

Analyzing the impact of context based hygiene awareness games on subsequent change in behavior



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Thesis Acceptance Certificate

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Approval

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CERTIFICATE OF ORIGINALITY

I hereby declare that the research paper titled “Analyzing the impact of context based hygiene awareness games on subsequent change in behavior” my own work and to the best of my knowledge. It contains no materials previously published or written by another person, nor material which to a substantial extent has been accepted for the award of any degree or diploma at NIIT or any other education institute, except where due acknowledgment, is made in the thesis. Any contribution made to the research by others, with whom I have worked at NIIT or elsewhere, is explicitly acknowledged in the thesis.

I also declare that the intellectual content of this thesis is the product of my own work, except to the extent that assistance from others in the project’s design and conception or in style, presentation and linguistic is acknowledged. I also verified the originality of contents through plagiarism software.

Author Name: Masooma Zehra Miyan

Signature: _____

Dedication

I dedicate this research to my parents, siblings, family, and friends. Last but not least, it is also dedicated to those wonderful children who participated in this study as well as those who will gain benefit from it in the future.

Acknowledgement

Allah, the most merciful and benevolent and undoubtedly Who provided constant support and guidance that I was able to complete this study and reach where I am today.

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Abstract

Pakistan as a developing country is lagging far behind its promise to the United Nation's Sustainable Development Goals (SDGs) targeted to be achieved by 2030; with 22 million children still out of school. There is a dire need for innovative interventions to speed up the progress. Hygiene education and promotion is a major issue concerning developing nations and its negligence is the cause of 110 deaths of children under the age of 5 every day in Pakistan (UNICEF, 2016). It not only affects the health sector but other sectors of development of society as well particularly Education. The students become victims of the diseases that arise due to inadequate hygiene resulting in poor academic performance.

With advent of technological boom in the 21st century with subsequent skills required to be effective, new forms of learning have emerged; game based learning is one of them. Therefore, to improve learners' hygiene practices in Pakistan, a context based serious game for primary level students was designed, developed and deployed. The focus of game was not only on personal hygiene but other relevant hygiene types as well such as food and environment. The aforementioned 2D game deployed in various schools particularly in Out of School Children School (OSCS). Two schools were selected to check impact of teaching hygiene through serious game, first school was OSCS whereas other was NUST Creative Learning School (NCLS) with a total of 44 participants. Mixed method approach was adopted to measure the effect of game on participants in terms of gender, school type and motivation. Students of both schools were found motivated to adopt the practices after playing the game whereas girls performed better than the boys overall. The deployed pedagogy was found effective in making daily routine tasks fun for the young learners of digital era. With relevant context and appropriate content and design/development, such games should be introduced to enhance learning in a captivating and interesting manner while being entertaining.

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Chapter 1. Introduction

This chapter provides brief overview on the current state of hygiene awareness in Pakistan and what methods and tools were adopted in the research to study this problem area under which objectives and hypotheses.

1.1. Problem Statement

Health is an important aspect of life that allows a human to manage other aspects of day to day life. Within this aspect, lies a core component – Hygiene, which is a guaranteed way to protect oneself from many epidemic and communicable diseases that are contracted in its absence. Most developed countries; including Saudi Arabia, UK and Japan follow proper and adequate hygiene practices to protect themselves from hygiene related diseases. However, third world countries such as Pakistan, also the focus of this study, are still battling those diseases because of inadequate sanitation and hygiene equipment, access and practices. UNICEF has been working on various projects for human and economic development of Pakistan and has been one of the prime promoters of proper healthcare facilities specifically adequate hygiene. According to the report published by UNICEF in 2017, millions still lack awareness regarding proper hygiene and have no access to its relevant equipment. Hence, there is a dire need to not only spread awareness regarding hygiene in the general public specifically among the young children who fall prey to those preventable diseases easily, but also to help Pakistan focus on battling and eliminating life-threatening and dangerous diseases.

With the arrival of 21st century, the world has changed rapidly, as now the information regarding any part of the world is a few clicks away. The world has transformed into a global village and new tools and methods are being introduced and adopted to meet the needs according to this digital era. Within this continuous advent of technological advancements, came the era of digital games which is now going towards VR and AR transformations, to engage users around the world on what they used to play on paper, sidewalks or boards. The generation of today is well versed in technology and doesn't need much time to understand how it works or to use it as they are surrounded by it

almost everywhere. Hence, methods from previous centuries won't work for the generation today. One such method, that was introduced in the last few years or last decade, is game based learning. A research was devised to study and observe the effect of context based game on hygiene awareness on primary level students in Islamabad belonging to two different school settings.

1.2. Research Objectives

This research was conducted under the following objectives:

- Improving knowledge on hygiene at primary level.
- Providing an alternate approach to practice and engage towards basic hygiene.
- Make a basic topic and habit more fun and interesting for kids/ of primary level students.
- To start dialogue on or pave a pathway for hygiene education.
- To study the effect of digital technology or method on hygiene awareness.
- To find innovative methods for teaching centuries old practices.
- To study the difference of hygiene on students of different schools.

1.3. Research Hypothesis and questions

The research was conducted by focusing on the following research questions and hypotheses. These questions were the basis for testing the following hypotheses.

RQ₁. Do context based games on hygiene have difference in impacting children of different genders and belonging from different schools?

H1. Context based games on hygiene impact children from different schools equally.

H2. Context based hygiene games have no impact on developing hygiene practices in students regarding gender type.

RQ₂. Do context-based games on hygiene play an important role in increasing motivation of children towards hygiene practices?

H3. Context based games on Hygiene don't play an important role in increasing motivation of children towards hygiene practices.

1.3. Thesis Outline

This report of the research is divided into seven chapters. The first chapter provides introduction to the research including problem identification, research hypothesis and questions. Chapter two provides relevant researches conducted prior to this research and literature available on the topic. Chapter three consists of details to research methodology as well as the design of tool used for intervention. Methods and tools used for studying the problem, target population and selected sample of the study are also described in the same chapter. Results generated through data analysis of the conducted study are presented in chapter four whereas, discussion on results that is their interpretation and what does the obtained data depict are contained in chapter five. The conclusion derived from this study based on results and various facts is stated in chapter six. Whereas, the limitations of this research as well as future recommendations are enlisted in the final chapter: seven. Regarding the process of research, it was conducted using mixed method approach involving collection of quantitative data from students whereas qualitative data was obtained from teachers in the form of semi-structured interviews along with observations and field notes. Two schools were selected as research sites: one being NUST Creative Learning School, a private school and other being Out of School Children School (OSCS), a school for students belonging to marginalized community as the name indicates. The tool i.e. the game was designed keeping in mind the language fluency of the students as well as their exposure to technology and involved different types of hygiene as stages of the game. After implementation of tool over several weeks, the obtained data was analyzed according to the types involved; the quantitative data was analyzed using relevant software whereas qualitative data was processed for themes. Further details can be read in the relevant chapters.

Chapter 2. Literature Review

This chapter provides overview to the available literature regarding the topic of this research. Pakistan belongs to the list of third world countries with current population over 208 million and still growing, making it the world's sixth populous country. It has been part of UN since 1947 even with various development programs; however the rates of unemployment, inequality and poverty are still at a high level. Furthermore, it has a multi-dimensional poverty rate of 38.8 percent according to (UNICEF Annual Report COAR).

United Nations Sustainable Development Goals (SDGs)

United Nations (UN) proposed it's Sustainable Development Goals (SDGs) to reinstall the spirit of developing societies around the world while trying to ensure that the prints left behind by humans in their progress don't damage or negatively impact other living creatures on this planet. There are a total of seventeen (17) SDGs, all interlinked and inter-dependent, formed in the wake of unattained/unaccomplished and failed Millennium Development Goals (MDGs), in 2015 at Incheon Declaration in South Korea. The updated goals emphasize the importance of interdependency of the goals and nations in order to accomplish the targets and goals and ultimately/most importantly for each nation to prosper. Among these SDGs, there are SDG 3 and 4, for good health and well-being and quality education respectively. Both of these are crucial and are among the foundations for healthy and well-balanced societies. ("About the Sustainable Development Goals - United Nations Sustainable Development", 2015)

Health is an important aspect of life, a blessing that is required for doing well in other sectors of daily living/life. It is one of the basics for a better lifestyle and important for achieving goals. It is also the essential ingredient for performing well in academic life and educational endeavors. And for a good health, good hygiene is a must, the unneglectable component of health.

UN and its subunits have been working worldwide especially in Pakistan to ensure good health and provision of basic health services and hygiene equipment/hardware.

World Bank Report

According to an article by Ahmed (2018), published on Dawn Newspaper, World Bank published a report on current status of poverty, water and sanitation across Pakistan in 2018.

The author has highlighted the fact that the rural areas account for 80 percent of the poor living in Pakistan with Balouchistan having the highest poverty rate overall. The gap between urban and rural areas in terms of poverty was observed greater in Sindh and Balouchistan as compared to Punjab and Khyber-Pakhtunkhwa. And the majority of poorest districts belong to Balouchistan, without a single one making it to the top 40 richest ones whereas Sindh has only Karachi and Hyderabad to represent it in the top 40. Another alarming fact is that the richest cities and districts of Pakistan such as Lahore and Karachi had equivalent share of the poor of Pakistan's population as that of the ten (10) poorest districts.

Maslow's hierarchy

A popular theory used in management and various other fields and also one of the early theories proposed and still referred to this day is Maslow's hierarchy. This motivational theory of psychology was proposed in 1943 by Abraham H. Maslow in his paper titled "A Theory of Human Motivation". It consists of five layers encompassing human needs often depicted in a pyramid shape, with physiological layer at the bottom, acting as the base and the starting point while self-actualization at the top representing the highest level. Each layer represents a set of needs required by any individual at that level. Maslow stated in his theory that without fulfillment of the needs of lower level, an individual can't move to the upper level. Fig 2.1 depicts this hierarchy of needs, where first four (4) layers represent deficiency needs, which arise because of deprivation and longer the deficit or lack of these needs remains, stronger the motivation in one becomes to fulfill them. Whereas, the top layer denotes growth needs which is the resultant of one's aspiration for personal growth. Maslow later on improved his model and stated that it is not necessary that the need of a layer or level must be met completely in order to move on to the next level, anyone can move up and down the hierarchy based on their conditions and other various factors. In other words, everyone is capable and aspires to move towards the top layer however unmet needs at lower layers and conditions such as unemployment, loss of family, job and so forth can cause anyone to alter between layers and hence, movement in the hierarchy won't be in a straight manner or line. The second layer, safety needs consists of needs relating to good health and hygiene, which are the focus of this study. This theory has been applied to educational sector as well and has contributed greatly in shaping classroom environment. It has also been utilized to improve

teaching strategies and management of classrooms to improve students learning. For better learning and sending or producing capable individuals into the society out of the four walls they are raised, the environment should be supportive not only to the content but also to the needs of the learners. Student with poor hygiene will fall ill easily to the hygiene related and avoidable diseases which will lead to poor health. And a learner with improper health will not be able to satisfy needs on the same level as well as those in the higher levels. He or she won't be able to perform efficiently and won't be able to realize his or her full potential to the optimum level. (Mcleod, 2018) Because healthier, happier and stronger individuals with sense of responsibility towards themselves and others will contribute positively for transforming their society for the better and for the greater good.

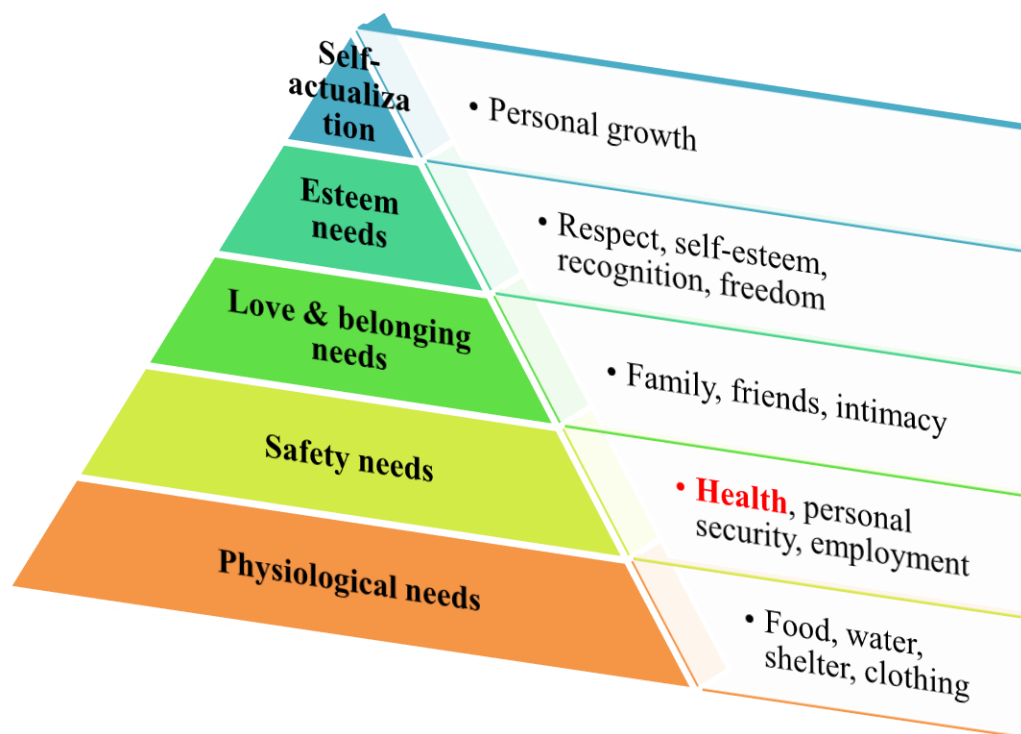


Figure 1 Maslow's Hierarchy

Hygiene: Personal, food and environmental

Nations around the world known for their cleanliness and good hygiene such as Japan, Hong Kong, South Korea in Asia, Germany, Spain, Austria, Italy, Switzerland, France, and United Kingdom in Europe and United States in North American continent have a well-developed

health sector. They are not only known for their clean streets but also for the well preserved Nature that is part of their landscape. World Economic Forum conducts a survey every two years and measures different countries around the world with respect to travel and tourism to guide readers on destinations that are best to travel to and offer good experience. In 2017, the report was published enlisting 136 countries around the world that were measured against different factors, one of them being health. Each country was rated based on the total scale of 7 against each factor. One of the important factors was health and hygiene that listed the level and quality of provision of basic facilities regarding this sector. Pakistan ranked 124th overall, better than 2015 when it stood at 125 however, still it lies close to the bottom of the list. This is an alarming and equally distressing situation that even though it improved its position by one point however it ranked poorly on majority of the factors involved. It received a score of 4.5 for health and hygiene and ranked 101 out of 136 nations measured. On the contrary, Spain, France, Germany and have Japan are the top four in the report and are among top 25 nations with better health and hygiene score with Germany ranked number 1. (World Economic Forum, 2017) (Colson, 2017) (Ahmed, 2017)

Freeman et al. (2014) reviewed studies worldwide from 1990 to August 2013 on hand washing practices and their effect on health. Even though the benefits of hand washing have been reported in all the studies cited however it isn't practiced widely after defecation.

Students equipped with appropriate knowledge and practices regarding personal hygiene are able to have better health and be productive at schools resulting in better performance at schools since to avoid communicable diseases, adequate knowledge and practices of personal hygiene plays a vital role. With poor knowledge and practice, a child's long-term growth hampers. On the contrary, children who are well aware of and practice hand hygiene have reduced risk of respiratory tract infections by 50% and fall ill less resulting in better attendance score at school. Health is one of the crucial factors in enrollment Developing nations like Pakistan are still bearing and fighting the load of diseases that are related to hygiene. With unsatisfactory sanitation facilities and hygiene practices, they are lagging behind in fulfilling their goals towards public health.

A cross-sectional study was conducted with primary level students of public sector in Sharjah, United Arab Emirates in order to gain insight on the level of knowledge and practice

regarding personal hygiene. Besides, results indicating that girls had better knowledge and practices regarding personal hygiene as compared to boys, the authors also emphasized the need for co-operation among parents, teachers, schools, and media to make positive efforts in introducing programs and interventions to communicate the importance of personal hygiene among school children from early stages. Students can bring the change required in the society for better health and hygiene by sharing their knowledge they have gained with their families and communities as a whole. (Ghanim et al., 2016)

Dongre et al. (as cited in Ghanim et al., 2016) emphasized that besides parents being one of the primary source for hygiene education, school is the second most important source where a child is not only taught on how to interact in social settings and different customs involved but also on sanitation and hygiene. However, the learners belonging to marginalized communities with some of them enrolled in schools made for educating learners out of school are affected the most.

According to the report by SPARC (2017), there are currently 22.6 million children out of school in Pakistan with 49% being girls whereas 40% are boys. Though the amount has decreased from 24 million in 2016 however this figure is still a matter of great concern pointing to inadequate measures and efforts been done to tackle this problem effectively. There are charity run schools across the nation that provide fast-track learning to learners out of school in order to prepare them for inclusion in mainstream education however these schools lack quality education including adequate knowledge regarding this subject and lacks implementation of innovative approaches to learning. Moreover, the parents of these children, who are primary source for hygiene education, themselves lack knowledge regarding this subject and their schools.

Pakistan can learn from those who have the best water and sanitation infrastructure as well as performing well in ensuring good health and hygiene of the public. Japan is well known worldwide for its uncompromising attitude and robust policies regarding health and hygiene. It is not breaking news or comes as a surprise that they are very conscious of their hygiene not only at personal level but of all other types as well. This is also evident from the policy they enforced or implemented in 1954 and is still in effect that all schools will include

“Kyushoku”, Japanese term for school lunch as part of their curriculum. This law and the individual items of the lunch have been updated over the years but have never been removed. The reasons for implementing this law are to help students learn the importance of eating a good meal as the basis for a healthy body, to let them experience the local/Japan’s food culture and to appreciate all those involved in preparing the school lunch. The rules require class or homeroom teachers to eat lunch with their respective classes i.e. in the classrooms. And the principal is responsible for checking the food before it is served to the students. The recent modification was to add the role of nutritionist in planning and designing the school lunch menu of each month beforehand, which is both nutritious and tasty for the students while keeping it under the budget. Most schools have their own built-in commercial style hygienic and clean kitchens with proper gear for the staff to prepare healthy and hygienic meals. The lunch includes variety of items according to the required nutrition; with most of the ingredients used are from across the nation especially fresh ones such as vegetables and meat. However, some of the ingredients are those that are processed in foreign nations. The meals are made from scratch and schools that have local greenhouses or small farms nearby use some of their produce for preparing the meals. The middle schoolers such as eight graders visit these farms and greenhouses for work experience to help pick up the vegetables where they are also taught about caring for and appreciating the plants and vegetables that are used in their meals. As students can’t help in cooking those meals but they do help peel the vegetables even those of 1st and 2nd grades. There are schools that have their own garden where they grow different plants and vegetables by themselves such as Umejima Elementary School in Tokyo. These farming experiences help students learn how different plants and vegetables are grown and observe the process closely. Another important factor is that before the lunch is served, the students are educated about the menu items they will eat that day, the name of each dish and its origin as well as benefits of ingredients used in regards to health. The school lunch addresses students that are picky eaters and those with allergies. Those who are picky eaters slowly develop taste for the variety of food offered to them on daily basis where as those who have allergies there are two solutions. First is the removal of ingredient from the recipe and if the ingredient can’t be removed then they don’t have to eat that food and instead eat more of those dishes they don’t elevate their allergies. Even difference in appetite of students is considered; those who want to have a second serving are given more.

If the students didn't like a particular meal item, the flavor and method of cooking are modified in order to help students enjoy it. Since children love sweet, fruits are offered as an essential part of the meal however desserts are offered on special occasions for example every month students who have birthdays are served jelly as dessert. Students' feedback is taken regarding their favourite menu item and if there is a dish that can be prepared again then it is scheduled more in the month such as Japanese curry. This school lunch program is funded by national and prefectural (provincial) governments to ensure equality among schools across the nation. The kitchen is built by the school and pays for the staff whereas the families pay for the ingredients used. There is social welfare system that pays for the lunch fee for students belonging to low-income households. A monthly meeting known as "Oishi Kyhushoku (Tasty school lunch)" of each city is held where nutritionists from all over the city attend to share and exchange their ideas. Students are also involved in this process by giving them the task of designing their own school lunches with their parents as part of their summer vacation work. The best ones from the submitted designs are picked and introduced in the school meals, and members of the community are invited to taste those meals. Each day the students of higher grades are assigned in serving the food to the rest of their classmates. And After the meal, all the students brush their teeth and pick up the dishes and return them to the kitchen or clean up after themselves. Furthermore, they clean up their classroom as well. (Life Where I'm From, 2018)

Besides, enjoying a healthy and hygienic meal at lunchtime and cleaning up after themselves, schools in Japan teach their students from the start of their elementary education to clean their own classrooms, which is termed as "O-soji". This practice has been part of the curriculum from a long time and is still practiced today. There are taught or the instilled the belief that their classrooms are their space that they use and it's better for them to clean up after themselves but for bigger tasks which they can't do on their own, adults help them out. The purpose of such practices is to build self-confidence of the students and prepare them for life from early stages. Because these are the tasks that one has to perform when they enter adulthood, hence they are prepared for that phase from their elementary level of school gradually. (AJ+, 2018)

Therefore, a developing nation such as Pakistan needs to double its effort in promoting hygiene awareness and successfully implementing UN SDGs. In order to ensure better progress, an approach known as game based learning can be utilized.

Serious games

In this digital era, Game Based Learning (GBL) is not a new concept and numerous researches have been conducted to study the benefit of this approach as well as the potential of serious games which are part of this particular method. Serious games refer to those games the underlying reason for development of which isn't entertainment rather education, training and marketing whereas entertainment is a byproduct. Sung, Hwang and Yen (2015) cited the works of many researchers who reported game based learning a highly potential and beneficial approach for enhancing students learning and motivation. These games not only enhance students' engagement to the content but also promote higher order skills. However, such results can only be achieved when the game is properly structured. Namee et al. (2011) further pointed out that there is a need of proper balance between the pedagogical objectives and the game elements. Hence, the benefits of game based learning can be utilized in order to maximize students learning regarding hygiene.

According to Ayazi (2016), this method is now getting more attention in Pakistan but its effects haven't been researched or studied properly. However, to keep up with the educational standards around the world, few educational institutions have made usage of tablets for learning compulsory at both schools and homes.

Children in their early years rely heavily on their senses and out of the five (5) senses they rely most on sight. In other words, they depend greatly on visual stimuli and data, hence they are going to remember and follow what they see more than what they have been told. (Newton & Harrison, 2005)

These (serious) games also cater to different learning styles such as visual auditory, kinesthetic as highlighted by Jones (as cited in Namee et. al., 2011) Hence, a game designed in an aesthetically pleasing manner with appropriate content and provides relevant visual stimuli will be beneficial in teaching children about daily life topics such as hygiene.

Context-based games

Besides learning content, the context involved in the game is of equal importance as well. Sung et al. (2015) explained that due to lack of learning activities for health education students are unable to realize the importance of knowledge about health and its maintenance. They further cited various researches that indicated that context is necessary in order to make learning more meaningful. The benefit of a context based game are greater than game based learning as it allows the user to be more creative as it simulates real world environment. The user is able to construct knowledge, retain information and apply gained skills and knowledge to various scenarios. The user is able to form connections of newly gained information and apply it to real world scenarios. The researchers developed a context based game for health education using context and game based learning approaches.

Namee et al. (2011) developed a serious game on food safety named “Serious Gordon” to teach basics of food hygiene and safety to workers in the food industry of Ireland according to the rules and guide set out by the Food Safety Authority of Ireland. The game was developed utilizing various pedagogical approaches and game design principles in a balanced manner. The induction skills of the guide shared by the authority mentioned earlier were used in 3D simulated environment. The game was designed to be as close to reality as it could be by using kitchen plans of real world restaurants and characters that could be found as part of the real world. After successful development of game, it was evaluated using focus group session with participants having different level of experience with regards to serious games. It was found to be more motivating and stimulating as compared to the traditional method of information broadcast and reliance on textbooks only. The participants also demonstrated increase in knowledge and understanding of food safety instructions.

Digital games relevant to the topic and available on Android play store were installed, played and tested to review the need for such a game in Pakistan. Almost all games played were developed in foreign nations and reflected the culture over there. Furthermore, the audio and text involved were in English language, which would have been an obstacle for students of OSCS. A detailed evaluation is discussed in Chapter 3.

Miyan, Baloch and Hussnain (2017) conducted a pilot project utilizing qualitative approach to study the effect of existing hygiene games on students who are enrolled at school for socio-economically marginalized children. The results indicated that the students were eager to play the games and even understood some of the basic elements of the game and were able

to identify and recall basic hygiene steps however they were not fully able to understand the concept of game and gameplay due to language barrier and context within the games. Games utilized were obtained from Google Play Store and unfortunately; no quality game on this subject has been developed in Pakistan yet. All games belonged to foreign nations and the language was English, which isn't the first language or mother tongue of the students. Furthermore, the context of the games didn't depict the local context; it was what users from those nations could understand or those belonging to elite faction of the society.

Pakistan lacks development of digital games regarding hygiene and health education for general public but specifically for children out of school who are most vulnerable to unhygienic environments and the diseases that are borne in such conditions. Hence, a context based game for learners out of school as well as those in school needs to be developed and tested that will not only allow them to understand the importance of hygiene but also motivate them to practice it on a daily basis in order to aid them in living a healthier life.

Chapter 3. Methodology

This chapter contains details regarding the design considerations and processes of the tool used for studying the impact of context-based game on students' hygiene as well as the research paradigm, methods and instruments for analyzing the impact. This study and the tool designed was aimed at primary level students of two schools, one private school which has technological equipment being used for teaching while other a charity run school for out of school children..

3.1. Research Methodology

In order to study the problem defined earlier, mixed method methodology in the research continuum was deemed as the best solution. A mixed method research as the name states, is the one that combines both quantitative and qualitative research methods to study a phenomenon or explore a problem. It utilizes both numbers (quantitative) and words (qualitative) to better understand the problem at hand. (Bergin, 2018) Miyan et al. (2017) conducted a pilot study conducted with students for out of school children, which served as the need analysis for the research apart from the purpose of achieving diversification. By diversification, it means to incorporate both quantitative and qualitative approaches to obtain diverse findings that aren't possible through any one of the approaches alone. The data was collected in both quantitative and quantitative forms. Pre and post tests were conducted with the participants before and after the intervention respectively while semi-structured interviews were conducted with the concerned members of the faculty of both schools. Observations and field notes were also recorded as part of qualitative data and methods to report effectiveness of the developed tool on participants. *Figure 2* shows the research process. It consists upon various modules involved as follows :

3.1.1. Tool Development:

In this phase, the tool to be used i.e. 2D game was designed and developed before moving on to later stages.

3.1.2. Ice breaking session:

This phase involved brief introductory session in order to make students comfortable and express themselves freely. This session was carried out at both schools but was required more at OSCS since they were more hesitant and quiet as compared to their counterparts.

3.1.3. Pre-test:

After successful ice breaking session and the students were comfortable to participate in the study, they were given pre-test questionnaire on the topic.

3.1.4. Intervention:

After conduction of pre-test, the intervention was executed. Students were given Android tablets to play the context-based game.

3.1.5. Post-test:

Following successful implementation of intervention, the next phase was post-test. Students' knowledge regarding the topic after playing the game was checked.

3.1.6. Post-post-test:

The phase that followed post-test was post-post-test, which was conducted to see whether students have retained the knowledge gained or not.

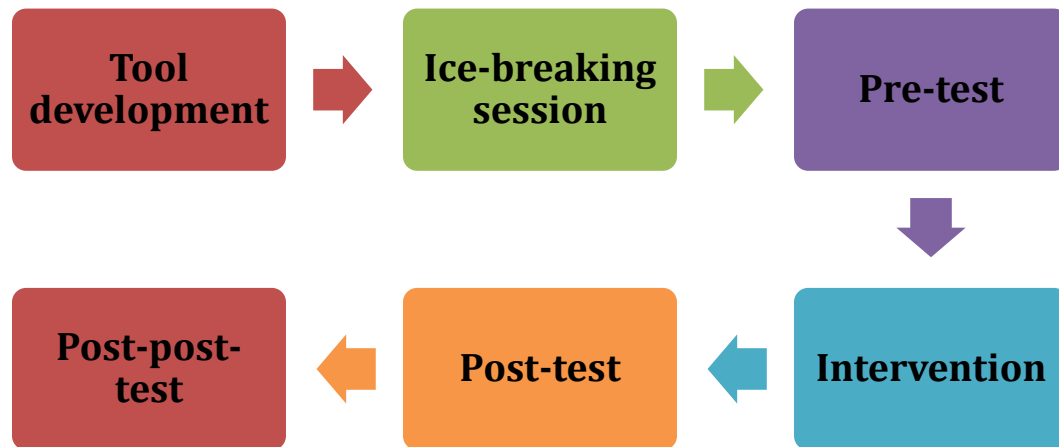


Figure 2 Research Process

Mixed Method Research design

Quantitative Research Design

Under quantitative paradigm, quasi-experimental design was selected and under that sub-category, pretest-posttest design was opted. Quasi-experimental design shares some similarities with experimental design however there is a difference where presence of both treatment and control isn't always necessary and does involves sub-types where there isn't

random selection of sample. (*Chapter 13: Quasi-Experimental and Single-Case Experimental Designs*, 2018) This design was implemented on both schools. The pre-test data collection took almost two days for both schools with almost 4 days long intervention of each school followed by post-test. The pre-test was designed using questionnaire in prior literature on hygiene research as well as the health education book of prior curriculum of NCLS. The decision to design a pre-test and post-tests and using them was because there is no prior literature or research conducted on this topic on primary level.

Qualitative Research Design

For qualitative part of the research, semi-structured interviews from teachers of both schools were arranged and analyzed. Besides interviews, observations and field notes were also recorded in order to obtain better insight into the matter, which were then analyzed for themes.

Sampling method

Regarding sampling technique, convenient sampling was used. This decision was based on the sampling population, which is discussed ahead as well as considering factors of accessibility and permission to conduct research at the school.

Research participants and target population

The population targeted in the research is primary level students of Pakistan particularly those belonging to marginalized communities. Since, at this level primary level students across the nation can't be reached and involved in the study, the sample was extracted from primary level students in Islamabad which served as the sampling population. The sample consisted of primary level students of two schools: NUST Creative Learning School (NCLS), a private school and Out of School Children School (OSCS), a charity run school. This sample was derived for collecting quantitative data and analysis whereas, for qualitative data and analysis the research participants involved teachers of both schools. The quantitative sample contained 44 students of both genders from both schools. Regarding technology awareness/skills, students of both schools knew how to use the

Android tablet but those from NCLS had access and exposure to smartphones, tablets and digital games more than their counterpart/ those belonging to OSCS.

Research Method

The experiment on the whole or overall lasted for a month including the pre-test, intervention, post and post-post-tests at both schools. The students were given pre-test before they were allowed to play the game. The intervention lasted for four (4) days followed by post-test. After the post-test, a one to two (1-2) weeks interval was set before post-post-test was conducted. The intervention at NCLS was conducted 1 week prior to OSCS. On Day 1, students of both schools had ice-breaking session and were given pre-test. The pre-test of remaining students were taken separately from their class on Day 2. On Day 2, the students were guided about how to use the Android tablets. From Day 2 to Day 5, students played the game and field notes and observations were recorded. On the last day of intervention, students were given post-test which stretched over two days. Along with the post-test, semi-structured interview with the teachers was conducted.

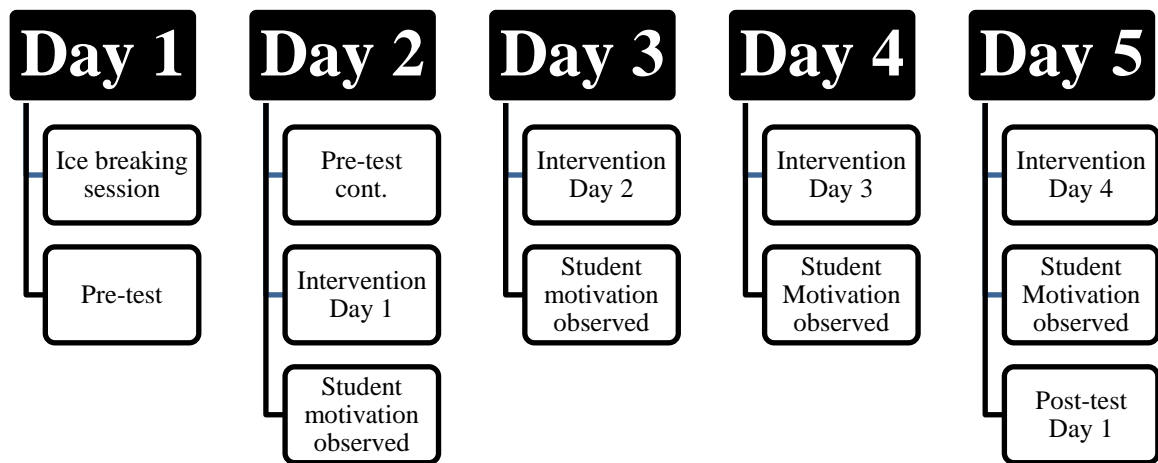


Figure 3 Intervention breakdown

Research instruments, data collection tools

For qualitative data, semi-structured interviews with teachers of both schools were conducted that contained questions relevant to the topic but not limited to students attitude

towards hygiene and digital games. For quantitative data, both pre-test and post-test were designed containing sections about the three types of hygiene targeted: personal, food and environmental. The pre-test was designed using health education book of NCLS used in their prior curriculum as well as hygiene questionnaire or survey used in a hygiene awareness research conducted in Sharjah with middle school students by Ghanim et al. (2016). The post-test however contained questions relevant to the game and then for retention only questions pertaining to environmental hygiene were recorded on paper whereas for personal and food hygiene, observations and field notes were maintained. The pre-test used is attached in [Appendix A](#).

Research variables

After finalizing research questions and relevant hypotheses, research variables were finalized for analysis. The quantitative data was collected for answering the research question 1 and hypotheses H1 and H2. With respect to RQ1 the tool developed i.e. the gender and school settings/types are the independent variables whereas, awareness level and retention represent dependent variables.

3.2.Design Methodology

Instructional design

The game was designed and developed by adopting ADDIE model as the instructional design model which consists of Analysis as the first stage, design as the second, development as the third, fourth being implementation whereas evaluation as the last stage. This model was adopted because there is room for making changes i.e. the game can be modified if any changes or improvements are suggested in each stage as well as after evaluation. The whole cycle can be repeated to accommodate the required modifications. (Ahmad, 2016) (Quigley, 2019) (ADDIE model diagram) Following is the breakdown of each phase of the model in accordance to the tool development i.e. the game.

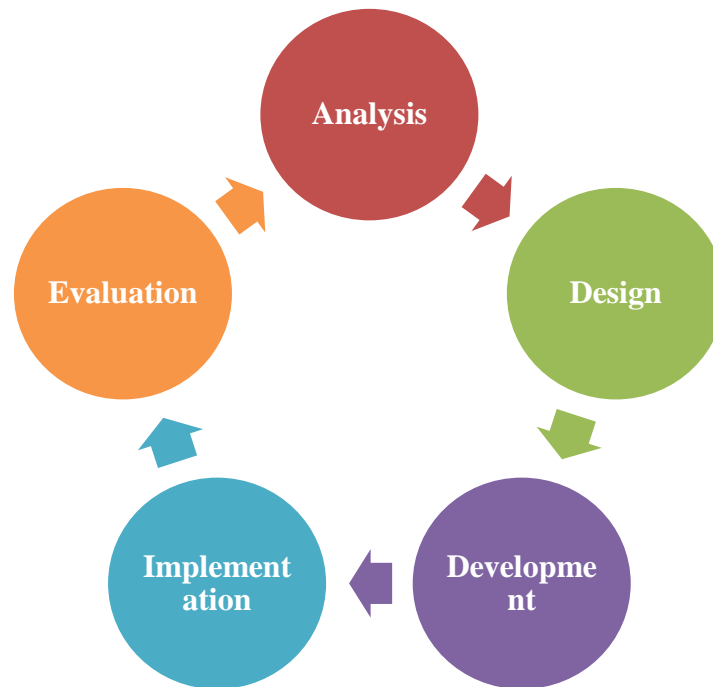


Figure 4 ADDIE Model

3.2.1. Analysis Phase

The pilot study conducted by Miyan et. al. (2017) under qualitative approach identified the need for a context based game and inclusion of Urdu audio to guide the players or users. The mentioned pilot study served as need analysis for this research and the developed tool. The students had difficulty playing the game as the context didn't depict the local environment and the audio that guided users regarding game flow, was in English language.

Besides prior literature indicating absence of a context based game close to or depicting the local environment that of Pakistan and involving audio in Urdu language, existing games on hygiene available on Google Play Store were tested and reviewed for guidance. The Play Store had absence of hygiene games developed in Pakistan and from the ones available on the topic; there was none that involved local i.e. Pakistani context. Furthermore, there was almost no game that has audio in Urdu language. It is to be noted that most of the games listed have games from a Chinese game studio, Baby Bus, who have created several short games for small children on health and etiquettes.

Following games were reviewed:

Table 1 Pre-existing Android Games

Game Title/Name	Short Description
My Healthy Little Baby	Pros: This game offers two characters: one baby panda and the other chibi lion. The user has to help the selected character in completing personal hygiene tasks. It incorporates colorful background and assets. Cons: It is of very small scale, doesn't include other types of hygiene. The audio is in English language even though the instructions are less.
Baby Hazel Hygiene Care	This game involves a single character as depicted in the picture, named as Baby Hazel. The user has to help the baby perform personal hygiene tasks. The game instructions or help guide as well as those involved during play mode are written in English. Some of the tasks aren't easy to understand at first and the user needs to figure it out after several tries e.g. when placing her dirty clothes inside the washing machine, the user needs to pick it up via certain angle. The context involved didn't depict the local environment. Advanced levels require payment to be unlocked.
Cleaning fun	This is the second game by Baby Bus. The user helps the baby panda in finishing chores. The cleaning involves doing laundry. This game also used good graphics however it involved using a washing machine of newer model or type, the one that is rarely found in Pakistani homes.
Food Jump	This game focuses on teaching users on eating healthy foods. The food items used are designed well however the game isn't easy to navigate. The instructions are written in English.
Healthy Eater	This game introduces healthy food to users through the character, a baby panda. The user has to help the baby panda eat its meal by picking healthy food from the ones presented.
Bathroom Cleanup & makeover	In this game, the task of user is to help clean the bathroom. Only the bathroom level is free, advanced levels are available after purchase.
Waste sorting	This game involves different categories of garbage and bins corresponding to each type. The user has to sort the coming garbage on automatic belt into the relevant bins. The game isn't divided to levels explicitly but the bins are

	introduced three at a time. There are plants at the end of the belt or channel that are destroyed if the garbage ends in their space. The graphics of the game and implicit division into levels are the pros of the game however there is only one scenario where all these are tested. Practical application of the idea of using bins of different shapes and colors will be useful however, in Pakistan the users may not be able to relate well to it as we usually have single bin and even if there are more than one are used then all are identical or alike.
Trash Treasure	This user gets to learn about recycling different reusable waste items into different things.
EcoMission	The user can play the basic version for free however advanced levels are unlocked through online purchase.
Mr Garbage Man	This is a small game on environmental hygiene focused on imparting knowledge on different types of garbage. The users help the character, Garbage Man in sorting and picking up garbage according to their types.
Saitama City Garbage Sorting	This is not exactly a game rather an application developed in Japan for Saitama city residents. However, this application can be helpful for non-residents as well in gaining knowledge about different type of garbage and how to dispose them off. There is also a calendar feature that notifies or alerts about you the type of garbage to throw out depending on the day of the week.

3.2.2. Design Phase

After analyzing the needs of target population and available games on Android Play Store, the concept of the game was designed. The aim was to provide information on and teach all types under one umbrella or inside one game. Game characters were designed to help users to relate to the content followed by the decision to utilize graphics and assets that pertain to the local context. Since the target population consists of students at primary level, hence content that was age appropriate was incorporated. In order to aid users in understanding and absorbing the information with ease, the game was divided into levels corresponding to main three types that are *personal*, *food* and *environmental*. According to Jean Piaget's theory, the primary level students belong to concrete operational stage in

which they can grasp the concept of class inclusion and thus are able to understand and classify variety of data into categories. (Mahmood, 2016) These children have developed thinking abilities that are able to remember, memorize and retrieve key data and information through categorization technique. Furthermore, they are to focus on the given task through selective attention and avoiding distractions. They are able to learn and follow the rules set by their parents, teachers and at school, which makes it easier for them to learn the game rules and play it according to them. ("Concrete Operational Stage", 2019) The background or scene setting of each type of hygiene was decided on the basis of where it can be understood best and performed more frequently during this phase. For personal hygiene tasks, it was finalized to set in bathroom where the user will help the character perform all these tasks. The food hygiene level focused on helping users to learn the difference between healthy and unhealthy foods, hence different types of food that the target population are familiar with were considered and divided into three categories: good, sometimes and bad food. Good food are those that are nutritious and boosts one health, whereas sometimes food refer to those food that aren't healthy to eat as good food but it is alright to eat them occasionally not regularly. Lastly, bad foods are junk food that one must avoid eating as they don't provide the required nutrition required by an individual and their prolonged and frequent consumption can post risk to health such as cholesterol, obesity and so forth. The theme/background of food hygiene level was set in kitchen area where the meal is cooked and eaten mostly. The children at primary level are able to understand the cause of illness, however they aren't able to comprehend the concept of future or long term benefits and consequences but they are able to grasp the concept of health according to the rules and information provided by parents and school. Furthermore, they rely heavily on their senses and out of the five (5) senses they rely most on sight. In other words, they depend greatly on visual stimuli and data, they are going to remember and follow what they see more than what they have been told. (Newton & Harrison, 2005) At this stage, they identify external element as cause to any illness which could be a person, object or action. For example, if they came in contact with someone who had flu or they ate the wrong food which made them fall ill. Hence, they will be to understand the concept of healthy and unhealthy food and its introduction at this stage would be appropriate for their age. ("Children's Understanding Disease Processes | Child

Advocate - Helping Parents and Professionals", 2015) Finally, the environmental hygiene level was divided into two sub units or settings. The first unit focused on teaching users to throw their trash in the bin and hence the environment of this sub unit depicted character's bedroom whereas, the second sub-unit environment was a park where three different types of bins were placed. The bins were of major categories that the users have come across in their daily lives were placed. Another important factor in designing the game was to incorporate rewards and feedback for the users in order to encourage them to perform better and play the game attentively. The audio script included words of praise for users when they perform the task well and when they aren't able to successfully complete the task, they will be notified through the audio feedback telling them to try again. Children at this level or phase are very responsive to and greatly reinforced by praise. (Newton & Harrison, 2005)

With levels and content finalized, the script of the game in both Urdu and English was developed with aim to use simple vocabulary that is easy to understand by the users. The storyboard was developed on paper first and then translated into PowerPoint slides before game development. Every relevant image and asset that was going to be used in the game was first searched through Google search engine to collect references. 2 and 2.5D images were used for designed for the game as 3D may prove to be confusing for primary level students.

3.2.3. Development Phase

After the storyboard illustrated in previous section was finalized, assets of the game were designed using Adobe Photoshop and Illustrator whereas the game audio was recorded using built-in recording application of Android Smartphone and then edited using Audacity software for desktop computer. Two separate Android applications were developed for the game for Urdu and English versions of the game. Both versions were developed using Unity software that is widely used for developing games belonging to various categories. Following are the images of digital storyboard developed in MS PowerPoint.

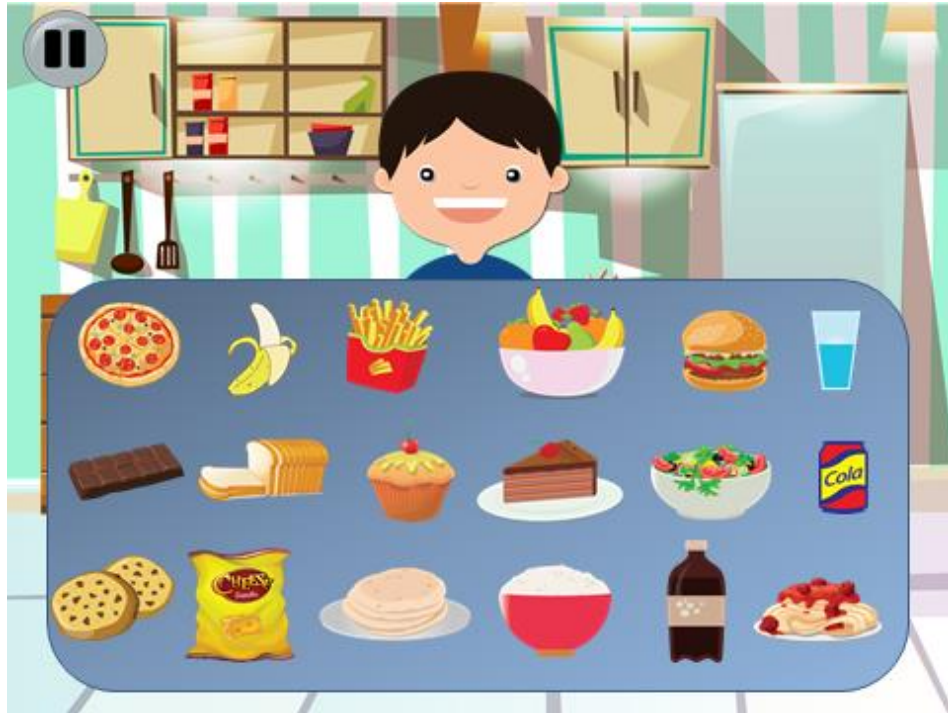


Figure 5 Food Hygiene Level



Figure 6 Environmental Hygiene Part 1-Room



Figure 7 Environmental Hygiene Part 2- Park



Figure 8 Personal Hygiene

3.2.4. Implementation Phase

In order to ensure that the game contained the relevant content, it was evaluated through heuristic evaluation. And subsequently required modifications were made. After the game was completely ready, it installed in Huawei Android tablets. Both English and Urdu audio versions were installed in all tablets. For implementation, as mentioned earlier in research methodology section, the game was deployed at NCLS and OSCS I-10/4, both schools located in Islamabad and offer primary level education. NCLS is a private school whereas OSCS is a charity run school for students belonging to marginalize communities. The students at both schools played the game for four days. However, the implementation of game at NCLS was earlier than that at OSCS. Initially, Urdu version was offered to students of OSCS whereas English version was offered to NCLS students however, later on students of both schools were given the choice of playing the version they liked.

3.2.5. Evaluation Phase

Heuristic evaluation was adopted at development phase to identify errors and necessary modifications. And with the help of heuristic feedback, necessary changes were incorporated before introducing the game to participants. On part of students, they were asked to provide feedback on the game, in terms whether they like it or not and what type of characters they would like to see in the game in the future. The teachers of both schools were asked to share the feedback students gave regarding the game. The verbal and written feedback of students were collected to be used for introducing new improvements later on in the game as part of future versions.

Chapter 4. Results

This chapter contains the results obtained after analyzing the data collected. The data collected through quantitative methods was analyzed using IBM SPSS Statistics software whereas qualitative data consisting of semi-structured interviews, observations and field notes was processed on themes.

The aim of this research was to analyze the effect of context based hygiene awareness game on students of primary level. Two schools were selected as part of this research: NCLS, a private school and OSCS, a charity run school for children belonging to marginalized communities. Participants included students of both genders and teachers of the respective schools. Quasi-experimental design was adopted to analyze for collecting and analyzing quantitative data whereas, semi-structured interviews were conducted with teachers of the schools for collecting qualitative data along with field notes and observations. The process of intervention at both schools was the same: they were first given pre-test, followed by intervention where they were introduced to the game, then post-test and finally a post-post-test was conducted after one week in order to determine whether students retain the information they learned from the game. According to the research questions and hypothesis presented in chapter 1, the analysis of both quantitative and qualitative data are divided into two separate sections in this chapter.

4.1. Quantitative Analysis

Pre-test and Post-test Analysis

Both pretest and posttest involved three basic types of hygiene: personal, food and environmental. And content relevant to all types that was appropriate for the students was incorporated in the study. In post-post-test, personal and food hygiene of students was observed whereas environmental hygiene data was collected on papers i.e. in both post-test and post-post-tests students were asked to throw the garbage placed in front of them to the bins according to the type a garbage item belongs to. In this section, there are two types of analysis of the quantitative data. The results from pretest and posttest data have been used to analyze the difference in understanding of the types of hygiene and impact of game on both genders and

schools setting. Whereas the post-post-test results were used for assessing the level of retention of the knowledge gained via game of students of both schools.

The pre-test was conducted at both schools to gain insight on prior knowledge regarding hygiene the students already have. Intervention lasted for four days where students were given Android tablets to play the game after the pre-test. Post-test followed the intervention/implementation. Post-test was made by modifying the pre-test in order to avoid memorization i.e. students don't reproduce pre-test answers. Table 2 shows total number of participants of both pre and post-tests and the division of participants according to gender. Fig 9 displays the pie chart of gender distribution. It can be seen that number of male students (23) is greater than that of female students (21).

Table 2 Total participants

		Valid	
		N	Percent
Total score of the student	Male	23	100.0%
	Female	21	100.0%

Table 3 Gender Division

Gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	23	52.3	52.3	52.3
	Female	21	47.7	47.7	100.0
	Total	44	100.0	100.0	

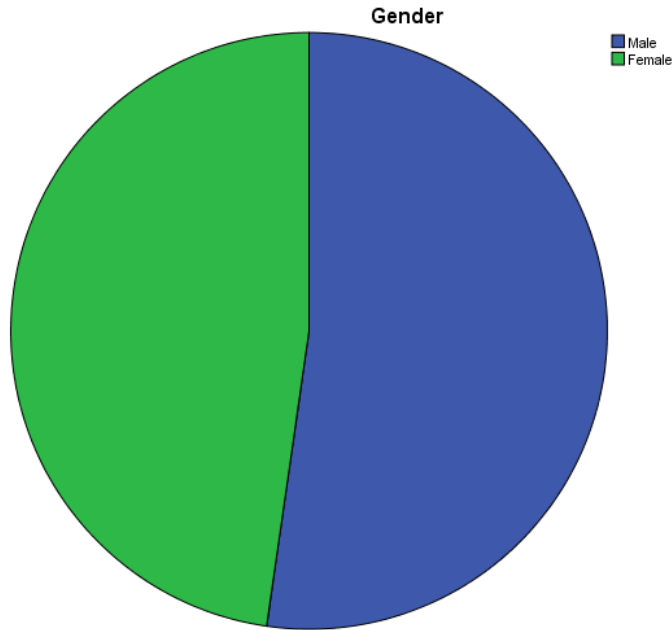


Figure 9 Gender Pie Chart

Gender-wise analysis

Table 4 and 5 enlist the descriptions of pre-test and post-test data of both gender types, which include mean, median, standard deviation and skewness. Table 4 indicates that mean of female students ($M = 10.90$, $SD = 1.972$) is greater than that of their male counterparts ($M = 9.82$, $SD = 1.969$). Similarly, median of female students (Median = 11.0) was also greater than that of male students (Median = 10.0). In case of post-test, similar result was found. The post-test descriptive in Table 5 shows similar trend.

Table 4 Gender Pre-test descriptive

Pre-test Descriptive					
	Gender		Statistic	Std. Error	
Total score of the student	Male	Mean	9.8261	.41059	
		95% Confidence Interval for Mean	Lower Bound	8.9746	
			Upper Bound	10.6776	
		5% Trimmed Mean	9.8068		
		Median	10.0000		
		Variance	3.877		
		Std. Deviation	1.96913		
		Minimum	7.00		
		Maximum	13.00		

		Range	6.00		
		Interquartile Range	3.00		
		Skewness	.265	.481	
		Kurtosis	-.871	.935	
	Female	Mean	10.9048	.43042	
		95% Confidence Interval for Mean	Lower Bound	10.0069	
			Upper Bound	11.8026	
		5% Trimmed Mean	10.7884		
		Median	11.0000		
		Variance	3.890		
		Std. Deviation	1.97243		
		Minimum	8.00		
		Maximum	16.00		
		Range	8.00		
		Interquartile Range	3.00		
		Skewness	.708	.501	
		Kurtosis	.897	.972	

In Table 5, it can be observed that the mean of female students ($M = 25.10$, $SD = 4.02$) is greater than that of male students ($M = 23.83$, $SD = 3.39$). Similarly, the median of female students (Median = 26.0) is greater than that of male students (Median = 24.0).

Table 5 Gender Post-test descriptive

Post-test Descriptive					
	Gender		Statistic	Std. Error	
Total score	Male	Mean	23.83	.696	
		95% Confidence Interval for Mean	Lower Bound	22.38	
			Upper Bound	25.27	
		5% Trimmed Mean	23.76		
		Median	24.00		
		Variance	11.150		
		Std. Deviation	3.339		
		Minimum	18		
		Maximum	31		
		Range	13		
		Interquartile Range	4		
		Skewness	.399	.481	
		Kurtosis	-.222	.935	

Female	Mean	25.10	.878
	95% Confidence Interval for Mean	Lower Bound	23.26
		Upper Bound	26.93
	5% Trimmed Mean	25.21	
	Median	26.00	
	Variance	16.190	
	Std. Deviation	4.024	
	Minimum	17	
	Maximum	31	
	Range	14	
	Interquartile Range	7	
	Skewness	-.377	.501
	Kurtosis	-.693	.972

Figure 10 and 11 display pretest and posttest graphs for the difference in score according to gender. Boxplot has been used to display the difference in scores according to gender and school. A boxplot is representation of the dataset useful for understanding the distribution of data through four quartiles (Q1, Q2, Q3 and Q4), median, whiskers, outliers (if any). ("Understanding and interpreting box plots | Wellbeing@School", n.d.) In Fig 10, it can be seen that the score of female students in pre-test is greater than those of male students. The highest score belongs to female students as well. The gap between maximum value and rest of the scores or the length of whisker in case of female students is greater as compared to that of male students. In both cases, the amount of students who scored greater than the median is less (25% in upper quartile) whereas majority scored lie below the median (75% in lower quartile). The long upper whiskers also indicate that the scores vary greatly in upper quartile as opposed to lower quartile that has shorter whisker. Furthermore, the knowledge and understanding of hygiene differs in both gender types, female students possessed more knowledge on the topic as compared to their counterparts.

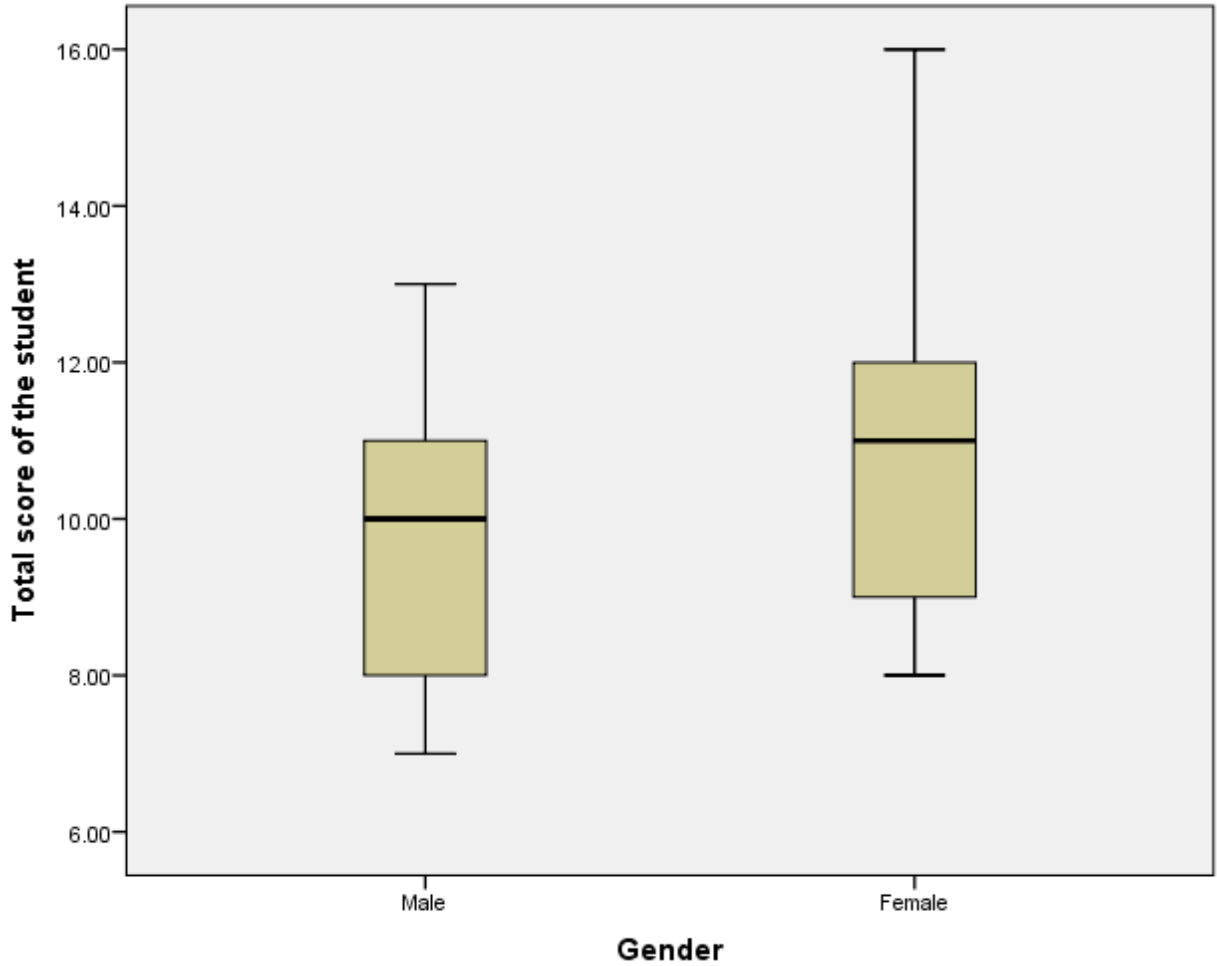


Figure 10 Gender Pre-test Boxplot

In Fig. 11, it can be observed that the boxplot of both genders are relatively closer in post-test as compared to pre-test. The box-plot of females in post-test is higher than that of males in post-test as well. And in this case, both maximum and minimum values lie in female boxplot. The male boxplot is short whereas female boxplot is tall indicating that there is less variation in scores of male students as compared to their counterparts. However, there are outliers in case of male boxplot indicating that there are students who have the highest score and the gap between them and the scores of the rest of the group is large. The median of female students is greater than that of male students however there are few students whose score lie above the median and majority scored below the median in female boxplot. On the contrary, the division is almost equal in male boxplot where almost half scored above the median while the rest below it.

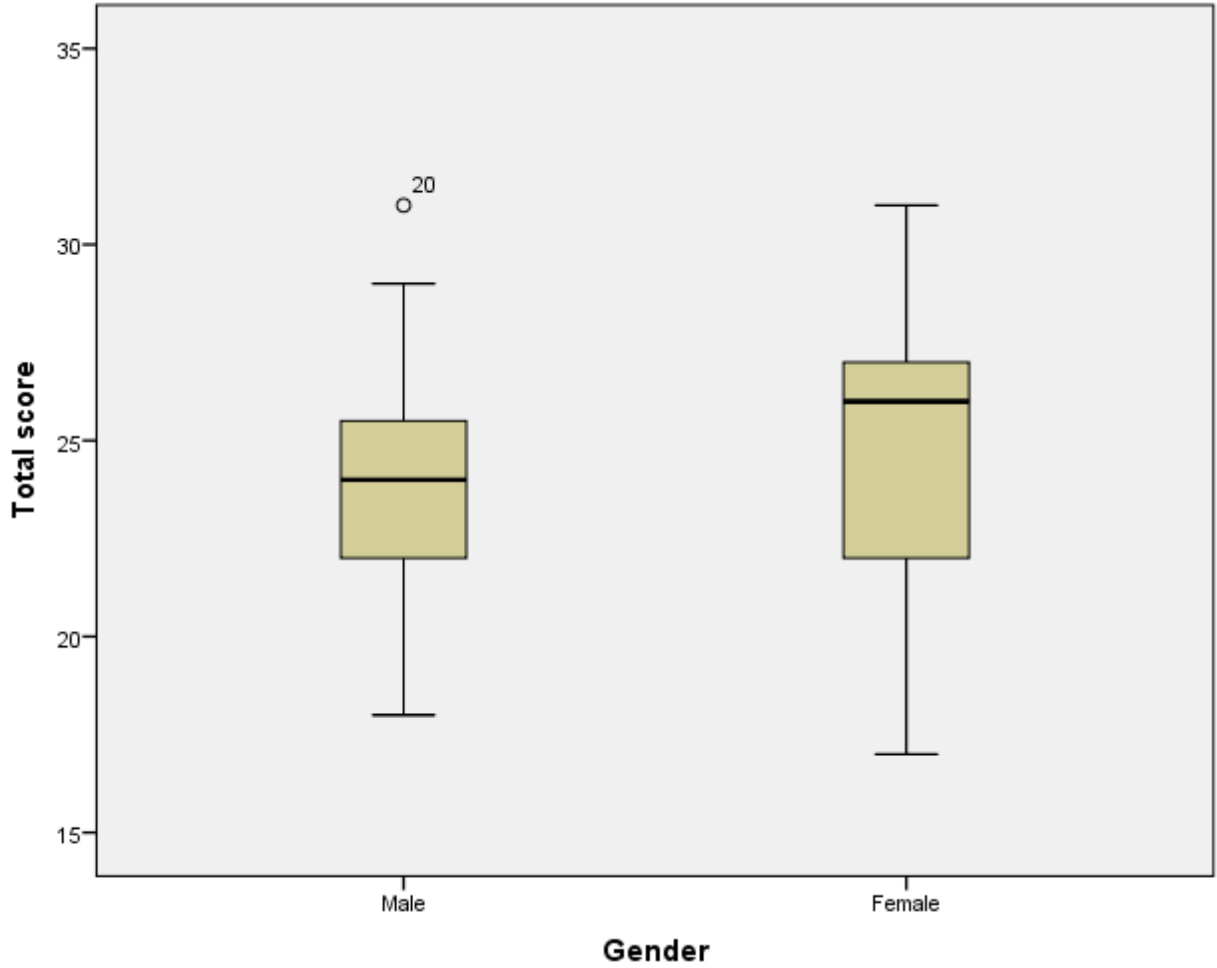


Figure 11 Gender Post-test Boxplot

Table 6 Gender Post-test v2

Post-test Version 2 Descriptives					
	Gender		Statistic	Std. Error	
Total score	Male	Mean		6.7826	.29459
		95% Confidence Interval for Mean	Lower Bound	6.1717	
			Upper Bound	7.3936	
		5% Trimmed Mean		6.8140	
		Median		8.0000	
		Variance		1.996	
		Std. Deviation		1.41282	
		Minimum		5.00	

		Maximum	8.00	
		Range	3.00	
		Interquartile Range	3.00	
		Skewness	-.426	.481
		Kurtosis	-1.845	.935
	Female	Mean	5.9524	.38715
		95% Confidence Interval for Mean	Lower Bound	5.1448
			Upper Bound	6.7600
		5% Trimmed Mean	6.0529	
		Median	5.0000	
		Variance	3.148	
		Std. Deviation	1.77415	
		Minimum	2.00	
		Maximum	8.00	
		Range	6.00	
		Interquartile Range	3.00	
		Skewness	-.099	.501
		Kurtosis	-.726	.972

The post-test was conducted in two parts. The first part is the one analyzed above catering all three types whereas the second part or version only targeted the environmental hygiene with the other two types covered through qualitative analysis. Table 6 consists of descriptives of second version of post-test in which it is evident that the mean of male students ($M = 6.78$, $SD = 1.41$) is greater than that of female students ($M = 5.95$, $SD = 1.77$). Similar difference can be observed in the case of median where median of male students ($Median = 8.0$) is greater than that of female students ($Median = 5.0$). Fig. 12 displays this difference in boxplot. The male boxplot doesn't contain any whisker indicating that both there is no significant variation of scores from maximum and minimum as well as the maximum and minimum values lie within the boxplot. There are no upper and lower quartiles as the maximum score of the test is 8 which is also the median of male boxplot, pointing to the fact that most of the male students scored below the median but not as low as the lowest score in female boxplot. In case of female boxplot, there is no whisker at the upper end whereas there is a long one at the bottom of the box indicating the gap between the lower quartile and median, which is 5, is great. Majority of the scores in this box are above the median. Moreover, the female box-plot is on the same level as male boxplot indicating that the difference isn't great.

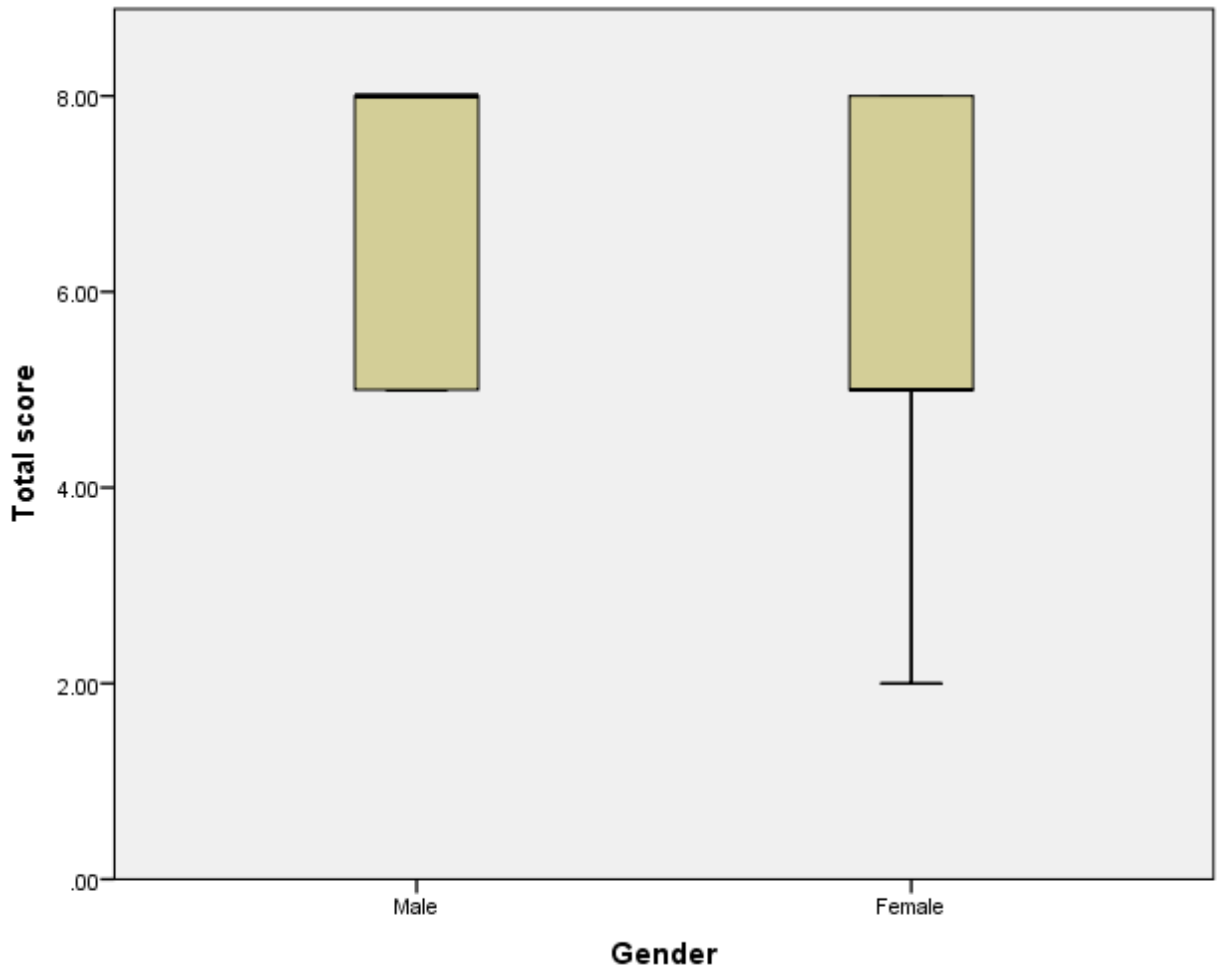


Figure 12 Gender Post-test v2 Boxplot

Post-post test

Table 7 Gender post-post-test

Post-Post Test Descriptives					
	Gender		Statistic	Std. Error	
Total score	Male	Mean	6.7391	.28959	
		95% Confidence Interval for Mean	Lower Bound	6.1386	
			Upper Bound	7.3397	
		5% Trimmed Mean	6.7657		
		Median	8.0000		
		Variance	1.929		
		Std. Deviation	1.38883		
		Minimum	5.00		

		Maximum	8.00	
		Range	3.00	
		Interquartile Range	3.00	
		Skewness	-.267	.481
		Kurtosis	-1.923	.935
	Female	Mean	6.4286	.39383
		95% Confidence Interval for Mean	Lower Bound	5.6071
			Upper Bound	7.2501
		5% Trimmed Mean	6.5794	
		Median	8.0000	
		Variance	3.257	
		Std. Deviation	1.80476	
		Minimum	2.00	
		Maximum	8.00	
		Range	6.00	
		Interquartile Range	3.00	
		Skewness	-.662	.501
		Kurtosis	-.394	.972

Post-post-test descriptives are enlisted in Table 7 with its corresponding graph in fig. 13. It is similar to the post-test graph in Fig. 13 however; in this case the median of both genders is the same i.e. 8 and a small difference between means in the descriptives given in Table 7. The mean of male students ($M = 6.73$, $SD = 1.38$) is greater than that of female students (Mean = 6.42, $SD = 1.8$). Both boxplots in the given figure suggest that most scores are below the median, while the female boxplot has a lower whisker that stretches to value 2 indicating the minimum score obtained by participant in that group.

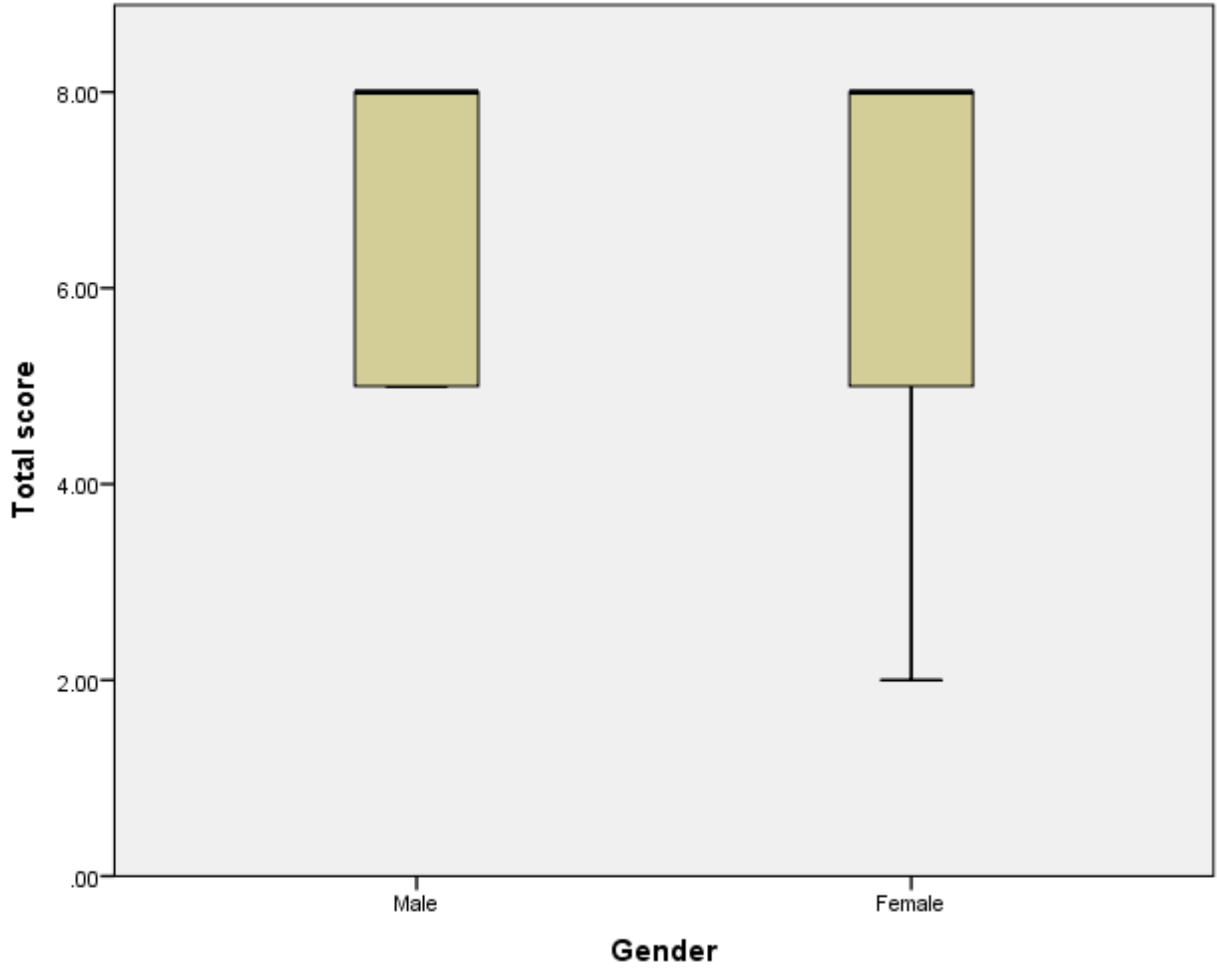


Figure 13 Gender post-post-test boxplot

School-wise analysis

Table 8 contains descriptives of pre-test data of both schools such as mean, median, standard deviation and skewness.

Table 8 School Pre-test descriptives

Pre- test Descriptives				
	School		Statistic	Std. Error
Total score of the student	NCLS	Mean	10.7143	.62396
		95% Confidence Interval for Mean	Lower Bound	9.3663
			Upper Bound	12.0623

		5% Trimmed Mean	10.5714		
		Median	10.0000		
		Variance	5.451		
		Std. Deviation	2.33464		
		Minimum	8.00		
		Maximum	16.00		
		Range	8.00		
		Interquartile Range	3.25		
		Skewness	.995	.597	
		Kurtosis	.535	1.154	
	OSCS I-1	Mean	10.1667	.34268	
		95% Confidence Interval for Mean	Lower Bound	9.4658	
			Upper Bound	10.8675	
			5% Trimmed Mean	10.1852	
			Median	10.5000	
			Variance	3.523	
			Std. Deviation	1.87696	
			Minimum	7.00	
			Maximum	13.00	
			Range	6.00	
			Interquartile Range	2.50	
			Skewness	-.158	.427
			Kurtosis	-.970	.833

According to the given table, the mean score of NCLS ($M = 10.71$, $SD = 2.3$) is greater than mean score of OSCS ($M = 10.16$, $SD = 1.87$). However, the median of OSCS (Median = 10.5) is greater than that of NCLS (Median = 10.0).

Table 9 School Post-test descriptives

Post- test Descriptives					
	School		Statistic	Std. Error	
Total score	NCLS	Mean	22.93	.788	
		95% Confidence Interval for Mean	Lower Bound	21.23	
			Upper Bound	24.63	
			5% Trimmed Mean	23.03	
			Median	23.50	
			Variance	8.687	
			Std. Deviation	2.947	

		Minimum	17		
		Maximum	27		
		Range	10		
		Interquartile Range	4		
		Skewness	-.487	.597	
		Kurtosis	-.322	1.154	
	OSCS I-1	Mean	25.13	.701	
		95% Confidence Interval for Mean	Lower Bound	23.70	
			Upper Bound	26.57	
		5% Trimmed Mean	25.19		
		Median	25.00		
		Variance	14.740		
		Std. Deviation	3.839		
		Minimum	18		
		Maximum	31		
		Range	13		
		Interquartile Range	7		
		Skewness	-.105	.427	
		Kurtosis	-1.046	.833	

Table 9 displays descriptives of post-test data of schools including mean, median, standard deviation and skewness. According to the values in this table, the mean score of OSCS ($M = 25.13$, $SD = 3.83$) is greater than that of NCLS ($Mean = 22.93$, $SD = 2.94$). Similarly, the median of OSCS ($Median = 25$) is greater than that of NCLS ($Median = 23.5$). The values of mean and median in post-test are in contrast to that in pre-test.

Fig. 14 displays the comparison of pre-test score of both schools whereas Fig. 15 displays the comparison of post-test score according to school type.

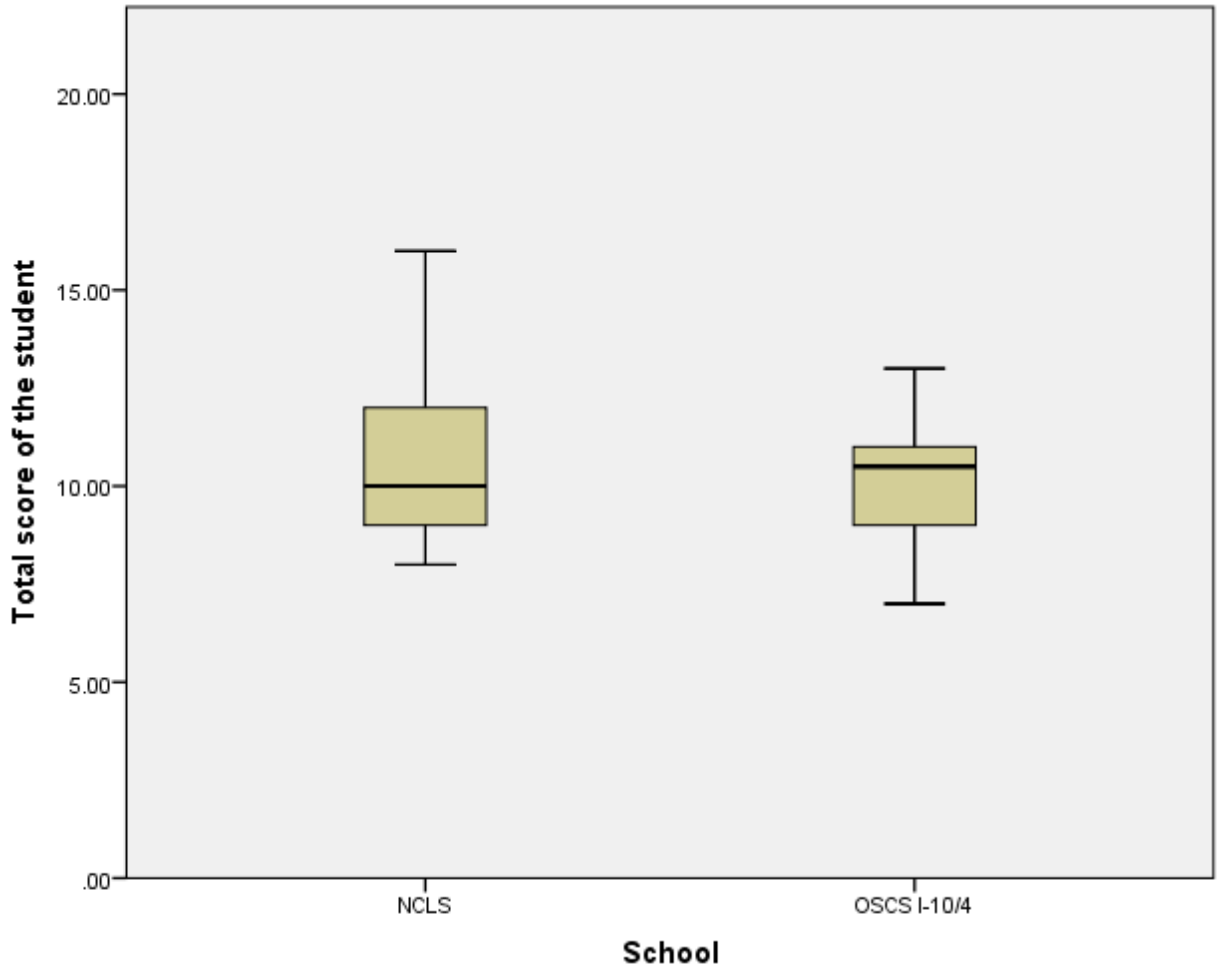


Figure 14 School Pre-test boxplot

According to Fig. 14, the boxplot of pre-test score of students of NCLS is bigger than that of OSCS. The highest score belongs to a student of NCLS whereas the lowest or minimum score belongs to a student of OSCS. The length of upper whisker in case of NCLS is greater as compared to that of OSCS indicating that the gap between maximum value and upper quartile is greater. However, the length of lower whisker is short indicating the gap between lower quartile and minimum value is less or the variation of values in lower quartile isn't great. In case of OSCS, the whiskers at both ends are of moderate length meaning there is moderate gap, not too big or not too small. The median of NCLS is less than that of OSCS, however, in NCLS boxplot majority (75%) of scores lie above the median as compared to OSCS where majority (75%) lie below the median. The boxplot of OSCS is short indicating the values or scores are close to each other as opposed to NCLS boxplot which is relatively tall. Moreover, the box of NCLS lies at a higher level than that of OSCS.

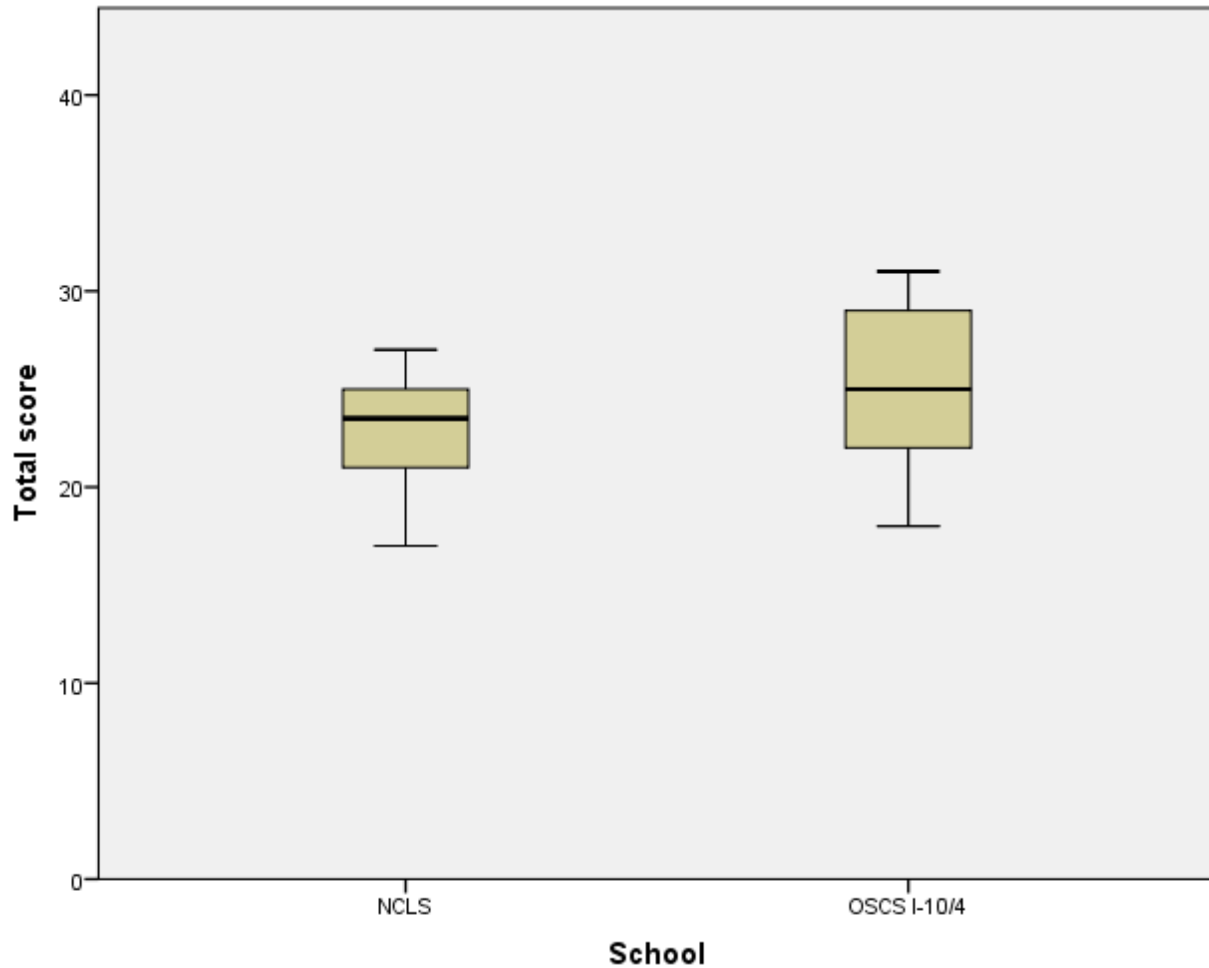


Figure 15 School Post-test boxplot

In Fig. 15, the boxplot of OSCS is at higher level than that of NCLS. The boxplot is also tall indicating that there is variation in scores. The median of OSCS is greater than that of NCLS and majority of the scores in this box lie above the median as opposed to boxplot of NCLS where majority of scores lie below the median. The upper whisker of both boxplots is short indicating that the gap between maximum score and upper quartile isn't large and in case of lower whisker, the one at OSCS is of moderate length as compared to that of NCLS where it is relatively longer.

Post-Test v2

Table 10 School Post-test v2

Post-test V2 Descriptives					
	School			Statistic	Std. Error
Total score	NCLS	Mean		5.7857	.36583
		95% Confidence Interval for Mean	Lower Bound	4.9954	
			Upper Bound	6.5760	
		5% Trimmed Mean		5.7619	
		Median		5.0000	
		Variance		1.874	
		Std. Deviation		1.36880	
		Minimum		4.00	
		Maximum		8.00	
		Range		4.00	
		Interquartile Range		2.25	
		Skewness		.868	.597
		Kurtosis		-.790	1.154
		OSCS I-1	Mean		6.6667
	95% Confidence Interval for Mean		Lower Bound	6.0362	
			Upper Bound	7.2971	
	5% Trimmed Mean		6.7963		
	Median		8.0000		
	Variance		2.851		
	Std. Deviation		1.68836		
	Minimum		2.00		
	Maximum		8.00		
	Range		6.00		
	Interquartile Range		3.00		
	Skewness		-.861	.427	
Kurtosis			-.138	.833	

Post-post test

Fig. 16 and 17 show boxplots of post and post-post-tests of both schools. These two post-test and post-post-tests have been used to determine retention of information over a given period of time.

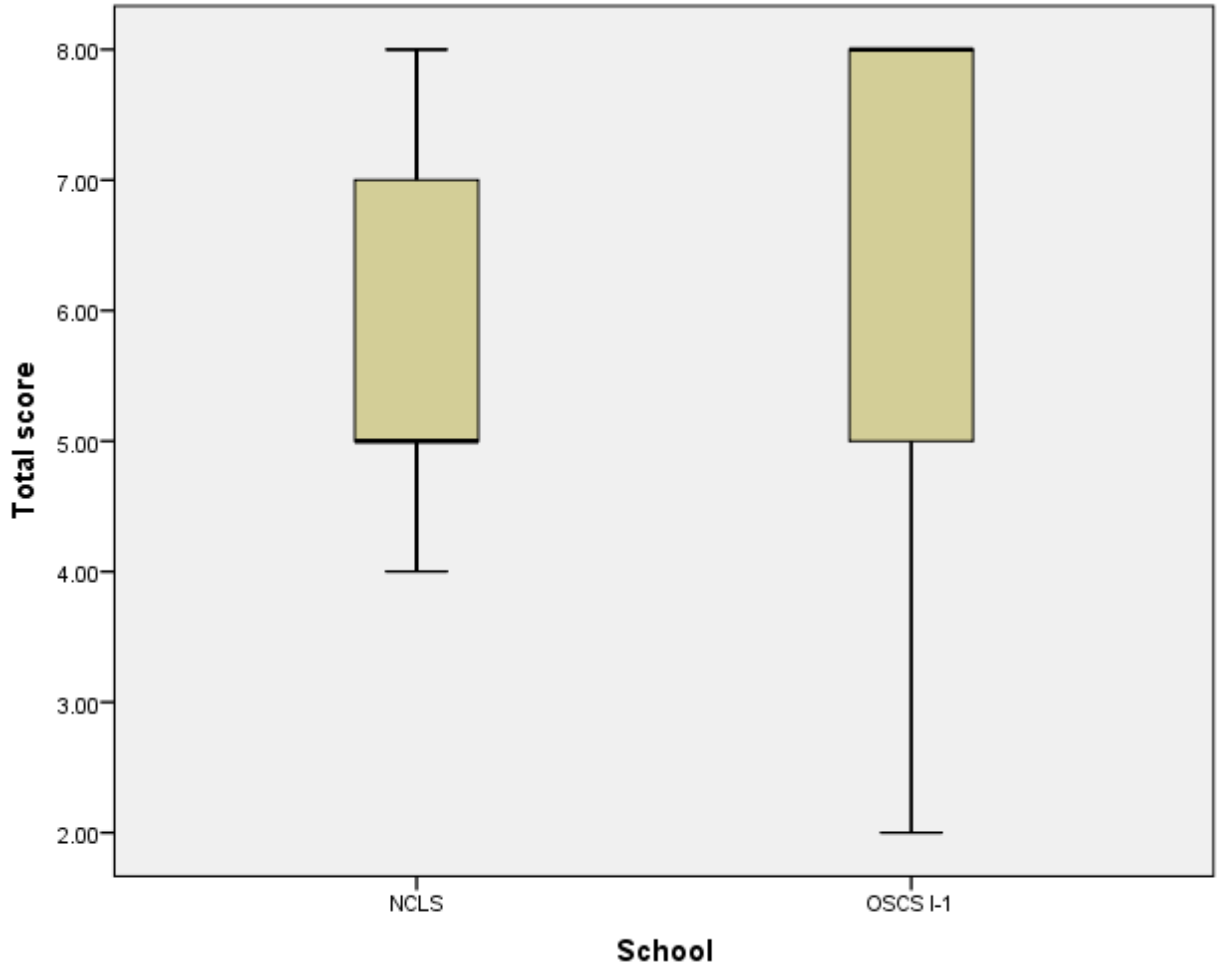


Figure 16 School Post-test v2 boxplot

The median of NCLS is lesser than that of OSCS in both tests however it was 5 in posttest and 6 in post-posttest indicating it increased in the second test. In post-test, majority of the scores lie above the median with a few below it in case of NCLS whereas all scores lie below the median in case of OSCS. In post-post-test, majority scores lie above the median i.e. upper quartile is larger than lower quartile where 25% score lie in case of NCLS. On the contrary, the boxplot of OSCS is the same as that in post-test, scores of majority of students lie below the median (8, also the maximum score).

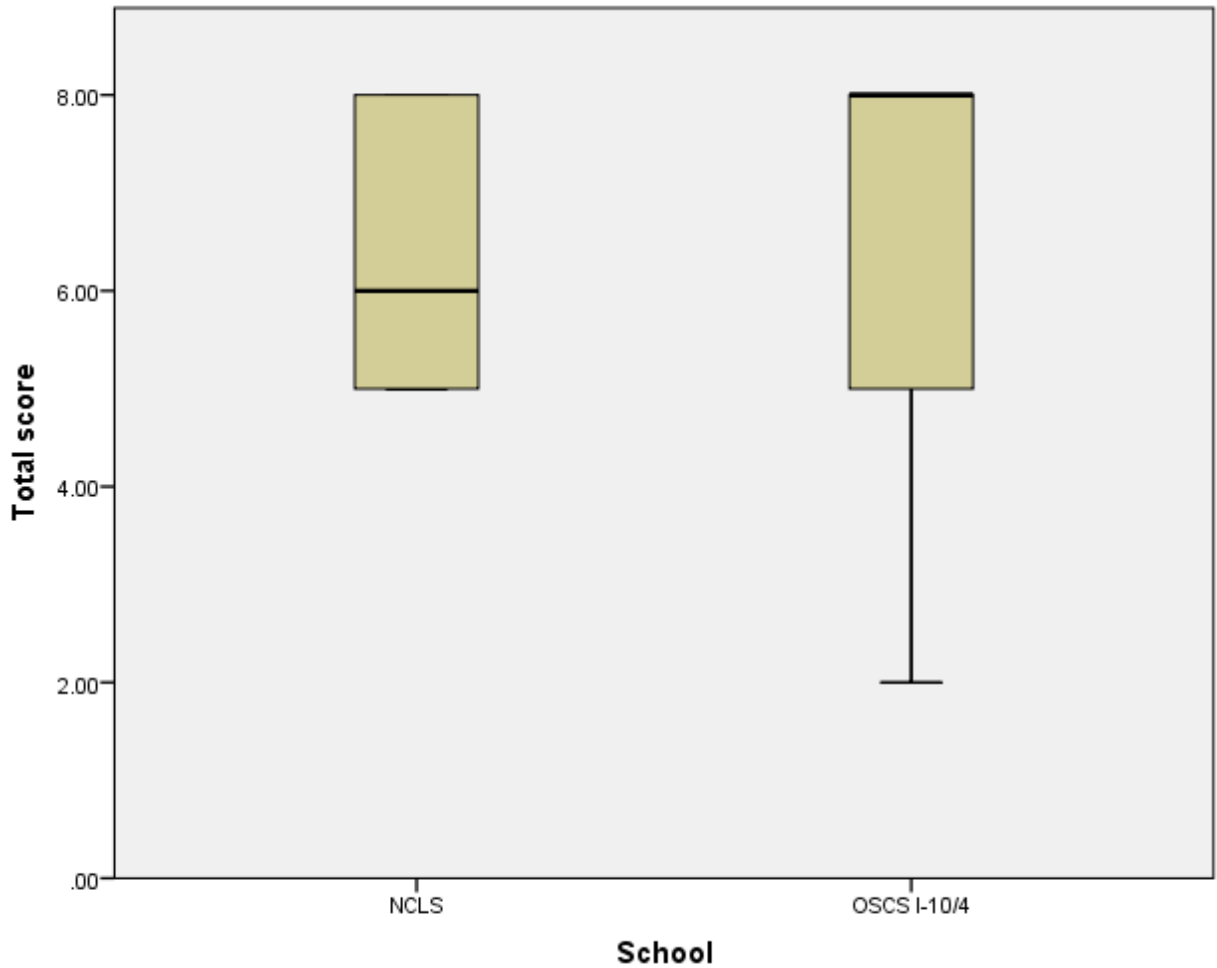


Figure 17 School Post-post-test boxplot

4.2. Qualitative Analysis

Interview and Observation Findings

Semi-structured interviews were conducted with teachers of both schools i.e. NCLS and OSCS. Each interview lasted for about 20 minutes. One interview was conducted before the intervention and the other after the intervention. As for observations, they were recorded from pre-test till post-post-test phase or from the start till end of the intervention. Students of NCLS belonged to families with better financial conditions and had access to better WASH infrastructure and equipment as well as digital devices such as smartphones, tablets and Internet connection. The students of OSCS, on the other hand belonged to low-income households with inadequate WASH facilities.

Following themes emerged from the qualitative data gathered from interviews, observations and field notes.

Teachers' knowledge of hygiene

The teachers of both schools knew about most common types of personal hygiene such as hand, nail, oral, face, hair and body but they were unaware of the different main categories and types of hygiene. They had knowledge about the difference between healthy and junk foods but still they had no idea about in-depth factors involved in food hygiene. They were unaware of the importance of having knowledge about different types of hygiene and their practices. They received no workshop, training or any sort of formal education regarding hygiene and its different types.

Teachers' attitude

Teachers of both schools were very welcoming towards the idea of utilizing game to teach students regarding hygiene, specifically teachers of OSCS who were more active during intervention by daily visiting the class to monitor the students and observe how they are behaving and their response to the game. Teachers of OSCS tried their best in co-operating with the intervention in any way they can, however they were of the view and could see areas where the education being delivered at their school can be improved. Teachers of NCLS also

co-operated however their prime focus was on performing their duties and covering their syllabus and lessons. Their views were similar to that of their counterparts in introducing new methods and games to improve learning of students. They inquired about activities and games that they could introduce in their lessons. However, the reason of their focus being majorly on their work can be traced to the school's priorities and rules. Regarding the game, teacher at NCLS was of following view, *"The kids did enjoy and were really happy to play the game. They would talk about it and were eager to play it again"*.

In case of OSCS, the teacher had these thoughts , *"Games like the one introduced should be made as through them they get to see by themselves what healthy foods are and what junk foods are and how to keep themselves clean. They select by themselves (in the game), so the game gives the more vision that what they should and shouldn't do."* The teachers of both schools expressed the need for health and hygiene education as part of curriculum with teacher of OSCS shared these thoughts, *"There should be such a subject because the students come from different environments and backgrounds. Therefore, to teach and nurture them there should be a game or separate period in which they can learn good things about how to keep themselves and their families clean"*.

Teachers' presence

Teachers' presence is an important factor that influences learning of the students. It was observed in both schools that mostly teachers would eat lunch together either in their staff room or in another class. There was an exception in the case of OSCS where teachers would eat lunch in the class with the students sometimes. The teachers of OSCS did their best in supporting the intervention by regularly monitoring behavior of their students and disciplining them when required. They were interested in the purpose of intervention and the game. They would carry out their work in the class as usual and inspected personal hygiene of students on daily basis. Furthermore, they would observe how their students were performing i.e. how are they are responding to the game and their behavior after playing the game. It was observed that they wanted to learn how to use such tools that could help them in improving the learning of students and viewed these tools positively, an idea that had potential to improve the quality of learning as students enjoy playing games and even can help poor performing students perform

well. They even asked if there could be a session for them or some sort of training about different types of games for variety of subjects and how to use them as students enjoy playing games and using them can help to engage them to the academic content.

Teachers' practices

It was observed that the personal hygiene of teachers of both schools was good, better than satisfactory. They tried to maintain their personal hygiene to their best. Whereas regarding food hygiene, in NCLS some of the teachers used to have home prepared meals they brought along for lunch while others buy food from the school canteen such as chaat, French fries etc. or snacks. Similar case was observed at OSCS, there were some who ate home prepared meals they brought while the rest used to have snacks i.e. packaged goods (junk food/processed food/convenience food) such as biscuits, potato chips, packaged juice (fruit flavoured drinks/sweetened drinks) from the nearby store. When it comes to practice of environmental hygiene, the teachers did throw their garbage in the bins but they never considered the need for separate bins for different type of garbage.

Students' knowledge

Students of both schools knew basics of personal hygiene but didn't have idea beyond that. Personal hygiene specifically handwashing was emphasized greatly by the teachers and school. However, the inadequacy of knowledge regarding other types of hygiene and what they include was observed on both schools which can be linked to the lack of proper knowledge on the subject of teachers and school administration as well as absence of health education in the curriculum being taught.

Students' attitude

Students responded positively to the game. All of them wanted to play the game, what was their score at the end and whether they had performed the tasks correctly. They mentioned what their parents and teachers told them about hygiene and the food they eat. The students of NCSL even mentioned their visits to the dentist. It was observed that the students of both school were receptive to the topic of hygiene and the game. Even when the intervention was

over and at the time of post-post-test, they asked if they will get to play the game that day too and wanted to play again to perform better.

Students' practices

Students of both schools practiced basics of personal hygiene but students of NCLS were better at maintaining their personal hygiene. After the intervention, it was observed that majority of students of both schools knew most of the steps of handwashing with exception of few. However, of those who learned the steps majority were girls as also found by Ghanim et. al. (2016) Girls are more attentive towards their hygiene could be the contributing factor or the fact behind this. Regarding their eating habits, some of the students ate what they brought for lunch from home whereas others used to have processed food available at the school cafeteria that contained mostly junk or packaged goods. This was observed in the case of NCLS. In case of OSCS, few of the students brought lunch which was mostly an apple or banana, or bottle of sweetened drink/ "sharbat" such as "Rooh Afza" and sometimes processed snacks such as potato chips. On the other hand, all of them mostly received snacks and on some days fruits for lunch which is given free by the school. The snacks were bought from the nearby store and contained convenience food such as biscuits, packaged juice, potato chips.

Moving on to environmental hygiene, students learned to throw garbage in bins but in case of separate bins it was observed that they were willing to follow that practice however the role of teachers and school administration was the key factor in encouragement and reinforcement of this behavior. They had one bin in each classroom and the bins outside the rooms weren't labelled to help student continue this practice. The students of NCLS asked "*Kiya ap humain yeh bins dain ge?*", "*If you give these to us, we will do this every day, we will put the garbage in separate bins*", "*We can't continue this practice now since we don't have separate bins at our school*". Similar case was observed at OSCS. The students also said a similar statement regarding brushing teeth, "*We don't have toothbrushes at school, we can't bring them, so we can't brush our teeth after lunch*".

Furthermore, the students of OSCS lacked proper hygiene facilities at school such as there was shortage of water supply in students' toilets. And their toilets were also not being cleaned on regularly as they should have been. As per interviews conducted with the teachers, they informed that students try their best to follow. The teacher at NCLS said "*These habits take*

time, they do try. I won't say all but most of them try to follow the hygiene practices such as handwashing and throwing garbage in the bin. These also depend on resources i.e. what they have access to. They did pick up some new information such as types of garbage and healthy vs junk food."

Engagement and motivation

Engagement and motivation are interlinked. Occurrence of one affects the other. (Mention article). Overall, students of both schools were excited and engaged in playing the game. They were motivated towards replaying the game many times and played it attentively to grasp the information being imparted through the game. However, the motivation of students of OSCS to play the game remained consistent throughout the intervention as compared to students of NCLS. In other words, students of OSCS were more motivated and engaged to the game as compared to those from NCLS. The students of NCLS like their counterparts were engaged to the game initially for the first three days however, on the last days of intervention they would ask *"Is mein koi aur game b ha? "*, *"Internet say mein aur games b download krsakta hun, mujhay ata ha"*. This could be due to the reason that NCLS students are exposed other activities as well, have a tablet room at school and have better access to digital technologies such as smartphones, tablets and internet connection at home.

Though students of OSCS have family members most prominently their parents who have smartphones however they aren't able to use it as freely as students of NCLS can. Students of both schools were eager to try and do something new and to play game. They also tried both versions of the game; NCLS students were given the English version whereas OSCS students were given Urdu version to play however later halfway through the intervention it was observed that the NCLS students played the Urdu version while OSCS students played the English version as well. And students learned some words from both versions as well such as *"Shahbash"* and *"Oho"* was picked up by the students of NCLS whereas students of OSCS picked up words such as *"Well Done!"* and *"Oh, no!"* from the game. After the intervention was completed, students of both schools asked where the game will be available, with students of NCLS specifically asked *"Kiya yeh game Play Store p hoge? We want to show it to our parents"*. All students were enthusiastic to play the game as it was a new tool that was introduced to them. However, students of OSCS followed the instructions during intervention

more than their counterparts. This could be due to the reason that they have limited access to games, internet and digital technologies as compared to those belonging to NCLS. They utilized the time they had to play the game and paid greater attention to it. A reward was set regarding which they were informed after the intervention and it was decided to be in the form of colorful stickers (Newton & Harrison, 2005).

Even the students who were not selected as participants were informed about the game by their peers and were interested in playing the game. Some of them were eventually allowed to play the game towards the end of the intervention. The students were willing to continue these practices for example during intervention for last few days, the students of OSCS received packaged or convenience food as lunch such as biscuits, juice etc., they wouldn't eat it and say, *"Teacher, ab hum kiya krain, yeh lunch mein mila ha but sehat k liye acha nahe, junk food ha. Hum isay bag mein daal daity hain, ghar mein behan ya bhai ko day dain gay"*.

Self-confidence/esteem

Students of NCLS had better self-confidence and esteem from the start, though some of them were shy at first however it didn't take much time for them to open up during the ice-breaking session. Majority knew how to operate the Android tablet and they weren't afraid to ask for the tablet to play again. The students of OSCS on the other hand were more shy and took longer than their counterparts during the ice breaking session to open up. They were afraid to make mistakes and even to ask to play again. They would hand over the tablet right away after they had their turn in playing the game. Students observed and paid attention to the expression on teachers' faces and it was observed that students of OSCS observed more as compared to their counterparts as they were afraid of making mistakes and in order to be viewed as a good student by their teachers. After playing the game, a little boost or increase in the confidence level or self-esteem of students of OSCS was observed. And most of them never missed a day i.e. were present from the pretest to post-posttest phase.

Interaction with peers

A similar case was observed at both schools that students who knew how to operate the tablet well helped their peers who didn't knew that well on how to operate it. They also mentioned the game and told about it to their peers who weren't part of the study.

Need for support

Majority of students from NCLS already knew how to operate the tablets well as they have used them before and have easy access to it however some of them needed guidance on how to use it. The students of OSCS on the other hand were given a brief demonstration on how to operate the tablets. collecting pretest data, most of the students from NCLS were able to fill their questionnaire with exception of few for whom the researcher filled out for by verbally asking for their answers. On the other hand, OSCS students needed support in filling out the questionnaire, they knew some of the words and could understand few basic questions however the questionnaire was orally translated for them.



Figure 18 Word Cloud

Chapter 5. Discussion

The aim of the study as previously stated was to analyze the effect of context-based hygiene awareness game on students' understanding of hygiene and motivation to follow those practices. This chapter discusses in detail about the obtained results with respect to the stated hypotheses and research questions in previous chapters.

5.1. Impact of context-based hygiene game according to school type

Hypothesis 1: Context based games on hygiene impact children from different schools equally.

As evident from the results of the data in previous chapter, the difference between mean scores of both schools isn't great however it still exists. The students at OSCS did better than those at NCLS in the post-test indicating that the students of OSCS learned more from the game as compared to those belonging to NCLS. The mean score of students belonging to OSCS was 25.13 as opposed to NCLS students who had mean score of 22.93. The case was opposite in pre-test results where NCLS students mean score (Mean = 10.71) was higher than that of OSCS students (Mean = 10.16) whereas median of OSCS (Median = 10.5) was greater than that of NCLS (Median = 10.0). This indicates that NCLS students performed well in pre-test and had more knowledge regarding hygiene than their counterparts, this can also be due to more access to hygiene equipment and surrounded by individuals who have good hygiene practices. In case of retaining knowledge gained, on both post and post-post-tests, students of OSCS performed better as evident from both mean and median values being greater than that of NCLS. This could be due to the reason that OSCS students were more attentive during the intervention and tests as well as the fact that they had less access to digital devices and internet that they put effort in utilizing the time they had access to tablet to play the game with full attention. On the contrary, personal hygiene of NCLS students was observed to be better than that of OSCS students. On the basis of results in the previous chapter and points discussed above null hypothesis is rejected indicating there was a difference in how students of both schools were affected by the game.

5.2. Impact of context-based hygiene game on gender type

Hypothesis 2: Context based hygiene games have no impact on developing hygiene practices in students regarding gender type.

According to the results obtained from the tests in previous chapter, the mean scores of male and female students are not the same. The female students' mean scores were higher or greater than the male students in both pretest and posttest, even in retention posttest. Though the difference of mean scores between both genders in post-test wasn't as greater as that in pretest however female students performed better overall. Similarly, in case of post-posttest, performance of female students was better than their counterparts. The observations documented also gave the same indication that the female participants were more conscious of their personal hygiene as compared to boys. Similar case was observed by Ghanim et. al (2016) in their research where they observed that female students possessed more knowledge regarding hygiene than their male counterparts. And they were more conscious about their hygiene.

Based on these findings, the null hypothesis is failed to accept and it can be said that the difference indicates that the game had more positive effect on female students as compared to boys in learning the concepts from the game.

5.3. Impact of context-based hygiene game on student motivation

Hypothesis 3: Context based games on Hygiene don't play an important role in increasing motivation of children towards hygiene practices.

One of the key objectives and variable for this research was motivation. Keeping in mind the recent rapid developments in technologies and considering the boom of video games in the last decade, a context-based game on the topic of hygiene was developed. Video games used to be available on limited devices and were platform dependent for example users could only play on SEGA, Play Station and desktop computers but now games can be developed for multiple platforms and with the advent of smartphones, the access to digital games has become even more easier. Now, anyone can play these easily portable games while carrying them in their pockets. The children of today belong to the digital generation (Smith, 2012) that was born in the era of and is surrounded by the ever evolving technologies and

innovations. They are familiar with the gaming technology i.e. they are aware of what digital games are.

Games are a tool that utilizes more than one type of primary senses (Annetta, 2008). They were used to be an activity for entertainment and leisure, performed as a hobby and accessed on free time. It was viewed as time wasting or entertainment purpose only activity but now the view has changed. Though it still offers entertainment, it has now expanded to encompass various other perspectives. Now it offers other services and has included various other categories, education being one of them. The development of serious games is gradually progressing and is somewhat slow as compared to entertainment only games, and in Pakistan the progress is lagging behind as compared to the developed world. However, step by step their value is being realized to improve learning of the learners.

These games cater to more than one learning styles and activate/trigger more than one senses such as sight, hearing and touch. With involvement of more than one sense, information received becomes more refined and is easy to store/retain. The students were observed to be engaged to the game and were curious about it. Students were highly motivated towards playing the game and participating in the tests conducted. Perhaps they weren't receiving a formal lecture as they usually do, that's why they were able to extract information from the game. The game not only fulfilled educational purpose but also offered entertainment and fun as a by-product due to which the students showed willingness to perform these practices but cited unavailability of relevant resources to successfully implement them. They mentioned the game to their peers and teachers and showed a desire to play the game again even when the intervention was over. They tried to play the game with full attention during the time they had tablets to play it with. Video games make a supposedly boring and serious topic and daily habit more interesting which is clearly evident from the data collected. The game enhanced and enriched their learning and interest on the topic via bright colors and relatable content. The local context enabled them to relate to the content in the game and remember the information being imparted. However, to aid children in making these practices as part of daily life, further research needs to be conducted on role of teacher and relevant activities that can be introduced along with the game.

On the basis of presented arguments and results from the data analysis in prior chapter, the null hypothesis is rejected indicating that context based video games do play a role in

motivating children towards learning about educational content and in this case learning about hygiene and willingness to adopt these practices.

Chapter 6. Conclusion

This research was undertaken to study the effect of context based game on hygiene awareness on knowledge and understanding of basics of hygiene and motivation on primary level students of both genders belonging to different type of schools. The rationale was to study whether a context based game increases students' learning and knowledge regarding hygiene and motivates them to adopt such practices and whether develops interest and positive attitude regarding everyday habits that may seem boring but are beneficial for health. Prior chapters contain the background and rationale of conducting this research, methodology adopted, tool designed and results from collected data. As evident from the results and hypotheses discussed in previous chapters, it can be concluded that students were able to learn and increase their awareness and knowledge regarding basics of hygiene through the game introduced. Likewise, students were found to be highly motivated and engaged to the content being imparted through the game and were happy to play the game as well. Furthermore, difference in learning was also observed in the obtained in the results with respect to gender and school type. Therefore, null hypotheses in all cases were rejected.

This research was aimed to be and will act as basis for further research on this topic and area that is ignored and has been ignored as part of the education system for a long time. The purpose was also to initiate a debate on reforming education system as well as updating education imparted at home to include health and hygiene education and practices that will not help young generation today and those to come but also their elders today in avoiding and reducing communicable diseases in Pakistan.

It can't be concluded solely on the basis of this research that games on hygiene must be incorporated in classrooms however there have been studies worldwide that indicate the benefit of incorporating games to enhance learning, specifically of serious games, those that are created for the purpose of education. Further studies need to be and should be conducted on developing and introducing serious games on health to different age groups. There is limited literature on such games on health, specifically in Pakistan and this is what needs to be addressed by developing appropriate serious games and authentic digital content on health for the digital natives besides conducting studies on this topic.

On the basis of this research, it can also be said that lack of access to digital technology didn't prove to be a barrier in motivation towards learning. The major sources of knowledge and examples for young children are parents and their teachers. Other sources are secondary, the children follow what they see most but it doesn't mean if they are able to learn something good they won't be motivated to adopt it. The classrooms today have different structure and environment on the basis of type of school. Schools like OSCS lack proper healthcare infrastructure and facilities that elite schools have, and still rely heavily on traditional methods of teaching i.e. broadcasting information. NCLS on the other hand is a private school however their use of technology needs to be investigated further to gain insight on its' effectiveness in improving learning of their students. Moreover, they haven't incorporated serious games on health in their curriculum. There is dire need to make use of innovative pedagogies and tools to expand students' knowledge and understanding and motivate them towards content that they may find difficult and boring.

The game introduced was one such tool that made a seemingly boring everyday task or habit fun for them due to the fact the knowledge wasn't being imparted through traditional methods and games are what children today are naturally attracted to. And a serious game that is based on local context is even more engaging and relatable for the young learners in order to gain maximum benefit from it. With that being said, role of teachers and parents need to be examined as well in addition to a call for attention for playing their part in improving not only the life of their children but also the ones that they are living. The question remains that with ever evolving technology, is mankind progressing positively on the same pace and whether it is using or knows how to use it properly, for good purposes. Do we really know how to save a life?

Chapter 7. Limitations and Future recommendations

7.1. Limitations

There were few limitations faced while conducting this research, if addressed and solved can benefit future researches on the topic.

7.1.1. Time constraint

As this research was part of the thesis requirement, the concept of game and its storyboard wasn't developed in depth. Due to this constraint, a limited version of the game was designed and developed. Both processes required ample time which is why only necessary and relevant information was incorporated. Furthermore, the intervention wasn't prolonged as OSCS provides fast-track program in which students cover course of the grade they are in six (6) months making it difficult to call for students who would haven't been available later on. Students' availability was one of the factors that required conducting intervention within limited time frame.

7.1.2. Lack and unavailability of funds

The intervention is a crucial part of the thesis and for this part it is required to conduct it at a location outside the lab or university premises i.e. at a school, college or university, a physical location with human participants to collect data for analysis and results. Furthermore, for better results and richer study good amount of time and days must be spent. For travelling to and from the research site, arrangement of transport is necessary. HEC has set funds for postgraduate students in their research phase however that fund was unavailable for this research and there was no other source for funding the study. Though money doesn't determine the success of the research and the researcher doesn't mind spending out of own pocket to conduct the study however provision of fund is a responsibility of both university and HEC and other parties who can fund such studies. The funds are helpful in making the process easier not only in terms of transportation but also for other resources such as printing of questionnaires, s/w both for tool development and data analysis such as IBM SPSS. Student level research can be enriched with required support.

7.1.3. Lack of educational research in Pakistan

There are very scarce researches regarding education and its quality in Pakistan. A country that needs innovative interventions and methods to improve its outdated system and curriculum is missing out on opportunities to achieve that purpose. A very few researches on education in Pakistan were found. There have been limited researches conducted on the benefits of serious games and how to include them as part of curriculum to avail those benefits with most of them being university based or student level researches.

7.1.4. Lack of serious games development in Pakistan

Pakistan is now emerging as a land with talented and skilled youth especially in the sector of IT. And it is now gradually catching up with the world in the area of game development and E-learning. However, it still lacks the progress it can make in development of serious games. There were no serious games found on hygiene and health that were developed in Pakistan. And the games from other nations found on the topic lacked local extent that would enable students to learn about hygiene. There is even need to develop serious games on topics besides hygiene.

7.1.5. Lack of curriculum on health education

The most evident limitation which was also pointed out by the teachers was the absence of health and hygiene education as part of the curriculum. Though it is the need of not just of the moment but for years to come, it has been overlooked and ignored from a long time. And negligence of this has cost greatly with diseases that can be prevented are still a threat to the community these days.

7.1.6. Technical expertise

The development of storyboard and designing of tool took good amount of time as these were performed for the first time and required learning of the software and appropriate strategies. Hence, the final product i.e. the game does fulfill the purpose for it was created however it isn't on the level of experts of game developers.

7.2. Future recommendations

As mentioned previously that there is lack of serious games on hygiene and educational researches on the same topic, hence this study was conducted to gain perspective with regards to effectiveness of hygiene awareness games. Following are recommendations for future studies on this topic as well as those who seek to develop serious games on this topic.

7.2.1. Detailed storyline or story based

As the current game was a limited version, there is still room for improvement. A detailed storyline based game with different levels can be developed into incorporating characters drawn by children with their voice-overs to create personalized experiences. The game can also be offered several regional and foreign languages. Different short levels or sections can be introduced as well focusing on seasonal diseases such as cold, influenza etc.

7.2.2. Other versions of the game

The current game was 2D based, apart from developing more 2D games on the topic; other versions can also be developed. 3D can also be utilized however that depends on how to utilize concept of 3D to engage users to the content. Virtual Reality (VR) and Augmented Reality (AR) are popular these days around the world and have been used to develop applications and games on various topics such as science, mathematics, online shopping to name a few. The AR version can be developed something resembling to Pokemon Go, a popular anime based game using AR, in which the users have to perform the tasks as they go.

7.2.3. Holographic experience

Hologram is relatively a newer technology as compared to VR and AR; it is being explored worldwide and has potential to make tasks easier. A hologram is an image that appears to be three-dimensional and can be viewed by naked eye. (Workman, 2013) Such an innovation can be used to design context-based games not only on topic of hygiene but others as well to create entertaining yet enriched learning experience for the users. This idea can be explored in depth for young learners to make their daily routine tasks and realization of their significance more engaging and stimulating since the users will be able to view the content, which is closer to reality in this method than in other technologies, with their naked eye.

7.2.4. Inclusion of nutritionist for proper nutrition and food hygiene

As discussed earlier in chapter 2, the practice of better educational systems and hygienic nations around the world, the role of nutritionist in designing lunch for students must be added in order to ensure better food hygiene and health of students. The lunch can be designed a month earlier with sweets and convenience food offered on special occasions to students for example on their birthdays or who do well on quizzes. The nutritionist will work with cafeteria staff to ensure that the prepared meals are nutritious and hygienic while also catering to different allergies and health conditions the students may have. As lunch is an important meal of the day and for students in schools like NCLS where some bring their own lunches and others buy from cafeteria and in case of OSCS where they are provided free lunch, it is of utmost importance that they are being provided and have access to a nutritious meal. This program should not only be limited to schools but incorporated in secondary level, colleges and higher education institutions as well.

7.2.5. Policy for hygiene and health education

In order to ensure better hygiene and health of learners, there is dire need to implement some policies regarding it specifically in terms of imparting relevant education which has been ignored for a long time. First key point regarding policy would be to make health and hygiene compulsory at all schools and higher education institutions. Moving on to the second suggestion is to add the role of nutritionist as compulsory part of lunch program, who will not only be responsible for designing every month's lunch but also giving sessions and workshops to students, teachers and parents on healthy eating and living. This program should be implemented to all levels of education. Besides lunch program, there is need to ensure that schools have adequate basic hygiene and sanitation facilities and equipment which will be the third clause of the hygiene and health policy amendment with regards to education sector. Fourth clause will be to promote hygiene practices by offering workshops and sessions at schools and vocational training institutions to students, parents, teachers and all those interested. Finally, the last clause for now which is to make inclusion of therapist and counselling services mandatory at all schools either public or private.

7.2.6. Health education workshops for teachers and health care providers

There is need to conduct workshops and practical exercises for teachers and health care providers regarding hygiene to equip with them necessary information and expand their knowledge base so that they are not only able to better help they counsel specifically students but also themselves and those close to them. Furthermore, the purpose is also to help them understand the importance of good hygiene in daily lives.

7.2.7. Therapist for researchers

The whole process of conducting research isn't an easy feat and demands maximum brainpower, stamina and emotional stability. It is unavoidable for researchers at student level to not be affected by what they observe and experience. This is not to say that the research is biased somehow or lacks in terms of effort or effect. They need someone to discuss and help them through the process, someone who can understand and provide feedback about their emotional and mental state. Furthermore, the therapist would also be able to help them on making progress with their work along with other matters of life so that they can achieve a good balance between all priorities.

7.2.8. Therapist for students, teachers and school administration

A therapist is not only required to help the student-level researchers in conducting their studies but one or more also required for students, teachers, administration and other staff of the school. It was observed that the teachers of both schools are not completely satisfied with their jobs but wish to improve things and progress their careers however there is minimum guidance and support for them in this regard. There are some matters that students aren't able to communicate or express to their teachers, and the school administration is on the same level as the teachers i.e. the students interaction is minimum and won't express to them as well as the administration doesn't cater to such matters and doesn't include that in their priorities. Teachers are heavily focused on completing their tasks that their interaction with their students have become solely on academic content, leaving little to no room for guiding the students or even noticing the problems they may be facing. Hence, therapist is needed to act as a liaison for students, teachers, admin and other staff so that what they can't share with each other can be shared with the therapist who can help them make their interactions and relationship better with each other without anyone feeling their privacy has been invaded. As

for teachers, the therapist is needed in order to make their work life better and feel fulfilled with their work. A happy teacher in turn grooms learners into happy, capable and responsible members of the society. And in order to ensure that we need someone with expertise who can help all these stakeholders in ensuring that they are physically, mentally and emotionally stable and sound.

7.2.9. Health education curriculum

Another key factor that can contribute in improving health and hygiene of students especially that of young learners, which was also suggested by the teachers, is to introduce health and hygiene education as part of curriculum. There is a dire need to introduce this as a subject, which can be non-graded but compulsory. Moreover, this would include appropriate or relevant knowledge regarding it at each grade level. This would help in reducing communicable diseases that are preventable by adopting hygiene practices and habits in their daily lives.

7.2.10. Provision of funds

For improved and quality researches in the sector of education at student level and ensuring that the studies lay some groundwork for further research, produce some effect on the society and benefit the general population then there is need to offer funds for the phase of intervention, purchase of licensed s/w and coverage of other costs relevant to the research that the students have to pay by themselves.

7.2.11. Inter-disciplinary approach

In order to improve the quality of research and develop and introduce innovative yet quality solutions and tools for educational purposes, we need to involve and bring together team of interdisciplinary individuals with expertise in their relevant areas. This is to gain insight into the issue from various perspectives, obtain variety of ideas and propose solutions that have various brains working on it. This approach will aid in solving problems at a faster pacer.

7.2.12. Role of teachers re-examined

After parents, teachers are the next source of information. They are the individuals that are highly regarded and viewed as examples by their students. Even though they may not see or believe it like that but students especially young learners observe what and how they say and

do, and what their views are. Even a small decision as eating junk food is observed by students. Young learners observe what their teachers do and try to follow their example and in that sense teachers need to be conscious about their choices and their conduct in order to not set a bad example especially regarding hygiene. Parents, teachers and schools have been neglecting the importance of their roles and that of each other especially that of teachers in development of lifelong learning of students. Teachers role have now become limited to broadcasting information and presenting academic content. However, the learners don't need teacher just for presenting information but also someone they can look up to and learn from and most importantly receive guidance from regarding other sectors of life.

Chapter 8. References

- United Nations (2015). *About the Sustainable Development Goals - United Nations Sustainable Development*. Retrieved from <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>
- Ayazi, H. (2016, March 4). Emerging e-learning technology and its impacts on child development - Dunya Blog [Blog post]. Retrieved from <http://blogs.dunyanews.tv/12263/>
- Ahmed, A. (2018, November 11). 80pc of Pakistan's poor live in rural areas, says World Bank report. *DAWN*. Retrieved from <https://www.dawn.com/news/1444874>
- McLeod, S. A. (2018, May 21). *Maslow's hierarchy of needs*. Retrieved from <https://www.simplypsychology.org/maslow.html>
- World Economic Forum. (2017). *Travel & Tourism Competitiveness Report 2017*. Geneva: World Economic Forum. Retrieved from <http://reports.weforum.org/travel-and-tourism-competitiveness-report-2017/country-profiles/#economy=PAK>
- Freeman, M. C., Stocks, M. E., Cumming, O., Jeandron, A., Higgins, J. P. T., Wolf, J., Pruss-Ustün, A., Bonjour, S., Hunter, P. R., Fewtrell, L. and Curtis, V. (2014), Systematic review: Hygiene and health: systematic review of handwashing practices worldwide and update of health effects. *Tropical Medicine & International Health*, 19 (8), 906–916. doi: 10.1111/tmi.12339
- Ghanim, M., Dash, N., Abdullah, B., Issa, H., Albarazi, R., & Al Saheli, Z. (2016). Knowledge and practice of personal hygiene among primary school students in Sharjah-UAE. *Journal of Health Science*, 6(5), 67-73. doi: 10.5923/j.health.20160605.01
- SPARC. (2017). *The State of Pakistan's Children*. SPARC. Retrieved from <http://www.sparcpk.org/2015/SOPC2017.html>
- Ahmed, A. (2017, April 7). Pakistan improves ranking on tourism competitiveness index. *DAWN*. Retrieved from <https://www.dawn.com/news/1325829>
- Colson, T. (2017, April 6). The 13 most safe, cheap, and hygienic countries in the world to visit as a tourist. *Business Insider*. Retrieved from <https://www.businessinsider.com/wef-the-13-best-countries-in-the-world-to-visit-2017-4#4-japan-526-japans-popularity-among-tourists-continues-to-grow-with-2403-million-international-tourists-visiting-in-2016-it-boasts-20-world-heritage-sites-including-the-ancient-monuments-at-kyoto-and-the-himeji-castle-10>

- Life Where I'm From. (2018, September 7). *Kyushoku: The Making of a Japanese School Lunch* [Video file]. Retrieved from <https://www.youtube.com/watch?v=fze5s1SlqB8&feature=youtu.be>
- AJ+. (2015, October 28). Japanese Students Clean Classrooms To Learn Life Skills [Video file]. Retrieved from <https://www.youtube.com/watch?v=jv4oNvxCY5k>
- Sung, H.Y., Hwang, G.J. and Yen, Y.F. (2015). Development of a contextual decision making game for improving students' learning performance in health education course. *Computers & Education*, 82 (2015), 179--- 190. doi: 10.1016/j.compedu.2014.11.012
- MacNamee, B., Rooney, P., Lindstrom, P., Ritchie, A., Boylan, F. and Burke, G. (2011). *Serious Gordon Using Serious Games To Teach Food Safety in the Kitchen*. Paper presented at 9th International Conference on Computer Games: AI, Animation, Mobile, Educational & Serious Games, Dublin Institute of Technology, Dublin, Ireland
- Miyan, M., Baloch, H. and Hussnain, M. (2012). *Hygiene Awareness Through Digital Game-Based Learning*. Unpublished manuscript, National University of Sciences & Technology.
- Bergin, T. (2018). *An Introduction to Data Analysis: Quantitative, Qualitative and Mixed Methods* (1st ed., pp. 176-183). London: SAGE Publications Ltd.
- SAGE Publications, Inc. (2018). *Chapter 13: Quasi-Experimental and Single-Case Experimental Designs* [Ebook]. Retrieved from https://us.sagepub.com/sites/default/files/upm-binaries/89876_Chapter_13_Quasi_Experimental_and_Single_Case_Designs.pdf
- Ahmad, F. (2016). *Theories and Models of Instructional Designing*. Lecture, Islamabad.
- Quigley, E. (2019). ADDIE: 5 Steps To Build Effective Training Programs [Blog]. Retrieved from <https://www.learnupon.com/blog/addie-5-steps/>
- Mahmood, A. (2016). *MSITE4 13-10-2016*. Lecture, Islamabad.
- Concrete Operational Stage. (2019). Retrieved from <https://www.pgpedia.com/c/concrete-operational-stage>
- Children's Understanding Disease Processes | Child Advocate - Helping Parents and Professionals. (2015). Retrieved from <https://childadvocate.net/childrens-understanding-disease-processes/>
- Newton, J. T., & Harrison, V. (2005). The cognitive and social development of the child. *Dental update*, 32(1), 33-38. 10.12968/denu.2005.32.1.33.

- Understanding and interpreting box plots | Wellbeing@School. Retrieved from <https://www.wellbeingatschool.org.nz/information-sheet/understanding-and-interpreting-box-plots>
- Anyaegbu, R., Ting, W., & Li, Y. I. (2012). Serious game motivation in an EFL classroom in Chinese primary school. *Turkish Online Journal of Educational Technology-TOJET*, 11(1), 154-164. Retrieved from <https://eric.ed.gov/?id=EJ976578>
- Annetta, L. A. (2008). Video games in education: Why they should be used and how they are being used. *Theory into practice*, 47(3), 229-239. DOI: 10.1080/00405840802153940
- Smith, D. (2012). Understanding the digital generation: Teaching and learning in the new digital landscape. *NACADA*, 32(2). Retrieved from <https://www.nacada.ksu.edu/Resources/Journal/Current-Past-Book-Reviews/Understanding-the-digital-generation-Teaching-and-learning-in-the-new-digital-landscape.aspx>
- Workman, R. (2013). *What is a Hologram?*. Retrieved from <https://www.livescience.com/34652-hologram.html>

Appendix-A

Questionnaire

Demographics

Name: _____ Age: _____

Gender: Male Female

Grade/Class: _____

Personal Hygiene Knowledge and Practices:

1. Who told you about personal hygiene?
 1. Parents
 2. Teacher
 3. TV
 4. Books
 5. Others:

2. Being neat and clean keeps you healthy?
 - Yes
 - No
 - Don't Know

3. Washing your hands with soap keeps ills away?
 - Yes
 - No
 - Don't Know

4. There is no need to brush teeth two times a day to stop teeth problems?
 - Yes
 - No
 - Don't Know

5. Do you comb your hair before going to school?
 - Always
 - Sometimes
 - Never

6. Do you cut your nails with nail cutter?
 - Always
 - Sometimes
 - Never

7. Do you use soap while washing your hands?

- Always
- Sometimes
- Never

8. What is the main reason to skip hand washing?

- 1) Far from the sink
- 2) No time.
- 3) No need.
- 4) Keep forgetting.

Do you brush your teeth:

9. After waking up?

- Always
- Sometimes
- Never

10. Before going to sleep?

- Always
- Sometimes
- Never

11. After eating food?

- Always
- Sometimes
- Never

12. After eating sweets?

- Always
- Sometimes
- Never

Food Hygiene Knowledge and Practices:

1. Who does the cooking at home?

- Mom
- Dad
- Sister
- Grandparents
- Other:

2. Do you like to drink cola or water?

- Cola
- Water
- Other:


3. Do you prefer to eat burger or roti?


- Burger
- Roti and Salan


4. Would you like to eat salad or cupcake for lunch?
- Salad
 - Cupcake

Environmental Hygiene Knowledge and Practices:

1. Where do you throw your trash?
- In bin
 - On ground
 - Anywhere I can
2. Do you know about different types of trash?
- Yes
 - No
 - Don't Know

3. What does this symbol stand for ?
- Metal
 - Plastic
 - Glass

4. What type of trash do we throw inside bins with this symbol: ?
- Food items
 - Plastic
 - Paper

5. What type of trash do we throw inside bins with this symbol: ?
- Electronics
 - Paper
 - Food items