

AMERICAN UNIVERSITY OF BEIRUT

REDUCE, REUSE AND RECYCLE SOLID WASTE: A  
CURRICULUM FOR SCHOOL TEACHERS

by  
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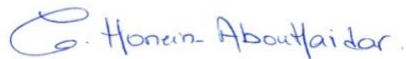
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# ABSTRACT OF THE PROJECT OF

Shereen Bessel Omar for Master of Science in Nursing  
Major: Community & Public Health Nursing

Title: Reduce, Reuse, and Recycle Solid Waste: A Curriculum for School Teachers

**Background:** The management of waste is a global concern and a responsibility of each individual. There are several types of waste: solid waste, industrial waste, agricultural waste and hazardous waste. Solid waste (SW) is the type produced by individuals; it includes non-liquid and non-gaseous unwanted material. Schools constitute a major source for solid waste production. Managing solid wastes in schools necessitates knowledge about reducing, reusing, and recycling.

There are different types of schools in Lebanon. Few are ‘eco- friendly’ or ‘green schools that receive certificates for this designation. The majority, especially public schools, have neither environmental focus nor initiatives. In fact, most public and many private schools do not have a school health nurse who can play the role of a champion for promoting health and preventing disease in the school community. Instead, they use science school teachers or school assistants whose vital responsibilities include creating educational programs to promote community health. Very few possess a program on environmental health. Hence, developing a prototype curriculum for science school teachers and school assistants on waste management to be rolled out to students helps to cultivate the concept of waste management among students and to motivate them to reduce, reuse and recycle wastes.

**Project Aim:** This project aims at developing a prototype curriculum to train teachers at schools in Lebanon on the different approaches to reduce, reuse, and recycle solid waste. Teachers will then use this curriculum to train their students on principles of solid waste management. The curriculum will also include guidance on designing educational strategies such as didactic sessions, fieldwork activities, and many others for their students.

**Methodology:** We conducted a literature search to identify the concepts that need to be included in the curriculum and that focus on the different types of indoor and outdoor school-based solid wastes, policies adopted to reduce, reuse, and recycle waste in schools, and interventions to ensure implementation. We also identified the curriculum delivery format to encourage active participation. The product includes a syllabus, learning activities, implementation means, and evaluation tools. Among the teaching methods integrated into the sessions are team-learning activities, real-world exercises, case-based learning activities, presentations, and group discussions. A pre-test is designed to assess prior knowledge of schoolteachers and school assistants on solid waste management and a post-test to assess knowledge acquisition of the project topics. We will present the curriculum to one of the schools to assess feasibility of its implementation, resources needed, and factors that may lead to its failure.

**Conclusion:** This curriculum aims at increasing the knowledge of teachers in schools about solid waste management to cultivate the concept among students and motivate them to reduce, reuse, and separate solid wastes for recycling.

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## ABBREVIATIONS

SW: Solid Waste

3Rs: Reducing, Reusing, Recycling

UN: United Nation

UNESCO: The United Educational, Scientific and Cultural Organization

HBM: Health Belief Model

CNS: The Clinical Nurse Specialist

SWM: Solid Waste Management

# CHAPTER I

## INTRODUCTION

### **A. Solid Waste Generation: A Worldwide Statistic**

Waste is a major global environmental problem (Iqbal, 2020). There are several types of waste: solid, industrial, agricultural, and hazardous wastes. According to the World Bank, the generation of solid waste (SW) globally reached 2.1 billion tons in 2016, when 33% of that amount could be recyclable. By 2050, it is expected that the estimated number of waste generation will be doubled, reaching 3.40 billion tons due to the increase in population. The average daily solid waste production by a person worldwide ranged from 0.11 to 4.54 kg in 2016 (Kazza et al., 2018). East Asia and Pacific regions spawned waste more than the Middle East and North Africa; at a later stage, it is expected that waste production will increase faster in Middle Eastern countries. By 2050, the rise in waste production in low-income countries will increase faster than in high-income countries by 40 % (Kazza et al., 2018).

In the Middle East, the annual production of municipal solid waste reached 150 million tons per year (Kazza et al., 2018). In Lebanon, one of the Middle East countries, and as reported by the Lebanese Ministry of Environment, the production of municipal solid waste per day was as high as 6500 tons in 2016 (Abed Al Ahad et al., 2020). Organic waste is the most common type of waste in Lebanon (Massoud & Merhebi, 2016).

In Malaysia, it is estimated that an average of 162.8 Kgs of solid waste are produced daily from cafeterias of 10 schools, and thus forms 19.6 kg per capita (Kasavan et al., 2020). However, another study in India estimated that solid waste production ranged from 0.117 kg/capita/day in higher secondary schools to 0.059 Kg/capita/day in primary schools (Ramamoothy et al., 2019). An increase in population could lead to an increase in waste

production. The available statistics on solid waste production presents an alert of what steps to take regarding solid waste generation, disposal, and management.

## **B. Types of Solid Waste**

Solid waste (SW) is discarded useless material that is unwanted anymore by a human. SW could be non-liquid or nongaseous material. A number of classification systems have been developed to categorize solid wastes. One important category relates to its correspondence to harm. Accordingly, SW can be categorized as hazardous and harmless. Examples of hazardous waste materials include acids, lead, arsenic components, and all self-oxidized wastes that can combine with other materials to become flammable and poisonous (Akbasli et al., 2010). Included as well are wastes generated from cleaning agents, insecticides, and electronic waste (Nightingale & Donnette, 2002). As for the harmless wastes, they may consist of paper, ash, metal, glass, and plastic (Akbasli et al., 2010).

Akpanudoh et al. (2005) categorized solid wastes into degradable, semi-degradable, and non-degradable material. A degradable substance reflects its ability to be catalyzed and changed into liquid at high temperatures (Akpanudoh et al., 2005); included are paper, textile, and food waste. Semi-degradable wastes include wood and disposable napkins, whereas the non-degradable ones include rubber, plastic, ash, metal, glass, leather, and electronic wastes. Furthermore, Bharadwaj et al. (2015) classified solid wastes into recyclable and non-recyclable material. Recyclable wastes can be transformed from recyclable to reusable material such as paper, metal, and glass. The non-recyclable material is unrecovered material that people could not reuse again (Bharadwaj et al., 2015).

Another classification of solid waste relates to it being organic or non-organic. Organic solid waste includes food and yard wastes, whereas the nonorganic ones include plastic, cardboard cans, and glass bottles (Dangi et al., 2011). Most of the solid wastes in schools include a combination of the above, such as cardboard, batteries, food, paper, textile,

plastic, glass, cans, and electronic wastes (Kasavan et al., 2020; Rada et al., 2016). However, most of these wastes are recyclable material that can be managed.

### **C. Solid Waste Management**

Solid waste is produced from human activity (Li et al., 2022), and the improper disposal of solid waste can cause serious health problems. There are three ways to managing solid wastes generated in schools. The first way is the incineration technique through littering waste in a garbage can near the school and burning it (Ana et al., 2011). The second way is by collecting and dumping waste in municipal open dumping sites which could be more economic (Kasavan et al., 2020), whereas the third is by littering the garbage in a specific landfill and covering it by soil (Abbas et al., 2012).

Landfill is the most common method used in Lebanon (Massoud and Merhebi, 2016), where 48% of waste management is by landfill (Abbas et al., 2017). However, most landfills in Lebanon have reached the maximum capacity and will be nearly closed (Abed Al Ahad et al., 2020). Moreover, Laner et al. (2012) revealed that the landfill process could harm the environment by polluting the underground water if it is not treated properly after being covered with soil. Many scientists believe that improper solid waste management will harm the environment and humans by causing pollution to the environment, resulting in many illnesses such as malaria. In addition, littering the waste in open dumping sites could attract insects and emit a bad odor (Ibrahim et al., 2021; Ndukwe et al., 2019).

In light of the above, overloaded landfills in Lebanon have compelled people to think of alternative means to improve waste disposal. However, the proper way to decrease the production of solid waste is through reusing, reducing, and recycling or the 3 Rs approach (Banchonhattakit et al., 2022; Song et al., 2015), as this approach helps to maintain environmental sustainability with less generation of solid waste (Yano et al., 2016). The 3 Rs approach differs from country to country due to the set laws regarding waste management

(Yano et al., 2016). For Leslie et al. (2021), 'reusing' is a process to reduce waste, such as by reusing a bag of food many times as the means to reduce waste production, whereas recycling, segregating waste according to type, is a process that transforms and treats waste by industrial companies to refurbish some material such as paper.

In Lebanon, only 8% of waste is recycled (Abbas et al., 2017). However, not all people are familiar with the 3 Rs of waste management. The barriers to applying the 3 Rs in Lebanon are lack of awareness and absence of law (Saad et al., 2022). According to Abed Al Ahad et al. (2020), the economic factors in rural areas in Lebanon constitute barriers to the management of solid waste, although it could yield an extra income to the community. One study by Kasavan et al. (2020) revealed that recycling cans, papers, and plastic could revenue approximately 0.6, 0.38, and 0.86 dollars per kilogram respectively. Knowing the economic benefits generated from recycling waste can motivate people to readily segregate waste according to type and apply the 3 Rs approach.

#### **D. Solid Waste Management in Schools**

The most effective way to cultivate the culture of proper solid waste disposal must start from youth. Most of the studies from different countries have reported that students do not have enough information on how to dispose waste properly. Students are not able to differentiate between hazardous and non-hazardous waste (Tomažič et al., 2011), yet they are aware of the problem but do not know how to manage it (Israel et al., 1993). Therefore, students can be oriented and prepared about managing solid waste, may be by their teachers.

In the light of the above, one may ask if it is enough to cultivate a culture of environmental sustainability among students by integrating few topics on environment in the Lebanese school curriculum. It is obvious that the existing integrated curriculum on waste management is not enough to instate an eco-friendly culture among students and to cultivate

the management of solid waste in the behavior and attitudes of students. Teaching the 3 Rs of solid waste management is worth considering to better prepare an eco-friendly generation.

### **E. Teachers' Perception about Solid Waste Management**

Teachers play a major role in inducing change among students. There is a strong correlation between students' motivation and that of their teachers in school (Murdock et al., 2000). Baysen and Baysen (2020) posited that teachers have good knowledge of the definition of solid waste, but they do not know about the effect of incineration on the environment. However, Karatekin (2014) revealed that not all preservice-social studies teachers are familiar with recycling solid waste. Current literature addresses the need to prepare teachers to be more familiar and knowledgeable about solid waste and the available ways of disposing them.

Ghosn-Chelala and Akar (2021) revealed in a recent study that teachers in Lebanon have different knowledge and concerns about environmental sustainability, where 80% of teachers disclosed interest about waste management, half expressed concerns about sewage disposal in the sea and air pollution due to vehicle usage. However, less than 25% of the study participants elaborated on the impact of waste on human health and environment; two-third expressed interest to preserve the raw material in nature and half of the civic and science teachers mentioned their need for information about recycling and reducing processes in managing solid waste (Ghosn-Chelala & Akar, 2021). The difference in knowledge can be related to the exclusion of environmental sustainability educational material from the school curriculum. These findings indicate that teachers lack information about solid waste management, especially the social studies, civic, and science teachers who are entitled to offering education about environmental sustainability in schools.

In the light of the above, there exists a dire need to teach solid waste management in schools. This project aims at developing a prototype curriculum to train teachers at schools in



Lebanon on the different approaches to reduce, reuse, and recycle solid waste. Teachers will then use this curriculum to train students on principles of solid waste management. Included in the curriculum are sessions on designing educational strategies such as didactic sessions, fieldwork activities, and learning experiences to train students.

## CHAPTER II

### LITERATURE REVIEW

The curriculum on reducing, reusing, and recycling (3 Rs) solid waste is crucial to promote health and wellness of communities. As informed by the United Nations Educational Scientific and Cultural Organization's (UNESCO) report in 2020, environmental education is needed by all members of schools, and the 3 Rs curriculum is a topic under environmental educational (Arenstein & Supple, 1981). A number of international organizations are concerned about maintaining healthy environments. In 1979, the California State of Solid Waste Management Board was assigned to develop a curriculum for students on environment (Arenstein & Supple, 1981). The United Nations (UN) and UNESCO have expressed concerns about environmental education, when cultivating the concept of solid waste management in schools remains a worldwide focus. According to Thorme (1990), the UN has highlighted that living in a healthy environment is a human right, whereas Ricoy and Sánchez-Martínez (2019) believe that preparing teachers on skills and capacities in environmental education remains one of the UNESCO's chief goals to be achieved in 2030. Thus, many organizations, as the UNESCO, recommend train-the-trainer programs as the means to initiate environmental education in schools.

Teachers need to have knowledge and skills on solid waste management. Students are not usually involved in solid waste management due to deficiency of teachers' knowledge on the topic (Debrah et al., 2021). Based on the United Environmental Protection Agency, education about the environment does not focus on delivering the information only, it is rather to think critically about the situation at hand and to solve problems as need be (Debrah et al., 2021). Yüzüak and Erten (2022) revealed in a study that although a project about solid waste management was presented in a school, only 56.6% of teachers were familiar with the concept. Similarly, Karatekin and Meray (2015) revealed that although some teachers have

knowledge about solid waste management, they have minor preparation in practicing solid waste segregation.

Awareness of teachers about the 3 Rs could affect students' attitudes and behaviors. Cutter-Mackenzie (2010) believed that training teachers in a program in Australia for reducing solid waste would help to cultivate the concept of environmental sustainability in schools. Educational activities such as lectures, videos, and films are significant predictors of changing teachers' attitudes and behavior in a positive way about managing solid waste (Aksan & Celikle, 2019; Hamalosmanoglu et al., 2020; Sadeghi et al., 2020). For example, Akasan and Celikler (2019) revealed that most science teachers in North Turkey understood the concept of recycling and started recycling frequently after the educational activity. Moreover, Lalamonan and Comighud (2020) supported previous claims that increasing level of awareness of teachers can have a positive impact on their attitude toward recycling.

After conducting an extensive search on the topic using CINAHL, PUBMED, Dimensions, Web science, educational index (ProQuest), ERIC (EBSCO), and MEDLINE (Ovid) at the American University of Beirut library. The studies on the teacher's role in solid waste management at schools in Lebanon are limited. This is despite the fact that there are different types of schools in the country, including "eco-friendly" or "green schools" which receive a certificate for this designation (Kadi, 2017). Among the many barriers to raising awareness about the 3 Rs of solid waste in Lebanon, lack of legislation and laws about solid waste management (Abbas et al., 2017) and lack of knowledge (Bardus & Massoud, 2022) are most prominent. The majority of public schools in Lebanon do not have an environmental focus or initiatives on solid waste management (Ghosn-Chelala & Akar, 2021). Schools have the potential to establish a system for segregating solid waste (Abbas et al., 2017), but there is a need for more research on the 3 Rs of solid waste management in Lebanon.

## **A. Impact of Improper Solid Waste Management on Human Health**

Improper disposal of solid waste can have several negative impacts on human health, including air pollution, water contamination, and the spread of diseases. An explanation of each impact reveals its effect on health as follows.

### ***1. Air Pollution***

Waste incineration can emit toxic gases. According to WHO report in 2021, gases contributing to air pollution can lead to respiratory problems such as asthma and bronchitis. The report reveals that 60% of Ghana's health issues have been linked to environmental problems in 2010. In addition, a study by Di Maria et al. (2021) reported the existence of an association between the incineration of solid waste and cancer development in Italy.

### ***2. Water Contamination***

Improper disposal of solid waste can contaminate water sources with hazardous chemicals and bacteria, which can cause waterborne diseases. A study by Alghamdi et al. (2021) revealed that groundwater near a landfill site in Western Saudi Arabia was contaminated with heavy metals such as zinc, cadmium, and chromium. The contaminated groundwater is not suitable for agriculture irrigation and drinking water, as it is contaminated with *Escherichia Coli* (Alghamdi et al., 2021).

### ***3. Spread of Diseases and Occupational Hazards***

Solid waste can be a breeding site for many vectors such as rats, flies, and mosquitoes. These vectors can carry microorganisms and transfer them directly to humans causing malaria (Nor Faiza et al., 2019). As for occupational hazards, workers in the waste

management industry can be exposed to hazardous materials, such as asbestos; these in turn can cause long-term health problems such as cancer (Thieves et al., 2022).

### **B. Using the Health Belief Model to Design Educational Programs**

The Health Belief Model (HBM) has had positive impact on the 3 Rs of solid waste education. Sadeghi et al. (2020) used educational interventions based on the health belief model in creating awareness of the Iranian community about waste segregation. Among the many educational strategies used in the study, sessions, group discussions, and workshops on solid waste management were effective in raising awareness and changing participants' attitudes and behavior (Sadeghi et al., 2020). The activities used in the program to ensure its success include: (1) sending messages on the content and purpose of the sessions before commencing the session, as the means to orient participants to what will be discussed, (2) group discussions as the means to encourage participants to change their attitude, and (3) selecting expert participants who were part of the program to lead a workshop. Expert participants could enhance self-efficacy, and their role was to oversee others' behavior regarding waste segregation (Sadeghi et al., 2020).

An example of educational activities is encouraging teachers to do a project about solid waste segregation. In a qualitative study that aimed at motivating science teachers in Turkey, Askan and Celikler (2020) assigned teachers to prepare a model or worksheet related to recycling after they had attended lectures on solid waste management. Activities included in the study were: (1) putting boxes for disposing batteries in classes and in the court, (2) meeting a lecturer at an engineering university, (3) taking a trip to a recycling plant, (4) preparing a poster about recycling, (5) preparing a model or worksheet about recycling, and (6) conducting public spot contest on recycling waste. In the end, teachers with the most effective set of activities were recognized (Aksan & Çelikler, 2020).

The Health Belief Model (HBM) as an interventional model provides another revenue to design educational programs. For example, Msengi (2019) examined the effect of HBM approach on motivating recycling behavior among participants in an educational program that focuses on weighing recyclable collected items. The theory was tailored to the knowledge, attitude, and beliefs of participants regarding the 3 Rs of solid waste management. Electronic messages, brochures, fliers, and telephone calls were used in the study to inform participants about recycling. Messages included measures on how to overcome barriers that prevent participants from recycling. These barriers were captured from the focus group discussion at the beginning of the study. In addition, problems and cases about solid waste segregation were posted on fliers or brochures. The program was applied over six months and evaluated over two sets of time for 6 months. For evaluation, two methods were used. The first method was a questionnaire that was collected before and after the intervention, whereas the second method was weighing collected recyclable items. The study revealed a strong association between HBM educational intervention and change in participants' behavior toward the 3Rs of solid waste, and the percentage of collected recyclable waste increased from 21.3 pounds to 59.3 pounds (Msengi, 2019). This study supported the use of the HBM in environmental practice, as the evaluation method was not expensive and could be used in coaching participants to recycle. This method can be applied in educating teachers in Lebanon.

### **C. Teaching the 3 Rs**

Education or preparedness of teachers and communities on the 3 Rs of solid waste has implications on health and wellness of the people. Being a topic of interest for a number of countries, educational programs have been developed to include tools that evaluate the effectiveness of the program, such as using pre-test and post-test methods (Aksan & Celikler, 2019; Hamalosomonglu et al., 2020; Sadeghi et al., 2020). Participants were evaluated before and after completing these programs, together with integrating diverse activities in the

curriculum, such as lectures, videos, photovoice, etc. All were strongly correlated with an increase in knowledge among teachers and communities, in how to segregate waste.

In a similar stance, Sadeghi et al. (2020), Soe and Chow (2019), and Mesengi (2019) used phone messages as an educational tool to increase awareness among participants about managing solid waste. Audio visual tools such as films, videos, and photovoice and other educational tools have been used as well (Brand et al., 2016; Coronado et al., 2020; Hamalosmonglu et al., 2020; Shawa, 2021; Wijinker et al., 2020). Enclosed is a description of each methodology.

### ***1. Photovoice***

Photovoice is a tool used to involve participants in the program to understand how they think about the 3 Rs. Coronado et al. (2020) advocated photovoice as a teaching method at universities, as it provided an in-depth understanding of participants' beliefs, values, and perceptions about any topic (Brand et al., 2016; Shaw, 2021). Photovoice requires that students choose a topic related to the environment, and then to reflect on related photos (Coronado et al., 2020).

### ***2. Video***

Utilizing visual perceptions through E-films encourages participants to become interested in learning. Hamalosmonglu et al. (2020) used E-films as an educational tool alongside the environmental education course to show the etiologies of environmental damage. The film was awarded the "Best Film" in 2009. Through videos, participants can pay attention to the environmental problems, etiologies, and role of people and give a conclusion about solid waste management (Hamalosmonglu et al., 2020). Wijinker et al. (2021) concurred that this tool has a good impact on learning with the use of a guideline. The guideline must include a short video that does not exceed 12 minutes, and no notes or

remarks should be given before showing the video. Using a video could be a predictor to initiate participants' interest in learning (Wijinker et al., 2021).

### ***3. Case Study Discussion***

Case discussion stimulates critical thinking and active participation in the educational approach. Learners are required to search the literature, to understand and analyze the problem at hand. Problem analysis will prompt learners to participate in discussing the information they prepare (Krain, 2010). As revealed by So and Chow (2019), case discussion can have a positive impact on understanding the recycling concept.

### **D. Lewins' Theory of Change Guiding Program Implementation**

The goal of any program is to bring about change. Lewins' change model with its three phases can guide the change in any organization. Creely et al. (2021) posited that using Lewins' change theory would have a significant effect to persuade change among learners. The model sets the stage for change, which happens in three phases: (1) unfreezing, (2) moving or transitioning, and (3) refreezing phases (Creely et al., 2021). Since Lewins' model is believed to be a strategy for reinforcing the human capital aspect of change, the model can guide the change intended by any project and help identify its restraining forces.

#### ***1. Unfreezing phase***

Creely et al. (2021) revealed that in this phase, the leader checks the readiness of the community to change. This necessitates that a meeting be held with the staff and stakeholder in the project or program to identify the problem and needs for change (Creely et al., 2021). In relation to the project under study, this phase can identify deficiencies about the 3 Rs of



waste disposal among teachers. Eventually, relevant content and evidence can be determined, and forces perceived to drive or resist the change can be identified.

## ***2. Moving/Transitioning Phase***

In the moving or transitioning phase, change will take place progressively, and thus time is needed for change to occur (Creely et al., 2021). Moreover, to make an individual responsible to change, the intention for change should be initiated. At this stage, there is a need to guide and communicate with participants in the project to prevent loss of sight of the desired target (Creely et al., 2021).

## ***3. Refreezing***

Refreezing demands new stability and new equilibrium (Creely et al., 2021). This equilibrium could be solicited by developing a policy. In this phase, the curriculum on reducing, reusing, and recycling solid waste could be embedded into the existing educational system intended for teachers. The teachers' role is to cultivate the concept of solid waste management among students and keep them practicing the 3Rs throughout the school year. At this stage, the driving forces to facilitate and counteract any arising restraining forces of the unfreezing phase will be accentuated in order to guarantee that the change will not be lost.

## **F. Role of Clinical Nurse Specialist (CNS) in Implementing the Project**

According to Ross (1999), the CNS has a crucial role in assessing the community's needs and establishing a program to optimize the health of students and the community respectively. Ross (1999) posited that the role of the CNS in the school setting expanded the role of school nurses by improving nursing practice and quality of care. The CNS and school nurses have multiple roles, among which is the educator and clinical care roles. Moreover, school nurses have a responsibility to participate in environmental health services, among

which is providing services to reduce air and water pollution and solid waste (Banerjee et al., 2018). In consequence, establishing a program to raise awareness in the community regarding solid waste management is the role of the CNS and school nurse, and thus are eligible to be coordinating and conducting this program. However, the most public and many private schools in Lebanon do not have a school health nurse who is meant to be the champion for promoting health and preventing disease in the school community (Jabbour et al., 2013). Schools in Lebanon use school teachers or school assistants whose vital responsibilities are creating educational programs to promote community health. Very few possess a program on environmental health (Jabbour et al., 2013). However, nurses could succeed in establishing environmental educational programs to preserve green school space, with the collaboration of teachers as addressed by Alexander et al. (2022). Hence, developing a prototype curriculum for schoolteachers and school assistants on waste management, to be rolled out to students helps cultivate the concept of waste management among students and motivate them to reduce, reuse, and recycle wastes.

## **G. Summary**

Even in schools that are applying solid waste management, not all teachers are familiar with the concept and not all have a positive attitude toward segregating solid waste. Teachers can play a major role in cultivating solid waste management in schools, and educational activities could influence their behavior and attitude. Educational programs by teachers can affect awareness about the 3 Rs of solid waste. Videos, films, case scenarios, phone messages, and case discussions are examples of teaching methods that can be used to increase teachers' awareness. School health nurses play a major role in designing and conducting such programs since their role is to promote health and prevent diseases.

## CHAPTER III

### THE CURRICULUM

Planning the curriculum necessitates an extensive literature search on the topic of solid waste management in schools, the 3 Rs, and the role of nurses in designing and implementing such curricula. The project commenced with a pilot survey to assess the learning needs of teachers on the topic of solid waste management in one of the private schools in Beirut, Lebanon. This was followed with designing the curriculum. This chapter describes the various phases required in developing and designing the curriculum for teachers on the 3 Rs of solid waste management, together with curriculum goals, purpose, outcomes, content, required resources, possible constraints, and budget plan.

#### **A. Needs Assessment of Teachers**

The variation in teachers' knowledge about solid waste management and the absence of a guiding policy or law on managing solid wastes in Lebanon, as assessed in the literature, necessitated a needs assessment of 10 teachers from one of the private schools.

The Modern Civic Education School, established in 1964 was selected as a pilot school to assess knowledge needs of teachers for this program. The school is classified as a primary school, located in Beirut, and its teachers teach in several languages (English, Arabic, and French); as for its students, they are from different nationalities. Initially, the school principal was contacted to secure a permission to meet teachers.

Interview questions on the topic of solid waste management were developed to assess the knowledge of the teachers. Interviews were conducted with 3 science, 2 civic, and 4

language teachers guided by the questions illustrated in table 1. Interviews were semi structured, conducted face-to-face on an individual basis over 15 to 30 minutes.

**Table 1-Interview Questions To assess Knowledge Needs of Teachers**

- |   |
|---|
| <ol style="list-style-type: none"><li>1. What do you know about solid waste management?</li><li>2. Do you have information on how to get rid of solid waste? Give examples.</li><li>3. Do you have information on how to segregate, reduce, and reuse solid waste?</li><li>4. Have you been involved in instructing students how to reuse, reduce, etc...?</li><li>5. Have you had any prior preparation about solid waste management?</li><li>6. What topics would you like to learn more about regarding solid waste management?</li><li>7. Do you believe that students can be involved in solid waste management?</li></ol> |
|---|

### **B. Categorization of Teachers' Knowledge Needs**

Teachers related solid waste management to recycling only; however, a few related recycling practices in their homes to segregating plastic bottles from other wastes. Nearly quarter of the participants, believe that sanitation is a way of managing waste, and that by asking students to pick up waste from the school ground is a way to manage waste disposal. All teachers stated that they have not attended any prior sessions about solid waste management, yet they would like to know more about the recycling process. Participants believe that students could be involved in solid waste management if some resources are made available such as recycling bins. Informing parents about solid waste management surfaced as a common concern for all. Moreover, teachers assured that there are no activities in the curriculum on solid waste management or environmental sustainability. Three of the participants used to do extracurricular activities for students, such as collecting and

segregating waste in the past before the COVID pandemic. The data supports the assumption that teachers do not have enough information about solid waste management.

Insufficient knowledge assessed from interviews with teachers can be related to a number of conditions. First, no awareness session has ever been given to teachers on the topic of solid waste management. Second, no teaching has ever been given to students on the concept of solid waste management. Third, teachers' knowledge about solid waste management focuses on recycling only. Fourth, few teachers believe in the effect of recycling.

Teachers' needs were further analyzed and grouped to help us identify the gaps in knowledge regarding solid waste management. The analysis process helped to design the goals and expected outcomes of the curriculum, to educate teachers about solid waste management. This in turn could be perpetuated to students by educating them about the 3Rs of solid waste management.

In conclusion, understanding that teachers do not have enough information about solid waste management and not all have attention toward the proper disposing of solid waste can be reflected on students' attitude and behavior. Thus, we need to formulate a program to close the gap.

### **C. Target Population**

Since most public and many private schools in Lebanon do not have a school health nurse, science teachers or school assistants may be given the responsibility of developing educational programs to promote school and community health. This prototype curriculum targets all teachers in schools, including the science teachers and school assistants as well, and thus helps to cultivate the concept of solid waste management among students and motivate them to reduce, reuse, and separate solid wastes for recycling.

## **D. Curriculum Goals and Objectives**

This prototype curriculum aims to train teachers at schools in Lebanon on different approaches regarding reducing, reusing, and recycling solid waste. Teachers will then use this curriculum to train their students on the principles of solid waste management. Thus, the chief goal is expanding teachers' knowledge and skills about reducing, reusing, and recycling solid wastes. Three objectives will guide the achievement of the program.

### **Objective (1)**

By November 2023, teachers will attend two educational sessions. Based on the covered content, 70% of teachers will increase their knowledge about types of solid waste and its impact on the environment, as well as the significance of the 3Rs.

### **Objective (2)**

By December 2023, teachers will attend all educational sessions. Based on the content of the curriculum, our aim is that 80% of teachers will increase their knowledge on the 3Rs of solid management by 75% as will be measured by an exam.

### **Objective (3)**

By February 2024, 70% of participants who attend all educational sessions will in turn design an educational session to students on solid waste disposal: "Reducing, Reusing

## **E. Health Belief Model Applied in the Curriculum Design**

The Health Belief Model (HBM) is used in designing the content of the curriculum of solid waste management. The HBM affects individual behavior through four perceptions: perceived susceptibility, severity, barriers, and benefits (see Figure 1). The course content based on these perceptions, whereas the course outcomes guides teachers on taking actions to cultivate the concept of the 3Rs of solid waste management among students.

Units 1 and 2 of the curriculum concentrate on the perceptions of severity and susceptibility of getting a disease due to exposure to chemical compounds produced from improper solid waste disposal. Statistical figures will be provided regarding the severity of littering solid wastes. Other perceptions of the health belief model include the perceived barriers and benefits. In this regard, unit 3 of the curriculum will tackle the absence of a recycling policy as a perceived barrier in segregating solid waste. However, the perceived benefits of reducing, reusing, and recycling solid waste will be included in unit 2. After valuing the perceived benefits, it is expected that the cues to action, on part of teachers, will rise by establishing a session about solid waste management for students.

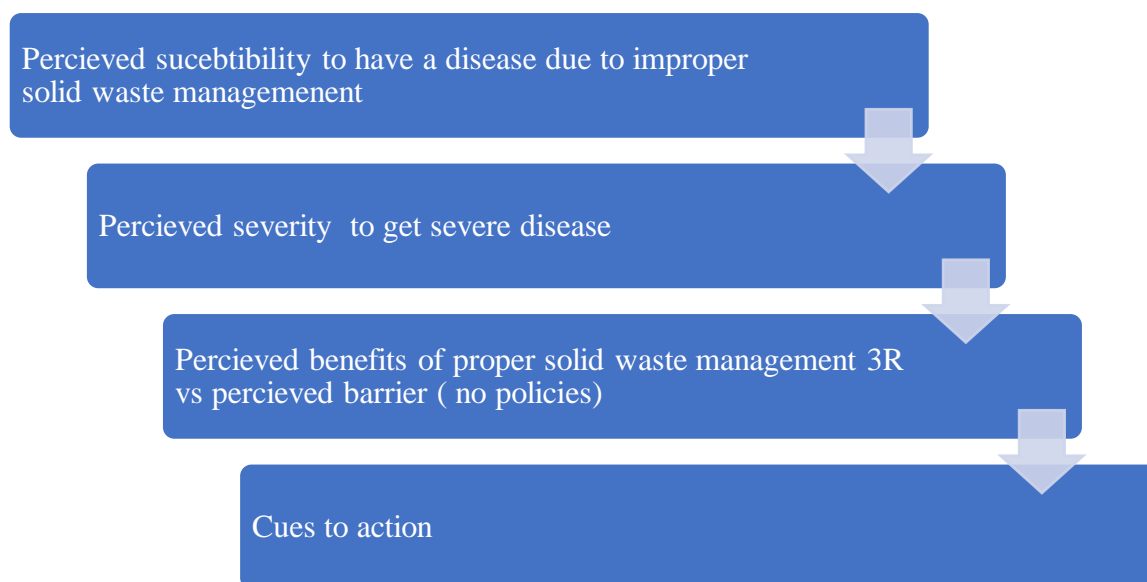


Figure 1: The Health Belief Model Applied

## F. Organization of the Course Material

The curriculum will be given over 12 hours and organized into an introduction session and 5 units. Most of the units start with a video, which complements the discussion but does not substitute it. For each session, there is an introduction followed by discussion of the topic. Assessing achievement of outcomes will take place through exercises, assignments, and quizzes to test knowledge acquisition of the participating teachers.

## **Curriculum on the 3Rs of Solid Waste Management**

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### **G. Curriculum Description**

This 12-hour curriculum on solid waste management is designed for schoolteachers in Lebanon. The curriculum advances teachers' knowledge regarding the different types of indoor and outdoor household solid waste, legislation and policies related to the topic, proper domestic waste practices, and waste disposal. Teachers' perceptions about the impact of wastes on human health and on-air pollution, together with an in-depth elaboration on the various principles of solid waste management will be explored. This curriculum will be delivered using the face-to-face format, and the applied learning approach includes field visits, team learning activities, application to real-world exercises, case-based learning activities, and presentations.

### **H. Purpose of the Curriculum**

There are two purposes for this curriculum: (1) helping teachers gain a solid understanding of core concepts of Solid Waste Management (SWM) in order to implement a culture of SWM in schools, and (2) safeguarding human health by preventing the spread of diseases due to improper waste management.



## **I. Placement of the Curriculum**

The curriculum will be conducted in the fall semester of the academic year 2023, from November to December, mounting up to a total of 12 hours. The sessions will be conducted on Fridays, from 2 pm until 4 pm, and thus 6 Fridays as a total.

## **J. Delivery Format**

The delivery format is face to face to encourage teachers to attend the sessions. However, the syllabus, assignments, and exercises will be completed electronically on the Google Classroom, and thus reduce the use of papers. Google Classroom is a free platform that is easy to utilize, and helpful in sharing the information between learners and teachers (Gupta & Pathania, 2021). Learners will submit their assignments on this platform.

## **K. Teaching Method**

Didactic teaching, team-learning activities, application to real world exercises, case-based learning activities, presentations, and group discussion will be used in delivering the curriculum.

## **L. Learning outcomes**

At the end of the curriculum, learners will be able to:

LO1: Identify the indoor and outdoor household solid wastes that affect human health and the environment respectively.

LO2: Demonstrate an understanding of international and local solid waste management policies.

LO3: Identify the proper domestic solid waste practices that can be applied in schools.

LO4: Design and deliver a teaching session about solid waste management for students.

**Table 1- Curriculum Outline**

Date	Unit	Topic
Week 1	<b>Unit I: The concept of wastes</b>	<b>The concept of wastes</b> <ul style="list-style-type: none"> <li>• Introduction &amp; Overview of the Course</li> <li>• Concept of solid waste: Categories of solid waste (degradable, recyclable, organic)</li> <li>• Indoor and outdoor types of solid waste</li> <li>• Hazardous and Nonhazardous solid wastes</li> <li>• Types of solid waste management: open dumping, landfill, leachate and incineration and its impact on human health and environment</li> <li>• Submission: Exercise (see Appendix I)</li> </ul>
Week 2	<b>Unit II: Impact of Solid waste disposal on environment and human health</b>	<b>Impact of Solid waste disposal on environment and human health</b>  <b>Module 1: Textile waste:</b> Textile Waste production and its impact on human and environment <b>Module 2: E-waste</b> E-waste & its impacts on human and environment  <i>Submission: Assignment 1– (see Appendix II)</i>
Week 3	<b>Unit II: Impact of Solid waste disposal on environment and human health</b>	<b>Impact of Solid waste disposal on environment and human health</b>  <b>Module 3: Agriculture waste:</b> a) Cereal-based waste b) Change agriculture waste into energy c) Effect of incineration residue on human and environment  <b>Module 4: Plastic Waste</b> a) Types of plastic wastes b) Effect of plastic waste on environment c) Management of plastic waste and impact on human and environment
Week 4	<b>Unit III: International and national legislation of solid waste management</b>	<b>International and local legislation of solid waste management</b> a) International and national legislation of solid waste management b) Situation of municipal SWM in Lebanon c) Key policy: challenges and recommendations for improving municipal SWM in Lebanon d) Restriction issues for initiating international legislation of SWM
Week 5	<b>Unit IV: Proper</b>	<b>Proper domestic waste practices</b> a) Factors affecting an individual behavior on waste separation

	<b>domestic waste practice</b>	b) Guidance for teachers on designing educational strategies for students (didactic sessions, field work activities) (see Appendix III & IV)  <b><i>Read supplementary articles for the unit IV</i></b>
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## M. Session-Description

### ***1. Session One: Why it is important to recognize the different types of solid waste?***

The session commences with welcoming and greeting the participants who will thereafter completing a pre-test. This will be followed by sharing the content of the curriculum.

Questions will be asked about the concept of solid waste, to assess teachers' knowledge.

After that, the concept of different types of indoor and outdoor solid wastes and its impact on the environment and human health will be explained using the prepared PowerPoint material.

Statistical values on solid waste production, locally and globally, will be shown to alert teachers on what must be taken regarding solid waste generation. In this session, the perceived susceptibility and severity of improper solid waste management will be

highlighted. From this session, teachers will be familiarized with the different types of indoor and outdoor solid waste and the impact of hazardous material on humans and the

environment, as well as the diverse ways in managing solid wastes that will help to segregate wastes according to type. In the last 30 minutes, a discussion will be opened for all inquiries

about solid waste management. At the end, teachers will be reminded about completing an exercise with description of the purpose and due date for submission.

### ***2. Session Two and Three: The effect of textile wastes and other types of solid wastes on the environment and human health.***

Sessions two and three will consist of four modules on textile waste, electronic waste, plastic waste, and agriculture waste. Consequently, teachers will expand their

knowledge about the types of solid wastes and their impact on the environment and human health. Moreover, perceived susceptibility and perceived severity of diseases due to the improper littering of solid waste will also be mentioned in this chapter. Teachers will be divided into groups to complete assignment 1. Each group should share ideas about the significance of the 3Rs (reduce, reuse, recycle). The participants should read the instructions carefully. It includes four parameters: (a) purpose, (b) directions on how to construct and present the work, (c) submission date/time, and (d) grading approach. At the end of the session, a quiz will be distributed to assess knowledge acquisition. Case scenarios will be provided to grab the attention of participants, and videos will be presented before starting the sessions to show the types of wastes and the way to reduce pollution. A debriefing on teaching techniques will be introduced.

Video 1: Textile waste: [https://youtu.be/BiSYoeqb\\_VY](https://youtu.be/BiSYoeqb_VY)

Video 2: Food processing: <https://youtu.be/DhR5CNJuk-g>

Video 3: Turning Agricultural Waste into Energy: <https://youtu.be/czB8nqeVi7I>

Video 4: Plastic, pollution explained [https://youtu.be/u56T\\_PpC6jk](https://youtu.be/u56T_PpC6jk)

### ***3. Session Four: Absence of policies and legislation in Lebanon causing a barrier for Lebanese people to reduce, reuse, recycle wastes***

In this session, teachers will be assigned articles to read and draw a comparison between the local and international policies of solid waste management to help teachers analyze how policies can be adopted to reduce, reuse and recycle wastes in schools. Moreover, they will identify key challenges and recommendations for improving municipal SWM in Lebanon. The lecture on legislation and policies will be explained thereafter. A video will be projected on the presence of legislation / policies on reduction, prevention and management of marine litter.

#### **Video:**

<https://youtu.be/CvB9Qnn9Ncw>

### ***4. Session Five: Technical skills to influence students' learning behavior***

Some strategies and ideas will be identified. In this session, teachers will report creative ideas to teach the concept of solid waste management, to influence students' behavior. Moreover, guidance for teachers on designing educational strategies for students (didactic sessions, fieldwork activities) will be provided and introduced. A video will be presented at the beginning of the session to show how to segregate solid wastes.

Video: [https://youtu.be/To\\_kETdq0-0](https://youtu.be/To_kETdq0-0)

### 5. *Session Six: Teacher presentation*

The last session will be allotted 3 hours instead of 2. Each teacher will present a 15-minute-session on a topic of their choice to students.

## N. Supplementary Reading Materials for Each Session

**Table 1-Supplementary Reading Materials for Each Session**

Unit I: The concept of Waste	Read chapter 1 & 2 (Kreith and Tchobanoglous (2002)). Article 1: Household and Hazardous Waste: Assessing Public Attitudes and Awareness(Scudder & Blehm (1991))
Unit II: Impact of Solid Waste Disposal on Environment and Human Health	<b>Articles</b> <i>Article 1: (Zhang, 2022)</i> Environmental Impacts of Hazardous Waste, and Management Strategies to Reconcile Circular Economy and Eco-sustainability) <i>Article 2: Public and Environmental Health Effects of Plastic Wastes Disposal: A Review (Okunola et al., 2019)</i> <i>Article 3: Possibility Routes for Textile Recycling Technology (Damayanti et al., 2021)</i>  <b>Presentation:</b> Presentation for textile and electronic waste (appendix V)
Unit III: International and National Legislation of Solid waste Management	<b>Articles</b> <i>Article 1:</i> Solid Waste Management in Lebanon: Challenges and Recommendations JEW (Abbas et al., 2019) <i>Article 2:</i> International Environmental Law in an Era of Globalized Waste(Barsalou & Picard, 2018)

Unit IV: Proper Domestic Waste Practice	<p><b>Articles:</b>  <i>Article 1:</i> Municipal Solid Waste Management(Sharma &amp; Jain, 2020)  <i>Article 2:</i> The Meaning of Reduce, Reuse, Recycle (Dijkers, 2019)  <i>Article 3:</i> Smart Recycling Bin (Wahab et al.,2014)  The English Plastic Bag Charge Changed Behavior and Increased Support for Other Charges to Reduce Plastic Wastes (Thomas et al., 2019).  <i>Article 4:</i> Identifying the Key Policy Drivers for Behavioral Improvement in Waste Source Separation in the Yangtze Delta Region, China(Li et al., 2022).</p>
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**O. Course Policy**

To complete this course, participants will have to attend all sessions and complete the assignments on the assigned dates. The test before and after the sessions should be completed. No special prerequisites are required. This program is designed for all teachers, school nurses, and teacher assistants at schools in Lebanon.

**P. Resources and Constraints**

Resources and constraints are crucial elements to consider before implementing the project. Human and non-human resources are included in Table 4.

**Table 1-Curriculum Resources Identified**

Non-human resources	Human resources
<ul style="list-style-type: none"> <li>o Resources to give a curriculum (LCD projector, electricity, Pens, handbook, papers A4, Ink for printer, poster, Computer, Google Classroom, Attendance sheet)</li> <li>o Recycle bins.</li> <li>o Studio to store the donation materials (cloths, toys, books et)</li> <li>o Drinking fountains</li> <li>o Transportation</li> </ul>	<ul style="list-style-type: none"> <li>o School spectator</li> <li>o learners</li> <li>o Volunteer students</li> <li>o Canteen’s stakeholder</li> <li>o Educator</li> </ul>

## **Q. Possible Constraints**

A number of constraints may impede the proper implementation of the curriculum. The first constraint, the manager may not support the program; however, this could be sorted out if the school principal will be informed that this program could provide extra money to the school by selling recyclable items. The second constraint, teachers may not be able to give a lecture for students due to increased academic tasks. This could be resolved if both the school principal and school spectator facilitate the implementation of the program. The third constraint, non-English speaking teachers may not comprehend the language, to mitigate this issue, the session will be conducted in the Arabic language. The fourth, constraint, teachers may not have internet to submit the assignment or fill the evaluation sheet. Access to the internet will be available at the school and teachers can use the internet at lunch breaks or can submit the assignment as a hard copy. The fifth, constraint is the incorrect usage of recyclable bins from the side of students. To deal with this constraint, student volunteers will be assigned at recycling bins and during the break to guide the students on how to use the recycling bins

## **R. Budget Plan**

The budget plan reflects the resources needed to initiate the activities for each objective. First, the program coordinator will volunteer to deliver the curriculum, to monitor, and to evaluate the program, and thus no budget is allotted to this aspect of the curriculum. The plan needs to accommodate the cost of instruments that will be used to deliver the sessions, such as the LCD projector, electricity, and internet. Expenditure will be allocated for pens, handbooks, A4 papers, and ink for printer. As for the pick-up charges for the recycle company to transport the recyclable stuff, charges, if any, will be the responsibility of

the company. The number of transportations per month will be determined according to the quantity of waste, and pick-ups will be negotiated with the recycling company.



## CHAPTER IV

### IMPLEMENTATION AND EVALUATION OF THE CURRICULUM

A curriculum on the Reduce, Reuse and Recycle solid waste will be rolled out for teachers to assist in cultivating the concept of solid waste management in students. The implementation and evaluation phases of this curriculum are quite linked and interconnected. Evaluating the outcome of the program will inform the curriculum developer about appropriateness of both curriculum content and implementation. This chapter includes three main parts: (1) elaborating on the steps and procedure to implement the curriculum, (2) describing the tools that will be used to assess knowledge acquisition and achievement of curriculum outcomes by the participating teachers, and (3) evaluating the curriculum and its effectiveness in inducing change.

#### **A. Implementing the Curriculum: Steps and Procedure**

The developed curriculum, as described in chapter III, will be presented to the principal of a private school in Beirut for approval. Once the approval to implement the curriculum is secured, an announcement will be posted on the school webpage or the Facebook page of the school inviting teachers to participate. This will take place one month before commencing the sessions, thus allowing time for advanced scheduling on part of teachers, school assistants, and the school nurse. During this time, resources of the sessions will be identified, and the budget for items that are currently lacking will be allocated. The principal will then give approval for these expenditures. Moreover, the intermediate and final outcomes of the program will be determined, and these will include increasing awareness about the 3Rs concept among the school population and disposing waste correctly.

The syllabus, PowerPoint material, assignments, and exercises will be uploaded on the Google Classroom. The link to join the Google Classroom will be sent to participants and attendance sheet will be developed as well. To ensure the connection between tasks, the Gantt chart will be used after taking into consideration the Provisional Academic Calendar of 2023-2024. To resolve any conflict or problem that could be faced while giving the sessions, frequent meetings will be scheduled with the principal and spectator of the school for feedback.

In line with planning for curriculum implementation, the school principal will be informed about a number of actions that will help monitor the effectiveness of the curriculum. An example is scheduling sessions on solid waste management to be delivered by each of the participating teachers to students, and thus ensure that all grades and topics are covered simultaneously throughout the school. The time frame for giving the lectures to all classes depends on the number of classes in that school.

Following the lecture delivery to students at the school, each teacher will select 10 or more students as volunteers; these volunteers are entitled to encourage their colleagues in the school to use recycling bins correctly and to monitor the number of students consuming water from drinking fountains weekly. However, the number of volunteers depends on the school area, of whether it is huge or small.

Other implementation steps include, but may not be limited to: (a) purchasing recycling bins to be distributed in the school, (b) communicating with a recycling company to transport recyclable stuff, (c) comparing purchasing plastic bottles from the canteen at school before and after implementing the program in order to check if staff and students are applying reducing principles of plastic bottles, and (d) scheduling two days, one day announce as a donation day where the students and staff can bring unused clothes, books, shoes, and toys to donate to those in need. On another day, the art project will be held, to evaluate changes in students' behavior towards the concept of reducing and reusing solid waste.

## **B. Use of the Gantt Chart**

Monitoring the program will be done by collecting valid and reliable data that reflect the actual performance. In this regard, a Gantt chart will be used. Robles (2018) revealed that the Gantt chart could be utilized daily to monitor the progress of the project over time in order to demonstrate incremental progress towards achieving the desired outcomes. The chart represents the status of a task (Robles, 2018). Data and resources must be filled in the chart to carry out the project tasks. This project will be tracked from the month of November until the end of the academic year; this will be helpful to resolve arguments or disagreements to complete the project on time.

The monitoring steps and procedure include the following: (1) submission of assignments on time and evaluation of assignment grades; (2) weekly report from the recycling company; (3) comparing consumption of drinking water from fountains; (4) number of students who donate unwanted items on the donation day; and (5) number of students participating in an art project. As for monitoring number 4, it can be monitored in two ways: first, by comparing the number of purchased water bottles from the school canteen before and after giving a session for students about the 3 Rs, and second by assigning students to supervise and keep track of the water consumption from drinking fountains on a weekly basis.

## **C. Evaluation of the Curriculum**

The curriculum will be evaluated based on the Donabedian Model, which is used in evaluating the structure, process, and outcome of the program (Ayanian et al., 2016). The structure of the program will be evaluated on content of the curriculum, organization, and delivery. For process, evaluation will include number of teachers attending the program and

acquisition of knowledge and experience by participants. As for the outcome, this can be evaluated by the number of volunteering students, encouraging and motivating colleagues on the use of recycling bins correctly. In addition, examining the flow of the program will be done by checking if teachers give educational sessions to all classes at the school. However, the outcome of the program will be assessed by detecting if the goals and objectives are met and if the program is completed on time.

## **S. Assessing Achievement of Curriculum Outcomes**

In this program, the achievement of curriculum outcomes reflects the knowledge acquisition of the respective participants. In this regard, completing a set of requirements will help assess acquisition. These include the self-test exercise, article summary, post-test, and designing and delivering a session to students at the school. A detailed description of each is enclosed.

### ***1. Self-test Exercise (3%)***

This self-test exercise is allotted 10% of the curriculum grade. It is an online exercise intended to help learners capture information about types of waste and their effect on the environment. The exercise consists of 14 questions. Participants will get access to the exercise by clicking the link on Google classroom. This exercise could be repeated several times to get a score of 100/100 (see Appendix VI).

### ***2. Article Summary (27%)***

As stated in objective (1) of the curriculum, 70% of participants will increase their knowledge about the types of solid waste and the significance of the 3Rs. This objective will be assessed by evaluating the summary of the assigned articles. The article summary will be

allotted 20% of the total score and will be evaluated based on a rubric (see Appendix VII), adopted from the Art and science college web page at the University of North Carolina Wilmington. The coordinator will evaluate the document based on four sections: content, completion, organization, and clarity of the document. Each section will be categorized as: meets standards for competence, needs improvement, and does not meet minimum standards.

### **3. *Test (50%)***

Based on program objective 2, 80% of teachers will increase their knowledge by 75% after attending the curriculum. The test will be allotted 50 % of the overall grade and will be used to assess the achievement of learning outcomes. A pre-test will be delivered to assess the prior knowledge of school teachers and assistants on solid waste management and a post-test to assess knowledge acquisition of the project topics. Regarding the pre-test, 4 open-ended questions will ask the participants to complete in 8 minutes (See Appendix VIII). However, the post-test consists of Multiple-Choice Questions, true and false items, and essay questions (see Appendix IX). The test duration is 45 minutes.

### **4. *Designing and delivering a session (20%)***

Depending on program objective 3, 70% of participants will design an educational session for students on “Reducing, Reusing, and Recycling solid wastes”. However, designing and delivering the teaching session will be evaluated according to appropriateness, organization, accuracy of the information, ability to engage participants in the discussion, creativity in using the tools in teaching, and proper time management (see Appendix X). Delivering the session will be counted as 20% of the total score.

## **T. Evaluation of the Curriculum**

Upon completing the curriculum, the participants will evaluate the content and the quality of teaching by filling out an evaluation tool. Question Pro team developed the adopted Instructor Course Evaluation Survey (see Appendix XI). The tool provides feedback on what to improve in the curriculum, be it in content or teaching approaches. The tool consists of 11 questions. All the items are rated from “definitely disagree or almost never” to “definitely agree or almost always”.

## **U. Evaluating Curriculum Effectiveness**

The effectiveness of the curriculum will be evaluated by assessing a change in teachers and students’ behavior toward solid waste management. Evaluating changes in teachers’ behavior will be done by checking the number of participants who give the sessions for students about reducing, reusing, and recycling solid waste compared to the total number of participants attending the program.

The change in students’ behavior will be evaluated by checking engagement of students in reducing, reusing, and recycling activities. For example, reducing solid waste is evaluated by comparing the total number of purchased water bottles, bought from the canteen at the school, before and after implementing the program at least two times. To evaluate recycling, the report from the recycling company will advise if the students are using the recycle bins correctly. As for the concept of reusing, this is evaluated by counting the number of students who donate clothes, toys, stories, books and shoes during the donation day and checking with the art teachers the number of students who participate in the art project.

## **Questions regarding the evaluation of the curriculum**

After checking the learning outcomes. The curriculum coordinator will evaluate the following:

**Table 1- Questions regarding the evaluation of the curriculum**

**(1) Relevancy:** Is the content, delivery format, and assessment modalities relevant to the topic? Does the curriculum need any modification? Did the teachers give a session to all classes at the school? Do the students use recycle bins correctly? Do the students reduce purchasing disposable plastic bottles from the school canteens and use drinking fountains or refillable water bottles? Is the number of students shading on the art day and the donation day adequate?

**(2) Progress:** Is the program progressing well, do all the criteria on the Gantt chart meet or not, in how much percentage was met? Does the number of students who are sharing in the activities to reduce using waste is expected? Do the intermediate and outcome meet the predetermined plan?

**(3) Cost-effectiveness:** What was the impact of the total program budget on teachers/participants and students' behavior regarding waste disposal?

**(4) Impact:** What is the long-term implication of this program? What are the changes in teachers and students' behavior and attitude toward waste disposal after the end of the school year?

**(5) Environmental evaluation:** What was the impact of the presence of recycling bins in a playground on Students' behavior in recycling? What was the impact of the drinking fountain on reducing the usage of disposable plastic bottles among students? What was the influence of the curriculum about solid waste management on students' behavior after 6 months?

**(6) Structure evaluation:** Is there any event that occurred during the program implementation that influences the effectiveness of the program?

## CHAPTER V

### CONCLUSION

Waste is a major global problem. The production of solid waste increases with the increasing population and improper solid waste management will harm the environment by polluting it and humans by causing diseases and illnesses. The management of waste is a global concern yet it is the responsibility of each individual. Moreover, the school constitutes a major source of solid waste production. The proper way to decrease the production of solid waste is through the 3 Rs: reducing, reusing, and recycling. Not all people are familiar with the 3 Rs yet the most effective way is to cultivate the concept in schools, at an early age. Teachers could play a major role in inducing change among students. However, very few possess a program on environmental health, and teachers in Lebanon have beginning knowledge about environmental sustainability. Hence, developing a prototype curriculum for teachers and school assistants on solid waste management is considered paramount.

The curriculum aims at increasing the knowledge of teachers in schools about solid waste management. Teachers will then use this curriculum to train students on the principle of 3 Rs. The curriculum will be taught over 12 hours. The teacher will acquire significant knowledge about solid waste management that will be evaluated by activities, assignments, and test. At the end of the program, teachers will evaluate the curriculum and deliver a session to students on how to reduce, reuse, and separate solid waste materials for recycling with the aim of cultivating the concept of solid waste management in schools. Evaluation of the effectiveness of the curriculum will be monitored by checking the students' attitude and behavior towards the 3 Rs of solid waste. Teachers will educate students on how to reduce solid waste and students will use recycling bins correctly, reduce the use of disposable plastic



items, and participate in the donation and art day. At the end, I will recommend that science teachers or school health nurses to consider a holistic approach when educating teachers about the 3Rs of solid waste management: Reduce, Reuse and separate for recycling purposes.

## APPENDIX

### APPENDIX I

**Exercise 1: Identify Types of waste and recognize the impact of mismanagement of solid waste on environment. Complete the self-test.**

**Purpose:**

This exercise will help you to capture some concepts about solid waste in general (Types & the problems due to solid waste mismanagement) and identify the learners about some terms related to waste (incineration, landfill). Recognize the impact of mismanagement of solid waste on environment

**Tasks and instruction:**

The exercise consists of 14 multiple-choice items (select one answer) and true or false items. You can start after you insert your registered email. Kindly, inform me if you change your email. Directly you can check the answer after you finish. This exercise may be taken several times until you complete the exercise and get 100%.

**Link for exercise 1:**

[https://docs.google.com/forms/d/e/1FAIpQLSeRjoDf57hLsX3-2INjy\\_kZqqj389LIAbRS3PuT9a5pdS\\_gZw/viewform?usp=sf\\_link](https://docs.google.com/forms/d/e/1FAIpQLSeRjoDf57hLsX3-2INjy_kZqqj389LIAbRS3PuT9a5pdS_gZw/viewform?usp=sf_link)

**Posting:**

Solve this exercise by first week of November.

**Grading** This activity is worth 3 points.

## APPENDIX II

### Assignment 1

#### Article Summary

**Purpose:**

The purpose of this activity is to recognize the effects of solid waste on human health and environment. This is a group activity. You are asked to form groups, maximum 3 learners per group. Each group will have access to the same forum on google classroom. All groups will work on the same concept.

**Tasks:**

Identify four types of solid waste disposal (Textile, E-waste, Agriculture waste, Plastic, and Food wastes)

1. Using an illustration (Ex: Table...), you are required to compare between each kind of wastes, its impact on environment and human health.
2. Report the most appropriate management/treatment for each type of solid waste disposal by using the concept of reduce, reuse, and recycle.

**Extra readings:**

Note: Refer to the readings of this week to complete this activity.

**Article 1:** (Environmental impacts of hazardous waste, and management strategies to reconcile circular economy and eco-sustainability)

**Article 2:** Public and Environmental Health Effects of Plastic Wastes Disposal: A Review

**Article 3:** Possibility Routes for Textile Recycling Technology

**Posting:**

Use this forum to discuss among your colleagues and share ideas to complete this activity.

The final illustration must be uploaded to the "**Final illustration**" Assignment in google classroom. Note: only one person from group will upload the final output to prevent duplication.

**Due date:**

Submit your final output, in the Assignment activity by at most 3<sup>rd</sup> week in November at 12:00 pm.

**Grading:**

This activity is worth 27 points. It will be graded based on this [rubric](#).

## APPENDIX III

### Didactic Teaching Approach

- The session contents should be related to the 3 concepts of waste management: 3 Rs.
- The session should be prepared using PowerPoint.
- The content and strategy in teaching the session is based on the level of students.
- The most attractive method in teaching should be used that affects student learning, attitudes, and behaviors, such as using photo voice, photos, videos, case discussion, group discussion, field visit, examples, and scenarios.
- The evaluation technique that will be used to check the effectiveness of session

## APPENDIX IV

### **Field Work Activities for Students Targeting 3Rs**

*The preparation is divided into three parts to encourage students reduce, reuse solid wastes and separate waste materials for recycling.*

For recycling, recycling company will be hired to pick up the recycled wastes from school every 2 or 3 weeks according to amount produced. Three stations will be constructed at different areas of the school and each station consist of four bins (food; plastic; metal; cardboard) marked with different colors (Rudiyanto et al., 2021). Teachers will select 10 students or more to be volunteers at stations at recess, to encourage students to use recycling bins correctly.

For reducing solid wastes, teachers will encourage students to avoid using non-reusable plastic bottles, or plastic bags in a session, instead they are encouraged to use drinking water fountain. Purchasing plastic bottles from the canteen at school will be compared before and after implementing the project.

For reusing material, donation day will be scheduled at the end of May to enhance students with the idea of reusing materials. The school spectator will document the names of students who will donate clothes, books, toys, stories, shoes. Allocate a studio to store the donated materials that will be shared, or reused (Manfredi et al., 2021). In addition, the art project is a good idea to reduce and ruse solid wastes.

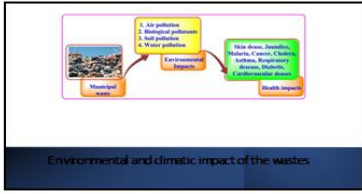
# APPENDIX V

## Presentation for Textile and Electronic Waste

<p>Solid waste and its impact on human health Textile and E-waste Done by aHarem Center</p>	<p>Learning outcome: Express the impact of SW on human health</p> <p>Objectives</p> <ul style="list-style-type: none"><li>1. To understand the impact of SW on human health</li><li>2. To identify the sources of SW</li><li>3. To understand the impact of SW on human health</li><li>4. To understand the impact of SW on human health</li><li>5. To understand the impact of SW on human health</li><li>6. To understand the impact of SW on human health</li><li>7. To understand the impact of SW on human health</li><li>8. To understand the impact of SW on human health</li><li>9. To understand the impact of SW on human health</li><li>10. To understand the impact of SW on human health</li></ul> 
<p>Solid waste and its impact on human health</p> <p><i>Mother earth is sick, mother earth is suffering let us help ourselves to survive</i></p> 	<p>Definition Of waste</p> <p>It is a product of substance it is a useless or unwanted material</p> <p>It is waste materials resulting from human activities</p>
<p>Source of waste:</p> 	<p>Solid waste</p>  <p>• Globally millions of solid waste generated every day</p>



Impact of waste  
 Impact of waste is a source depletion, pollution and climate change.



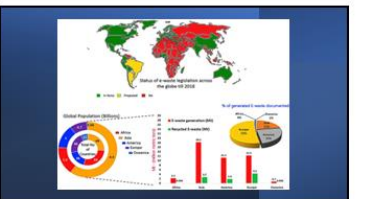
This is textile waste.

- What do you know about the source of waste?
- 2% of total waste (textile) (Gardner and Kuo 2007)
- One of most polluting due to the weight (100 kg) that was taken to the landfill
- Control of raw material (cotton and polyester)
- What (yarns, fabrics, etc.)



E-wastes

In 2019, 53.6 million electronic wastes were generated, a 21% of this result was increased in the last 5 year, less fifth percent of this result was recycled or disposed properly (WTO, 2021).





### E-waste

- The e-waste can be considered as a **homogenous mixture of plastics, glass, metals, and resins**.
- Contains toxic metal like The e-waste contains toxic metals like arsenic, copper, cobalt, lithium, chromium, cadmium, **zinc, lead, mercury**, etc.
- It also contains some **high-hazardous metals** like **lead and brom**, and some rare earth materials such as **gadolinium, europium, neodymium**, etc.
- It also contain some of **organic and non organic** materials
- In general, the e-waste consists of 30% ceramics, 30% organic matter (glass fiber, polymers, retardants), and 40% **inorganic matter** (metals).

### Potential health effect from e-waste

### Carbon foot print

### Carbon foot print

- It is an internationally recognized standard for demonstrating the carbon
- It is a calculator used to reduce CO2 production and energy

How we can use it?

### Solution

- The practices like **resource recovery, recycling, reuse of functional gadgets, and proper disposal** must be included in the system by the Governments. The policies like **advance recycling fee, extended consumer responsibility tax credit, etc.** should also be strengthened by the law and legislative authorities.
- The **transportation of e-waste** to developing countries for the sake of trade is also a major issue. There is a need to develop proper channels under the **supervision of experts** for safe transportation and disposal of e-waste.

### Assessment

### Assessment

Objective: By the end of this session, the learners will be able to identify the impact of SW on human health.

### Question 1:

- What happens to the chemicals used in clothes making when the clothes are thrown away?
  - They pollute the environment
  - They improve the environment
  - They have no impact on the environment

### Answer Question 1

- What happens to the chemicals used in clothes making when the clothes are thrown away?
  - They pollute the environment**
  - They improve the environment
  - They have no impact on the environment

### Question2

- What Happens To The E-waste If Not Recycled Through Proper Channels?

### Answer 2 :What Happens To The E-waste If Not Recycled Through Proper Channels?

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- <https://www.fiber2fashion.com/>

# APPENDIX VI

## Online Self-test Exercise

### I- Types of waste

Answer the questions by True or False.

1-The definition and classification of waste are important in order to provide appropriate waste management based on risks related to the environment and human health. \*

- A. True
- B. False

2-Defining waste cannot be a case-by-case decision – a universal approach needs to be applied. \*

- A. True
- B. False

3-Waste can be classified based on source, substance, hazardousness or management\*

- A. True
- B. False

4-Paper, plastics, glass, metal and organic waste are the most regular types of non-hazardous solid waste\*

- A. True
- B. False

5-Electronic waste is generally classified as hazardous because it contains toxic components\*

- A. True
- B. False

6-While non-hazardous waste is usually regulated at the national level, hazardous waste management is regulated at the regional or local level\*

- A. True
- B. False

7-By volume, plastic waste is the main type of waste produced in most regions of the world.

\*

- A. True
- B. False

8-By 2050, the total quantity of waste is expected to increase in most regions of the world. \*

- A. True
- B. False

### II- Solid waste management-related problems listed below.

These questions will help learners to identify the problems due to solid waste management.

9- Unpleasant odors and disease-spreading pests such as rodents and insects result from:

..... \*

- A. Landfill
- B. Waste incineration
- C. littering
- D. waste transfer station

10- Aesthetic problems in the living environment are due to ... \*

- A. landfill
- B. waste incineration
- C. waste transfer station
- D. littering

11- Changes in the status of groundwater\* result from:

- A. landfill
- B. waste incineration
- C. waste transfer station
- D. littering
- E. Other:

12- Islands of debris drifting in oceans cause problems within marine ecosystems\*

- A. landfill
- B. waste incineration
- C. waste transfer station
- D. littering
- E. Other:

13- Contaminated soil damages the food chain by ..... waste \*

- A. landfill
- B. waste incineration
- C. waste transfer station
- D. littering

14- Respiratory infections, changes in the nervous system, or cancer caused by dangerous substances from fumes\* due to:

- A. Landfill
- B. waste incineration
- C. waste transfer station
- D. littering

## APPENDIX VII

### Assignment Rubric

Learner name \_\_\_\_\_ date: \_\_\_\_\_

**2 = Meets standards for competence**

**1= Needs improvement**

**0 = Does not meet minimum standards**

\_\_\_\_\_/\_\_\_\_\_ The Main idea is clearly presented.

\_\_\_\_\_/\_\_\_\_\_ Supporting Details: Main idea is fully developed with appropriate support  
(Facts, examples, analysis, etc.).

\_\_\_\_\_/\_\_\_\_\_ Focus: Paper contains a single focus/major point of discussion and does not wander or give unnecessary or extraneous details.

\_\_\_\_\_/\_\_\_\_\_ Coherence: Logical progression of ideas using transitions and key words.

\_\_\_\_\_/\_\_\_\_\_ Mechanics: Correct use of spelling, grammar, punctuation, capitalization, word choice, and sentence structure.

\_\_\_\_\_/\_\_\_\_\_ Style: Awareness of audience, appropriate language, originality of ideas.

Comments:

Adopted from the College of Arts & Sciences (no date). University of North Carolina Wilmington. Available at: <https://uncw.edu/cas/programs/index.html>

## APPENDIX VIII

### Pretest

Answer the following questions in 8 minutes. (5 marks for each question)

1. Could you name 3 kinds of indoor and outdoor solid wastes and their effect on humans and the environment?
2. Do you know if there is any policy or legislation about proper solid wastes disposal in your country? If yes, could you elaborate on what you know briefly in 3 sentences?
3. What is the suitable management of domestic solid waste? Summarize your answer in four sentences.
4. How could we cultivate the concept of solid waste among students? Write maximum 5 sentences.

## APPENDIX IX

### POST-TEST EXAM

#### A- Matching

1. Match the description on the left with the correct term on the right (2.5 marks)

<p>1. Includes scrap metal, plastics, paper, sludge, and ash - Manufacturing waste</p> <p>2. May be harmful even though it is biodegradable _ Agriculture waste</p> <p>3. Paper, wood, or fibers - Biodegradable</p> <p>4. Involves settling of wastes while surface water evaporates - Surface impoundment</p> <p>5. Must be lined and must have a way to collect leachate - Landfill</p>	<p>A. biodegradable</p> <p>B. landfill</p> <p>C. surface impoundment</p> <p>D. agricultural waste</p> <p>E. bacteria</p> <p>F. manufacturing waste</p>
--	--

3. Match each item in column II with suitable classification as hazardous and non-hazardous waste (2 marks).

a- Hazardous waste	1. Food
	2. Batteries
	3. Glass Thermometer

b- non-hazardous waste	4. Corrosive material
	5. Recycling E-waste
	6. Incineration residue
	7. Cardboard
	8. Plastic
	9. Textile waste

Answers:

Hazardous waste: 2-3-4-5-6-8

Non-hazardous waste: 1-7-9

**B- Multiple choice (1/2mark for each answer)**

**Choose all that apply to answer each item.**

1. Which products are not considered textile?

- a. Oil filter
- b. Diaper
- c. Clothing
- d. Wood chair

**Answer: A & D**

2. Unpleasant odors and disease-spreading pests such as rodents and insects occur due to:

- a. Landfill
- b. Waste incineration
- c. Littering
- d. Waste transfer station

**Answer: waste transfer station & Landfill**

3. Respiratory infections, changes in the nervous system, or cancer caused by dangerous substances from fumes resulting from:

- a. Landfill
- b. waste incineration
- c. waste transfer station
- d. littering

**Answer: waste incineration**

4. Which of the following is done on an individual level?

- a. Burning
- b. Disposal
- c. Recycling
- d. Source reduction

**Answer: (d) Source reduction**

5. Which of the following wastes is called the Municipal Solid Waste (MSW)?

- a. Food wastes
- b. Wood pieces
- c. Plastic cans
- d. All of the above

**Answer: d**

6. An example of something that is biodegradable is

- a. plastic milk jug in a landfill.
- b. a leaf in a compost pile.
- c. a polystyrene burger container in a trash can.
- d. All of the above

**Answer: a**

7. Which of the following are not types of solid waste?

- a. coffee grounds, computers, and cars
- b. scrap metal, sludge, and ash
- c. packaging materials, batteries, and grocery bags
- d. methane and water

**Answer: d**

8. Which of the following are problems associated with landfills?

- a. source reduction and composting
- b. leachate
- c. methane production



- d. surface impoundment and leachate
- e. all of the above

**Answer: e**

9. Examples of ways that you can produce less waste include

- a. using canvas shopping bags.
- b. composting.
- c. using rechargeable batteries.
- d. All of the above

**Answer: d**

10. You can use your consumer buying power to reduce solid waste by

- a. shopping at discount stores.
- b. buying something only when it is on sale.
- c. using rechargeable batteries.
- d. asking for paper bags instead of plastic bags

**Answer: c**

11. What steps are involved in the recycling of materials?

- a. composting, decomposing, and burning
- b. burning, aging, and putting the material into deep wells
- c. sorting, aging, and crushing
- d. sorting, cleaning, and crushing

**Answer: d**

12. All of the following describe hazardous wastes except

- a. they may be solid or liquid but not gas.
- b. they may contain toxic, corrosive, or explosive materials.
- c. they may be cleaners, lubricants, or heavy metals.
- d. Both (a) and (b)

**Answer a**

**C- Read each of the below statements and answer by either True or false. (1/2 mark for each answer)**

13. Waste can be classified based on source, substance, hazardousness, or management

a. True

b. False

**Answer: true**

14. Electronic waste is generally classified as hazardous because it contains toxic components.

a. True

b. False

**Answer: true**

**D- Answer the following questions**

15. Batteries contains toxic material. Do you know how could we eliminate batteries in a safest way? (2 marks)

16. International solid waste management policy aims to establish a solid waste management, which is holistic, integrated, cost effective, sustainable and acceptable due to the community. Besides that, it emphasizes waste minimization through 3 Rs, intermediate treatment and final disposal. Discuss your opinion on the outcome of international policies and legislation in reducing, reusing, recycling solid waste. (Do not exceed 100 words) (2 marks)

**18. Answer the following question after reading the scenario below.**

**Scenario**

Sykline is a company that collects wastes and dumps it on Costa land. Open dumping is most common method in waste disposal in developing countries. "Open dumping method creates environmental damage. It takes up not only more and more valuable land space, but also causes air, water and soil pollution by discharging greenhouse gas i.e. methane (CH<sub>4</sub>), carbon dioxide (CO<sub>2</sub>), nitrous oxide (N<sub>2</sub>O), and nitrogen oxide (NO<sub>x</sub>) into atmosphere and chemicals into the earth and groundwater which can threaten human health, plants and animals" (Meidiana, 2012).

Provide a short-written explanation for the questions below. Do not exceed 100 words.

A. What are the indoor materials dumped in open land could have effect on environment and human? (2.5 marks)

B. How can humans reduce the number of landfills waste? Explain (2.5 marks).

Answer: Correction of the last 2 Questions based on the (Rubric Appendix VII)

## APPENDIX X

### TEACHING SESSION EVALUATION

Participant Name.....

Lecture content including a topic about Solid waste.....1 pt

Objective clearly identified and target population well defined (Grade)... 2 pts

Well-developed ideas..... 1pt

Clear idea..... 1pt

Information related to the topic..... 1 pt

Using creative ideas on how students reduce solid waste ..... 1 pt

Appropriate to use media..... 1pt

Ability to engage participants..... 1 pt

Finished on time..... 1 pt

**Comments**

# APPENDIX XI

## INSTRUCTOR COURSE EVALUATION

**1. The instructor was well prepared for the class**

- Almost always
- Frequently
- Sometimes
- Rarely
- Almost never

**2. The instructor showed an interest in helping learners to learn**

- Almost always
- Frequently
- Sometimes
- Rarely
- Almost never

**3. I received useful feedback on my performance on tests, papers, etc.**

- Almost always
- Frequently
- Sometimes
- Rarely
- Almost never

**4. The lectures, tests, and assignments complemented each other**

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

**5. The instructional materials (i.e., books, readings, handouts, study guides, , multimedia, software) increased my knowledge and skills in the subject matter**

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

**6. The course was organized in a manner to understand the underlying concepts**

- Strongly agree

- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

**7. The course gave me the confidence to do more advanced work in the subject**

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

**8. The examinations, assignment measured my knowledge of the course material**

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

**9. I believe that what I'm being asked to learn in this course is important**

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

**10. I would highly recommend this course to other learners**

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

**11. Overall, this course met my expectations for the quality of the course**

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

<http://www.questionpro.com/survey-templates/>

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