, Jamshoro, Pakistan. In this regard, financial support from the United States Agency for International Development, and technical support from the University of Utah, USA, is highly appreciated.

REFERENCES

1. United Nations, "Transforming our world: the 2030 agenda for sustainable development", 2017.

http://www.un.org/sustainabledevelopment/water-and-sanitation [Accessed on 25th August 2018

2. Cronk R., Slaymaker T., Bartram J., "Monitoring drinking water, sanitation, and hygiene in non-household settings: Priorities for policy and practice", *International Journal of Hygiene and Environmental Health*, Vol. 218, No.8, pp. 694-703, 2015
3. Bartram J., "Improving on haves and have-nots", *Nature*, Vol. 452, pp. 283-289, 2007.
4. World Health Organization. "UN-water global analysis and assessment of sanitation and drinking-water (GLAAS) 2014 report: *Investing in Water and Sanitation: Increasing Access, Reducing Inequalities*, 2014 https://reliefweb.int/report/world/glaas-2014-report-investing-water-and-sanitation-increasing-access-reducing [Accessed on 25th August 2018].
5. Albuquerque C., "United Nations report of the special rapporteur on the human right to safe drinking water and sanitation", No. A/HRC pp. 24-44, 2013. http://www.unwater.org/report-of-the-special rapporteur-on-the-human-rights-to-safe-drinking-water-and-sanitation/ [Accessed on 1st Sep 2018].
6. Oke M., Atinsola M., Aina, M. "Evaluation of sanitation practices in Ibadan South East LGAs of Oyo State, Nigeria", *Academic Journal of Interdisciplinary Studies*, Vol. 2, No.5, pp. 79-94, 2013.
7. Vivas A., Gelaye B., Aboset N., Kumie A., Berhane Y., Williams M. A., "Knowledge, attitudes, and practices (KAP) of hygiene among school children in Angola, Ethiopia", *Journal of Preventive Medicine and Hygiene*, Vol. 51, No.2, pp. 73-79, 2010
8. Burgers, & Lizette, "*Background and rationale for school sanitation and hygiene education*", UNICEF, New York, USA, 2000. https://www.ircwash.org/resources/background-and-rationale-school-sanitation-and-hygiene-education [Accessed on 1st August 2018].
9. Snel M., "WELL Factsheet: School sanitation and hygiene education. WELL – Resource Center Network for Water, Sanitation and Environmental Health", 2003 http://www.Iboro.ac.uk/well/resources/fact-sheets/fact-sheets-html/ssahe.html. [Accessed on 25th August 2018].
10. Dreibelbis R., Winch P., Leontsini E., Hulland K. Ram P., Unicomb L., Luby S., "The integrated behavioural model for water, sanitation, and hygiene: a systematic review of behavioural models and a framework for designing and evaluating behaviour change interventions in infrastructure-restricted settings", *BMC Public Health*, Vol. 13, No. 1, pp. 10-15, 2013b.
11. Dreibelbis R., Greene L., Freeman M., Saboori S., Chase R., Rheingans R., "Water, Sanitation, and Primary School Attendance: A multi-level assessment of determinants of household-reported absence in Kenya", *International Journal of Educational Development*, Vol. 33, pp. 457-465, 2013a.
12. Kara A, Tanui E., Kalai J., "Quality of academic resources and students' satisfaction in public universities in Kenya", *International Journal of Learning, Teaching and Educational Research*, Vol. 15, No. 10, pp. 130-146, 2016.
13. Bradley D.J., Bartram J.K., "Domestic water and sanitation as water security: monitoring, concepts, and strategy", *Philosophical Transactions of the Royal Society, A: Mathematical, Physical and Engineering Sciences*, Vol. 371, pp. 1-20, 2013.
14. Edition F., "Guidelines for drinking-water quality", *WHO Chronicle*, Vol. 38, No. 4, pp. 104-108, 2011.
15. Leech N., Barrett K., Morgan G., "SPSS for intermediate statistics: Use and interpretation", Routledge, 2013.
16. Water aid. "WASH situation in Pakistan know and act: National water facts. Water aid, Pakistan". 2016 http://washwatch.org/uploads/filer_public/c3/61/c361cf33-2fbc-4b68-9fad-ac2337b17145/wash_situation_in_pakistan_wateraid_pakistan_2016.pdf [Accessed on 29th August 2018].
17. Morgan C., Bowling M., Bartram J., Kayser G., "Water, sanitation, and hygiene in schools: Status and implications of low coverage in Ethiopia, Kenya, Mozambique, Rwanda, Uganda, and Zambia", *International Journal of Hygiene and*

Environmental Health, Vol. 220, No. 6, pp. 950-959, 2017.

18. Bryman A., Bell, E. "*Business Research Methods*", Oxford University Press, USA, 2015
19. Butt N., "Evaluating water, sanitation, and hygiene (WASH) affecting school children performance in Lahore and Islamabad, Pakistan", Albert-Ludwigs-Universität Freiburg, Germany, 2014.
20. Bowen A., Ma H., Ou J., Billhimer W., Long T., Mintz E., Luby S., "A cluster-randomized controlled trial evaluating the effect of a hand-washing-promotion program in Chinese primary schools", *The American Journal of Tropical Medicine and Hygiene*, Vol. 76, No. 6, pp. 1166-1173, 2007
21. Talaat M., Afifi S., Dueger E., El-Ashry N., Martin A., Kandeel A., El-Sayed N., "Effects of hand hygiene campaigns on incidence of laboratory-confirmed influenza and absenteeism in schoolchildren, Cairo, Egypt", *Emerging Infectious Diseases*, Vol. 17, No. 4, pp. 619-625, 2011.
22. Imran U., Chandio A., Soomro J., Kumar H., "Assessment of Homemade Liquor" Tharra" Quality by GC-FID and its Potential Impacts on Human Health, *Mehran University Research Journal of Engineering and Technology*, Vol. 36, No. 4, pp. 1025-1036, 2017.