



Evaluation from an educational perspective of the effects of waste batteries on the environment

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Abstract: The aim of study was to determine the locations where students studying Science Education (i.e. science teacher candidates) in Turkey dispose of waste batteries, and to identify their views regarding the effects of waste batteries on the environment. A total of 80 volunteer, third-year students from the department of science education participated in the study. Based on the study results, it was determined that the large majority of the students disposed of waste batteries in ordinary trash cans. It was also determined that the students lacked sufficient knowledge regarding the recycling of waste batteries and their effects on the environment. After waste batteries are disposed in ordinary trash cans, the chemicals they contain can mix with the soil and underground water in land fill areas, and cause pollution. To prevent waste batteries from having detrimental effects on the environment, they should be collected in containers specifically designed for waste batteries. In addition, students should be informed about practices relating to the proper disposal of waste batteries, and actively participate in them.

Keywords: Waste Batteries, Environment, Science Teaching Student

1. Introduction

Batteries represent one of the different types of solid wastes. Once they become solid wastes after being used, batteries are considered and classified as “hazardous wastes”, since they can lead to significant problems if disposed improperly. By definition, hazardous wastes include all types and forms of wastes (solid, liquid, gas, sludge, etc.) which pose a hazard for human health and the environment. Hazardous wastes can be either of domestic or industrial origin, and display a wide range of different properties. Thus, hazardous wastes are solid wastes which represent a potential threat for public health and the environment (1).

Due to their toxicity, their prevalence, and their physical resistance to deterioration, waste batteries represent a significant threat for the environment and human health (2, 3). The toxicity of batteries is mainly due to their lead, mercury, and cadmium content. In addition to this, the other metals in batteries such as zinc, copper, manganese, lithium, and nickel can also pose a threat to the environment. Alkali and zinc-carbon batteries contain heavy metals such as mercury, zinc, and manganese; for this reason, it is necessary to recycle these types of batteries (4).

Considering that batteries, which are widely used in daily

life, represent a form of hazardous waste, it is both necessary and important for batteries not to be disposed together with other types of waste. In this context, the Portable Battery Producers and Importers Association (*Taşınabilir Pil Üreticileri ve İthalatçıları Derneği*, TAP) in Turkey distributes materials, free of charge, to form battery collection points across the country, and also conducts efforts to ensure the widespread collection of waste batteries by using various types of containers. The association also ensures the participation and contribution of consumers to these efforts by informing them about the detrimental effects of waste batteries and their recycling. As science education students will become science teachers in the future, it is very important for a sustainable future that these teachers are both aware and have knowledge regarding the collection of waste batteries and their effects on the environment. In this context, this study evaluated and reflected in detail the views of science education students regarding the collection of waste batteries and their effect on the environment. We believe that the findings of this study will contribute to and provide further depth to the literature on this subject.

2. Methodology

The study was conducted using the general screening model. The general screening model is a screening approach conducted on populations consisting of a large number of individuals in order to reach a general conclusion regarding the population. It is performed by screening the population as a whole, or a certain group or sample within the population (5).

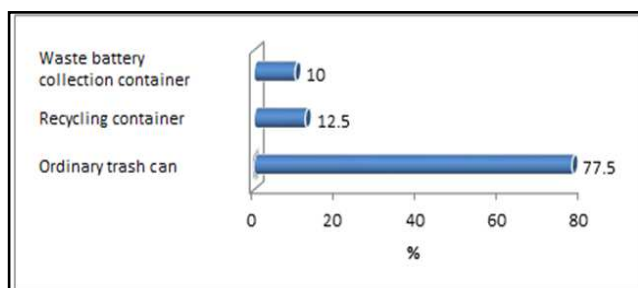
The study was performed with the participation of 80 volunteer, third-year students receiving education at the Science Education Department of an Education Faculty in Turkish public university. To determine the students' views regarding the collection of waste batteries and their effects on the environment, the students were asked to answer two open-ended questions in writing. Examples of the answers provided by the students are shown below by keeping the students' name confidential and coding them as "F₁, F₂...F_n".

3. Results

The study results concerning the answers provided by the students to the questions on the collection and the environmental effects of waste batteries are provided in two sections.

Section 1: Collection of Waste Batteries

The percentage distribution of the answers given by science teaching students to the question, "Where do you dispose waste batteries?" is provided in Graph 1.



Graph 1. Percentage distribution of the locations where students disposed of waste batteries

Table 1. The frequency distribution of the underlying reasons provided by the students concerning the locations where they disposed of waste batteries

Student's answers	Answer Frequency
	f
I throw waste batteries into ordinary trash cans, because I am not knowledgeable about their proper disposal.	29
I throw waste batteries into ordinary trash cans, because I think they are non-recyclable.	18
I throw waste batteries into ordinary trash cans, because I consider them as ordinary waste.	16
I throw waste batteries into ordinary trash cans, because I am not knowledgeable about recycling.	11
I throw waste batteries into ordinary trash cans, because there are no waste battery collection points near where I live.	7
I throw waste batteries into recycling containers, but have no knowledge about how they are recycled.	10
I throw waste batteries into was battery collection containers, but have no knowledge about what happens next.	8

An evaluation of Table 1 indicates that the science education students threw waste batteries into trash cans mainly because they lacked knowledge regarding waste batteries and the disposal and recycling of waste batteries. In addition, it was noted that some of the students threw waste

As shown in Graph 1, most students explained that they disposed of waste batteries in ordinary trash cans. Some of the students expressed that they disposed of waste batteries in waste battery containers. Direct citations of the answers given by the students to this question are provided below:

"I dispose of the batteries I use into the trash." (F₁₀)

"I don't know much about recycling, so I throw waste batteries into trash cans." (F₄₃)

"I don't think that I know enough about the collection of used batteries and the processes they have to go through. That's why I just throw the batteries I use into the trash." (F₂₃)

"I just throw batteries into the trash; because it is more difficult to find waste battery collection containers and to throw used batteries in them." (F₇₄)

"The only thing I pay attention to when it comes to recycling is the proper disposal of waste batteries." (F₅₆)

"I throw used batteries into waste battery containers." (F₁₇)

"I dispose of used batteries into a battery collection container at the grocery store. These containers should be more common." (F₂₇)

Table 1 provides the frequency distribution of the underlying reasons provided by the students concerning the locations where they disposed waste batteries.

batteries into trash cans because of the lack of waste battery collection containers near the places they lived. Furthermore, it was observed that students who threw waste batteries into recycling and waste battery containers lacked any knowledge regarding the processes which the collected waste batteries

underwent. These results demonstrated that the students lacked adequate knowledge regarding waste batteries. Direct citations of the answers given by the students to this question are provided below:

“I don’t know much about waste batteries, and I don’t know what else can be done with them other than throwing them into the trash.” (F₆₃)

“I throw them into trash cans, because I think that they would then be taken for recycling.” (F₇₁)

“I dispose of waste batteries in battery collection containers. I have no idea about what the processes that are performed afterward.” (F₃₇)

“They are generally thrown into the trash along with other domestic waste. However, owing to a project initiated by some schools, waste battery collection containers are now being placed within the school premises, and teachers are informing students that they should dispose any waste batteries at home into these containers.” (F₁₂)

Section 2: The Effects of Waste Batteries on the Environment

The frequency distribution of the answers given by the science teaching students to the question, *“What effect do waste batteries thrown into the trash have on the environment?”* is provided in Table 2.

Table 2. The views of students regarding the effects of waste batteries on the environment

Student’s answers	Answer Frequency
	f
Lack sufficient knowledge regarding the detrimental effects of waste batteries on the environment.	51
Throwing waste batteries into trash cans will lead to ground pollution.	8
The heavy metals in batteries pose a threat for the environment.	6
Throwing waste batteries into trash cans will lead to water pollution.	5
Waste batteries are harmful for aquatic creatures.	5
The heavy metals in batteries are harmful for the environment and human health.	5
Throwing waste batteries into trash cans will lead to environmental pollution.	4
Throwing waste batteries into the ground/soil will reduce its fertility.	2
In nature, the elimination of batteries takes many years.	2
Throwing waste batteries into trash cans will lead to air pollution.	1

An evaluation of Table 2 indicates that most of the science education students were not sufficiently knowledgeable about the effects that waste batteries have on the environment when thrown into trash cans. On the other hand, some of the students were aware of the hazards associated with waste batteries, stating that throwing waste batteries into trash cans would lead to ground and water pollution due to the heavy metals they contain; that waste batteries represent a threat for the environment; that waste batteries are harmful for the environment and human health; and that waste batteries would reduce the fertility of soils/grounds. Direct citations of the answers given by the students to this question are provided below:

“If they are not recycled, batteries will lead to environmental pollution. They will especially cause ground pollution.” (F₈)

“When batteries are thrown into the trash, their chemicals will mix with the soil and waters. The heavy metals in batteries will thus pass into the food chain.” (F₈₀)

“If waste batteries find their way into the ground, the metals they contain may pass into the soil and reduce its fertility.” (F₆₇)

“Throwing waste batteries into the trash causes air, water, and ground pollution. It reduces the fertility of the soil, and harms plant life.” (F₄₃)

“Because they contain elements such as mercury and lead, waste batteries will harm the environment; the metals they

contain will cause ground pollution.” (F₃₉)

“Because they contain metals, batteries have detrimental effects on the ground, water, plants, animals, and humans.” (F₇₁)

“When they are thrown into the environment, waste batteries take many years to be eliminated, significantly harming the environment in the process.” (F₂₄)

4. Discussion and Conclusions

It was determined that the large majority of the students participating in the study disposed waste batteries by throwing them into ordinary trash cans. However, as waste batteries represent hazardous wastes, they should not normally be thrown into trash cans along with domestic waste. The students threw waste batteries into trash cans mainly due to their lack of knowledge regarding the recycling and disposal of waste batteries. In addition, students who disposed of waste batteries into recycling containers erroneously assumed that waste batteries are collected together with solid wastes. This situation illustrated that the students were generally unaware that waste batteries are collected using separate waste battery collection containers.

This study demonstrated that most of the students were not knowledgeable about the detrimental effects of waste batteries on the environment. On the other hand, students who were able to describe the detrimental effects of waste batteries especially mentioned that they can cause air, water and ground pollution; reduce soil fertility; lead to pollution and

environmental hazards; and endanger the health and life of living creatures. However, only a few of the students were able to provide explanations concerning how waste batteries led to such detrimental effects. When batteries are disposed into the environment in an uncontrolled manner, the heavy metals they contain present the risk of causing ground and water pollution. In addition, these chemicals are toxic substances for both the environment and human health. Throwing waste batteries into trash cans thus leads to environmental pollution as well as detrimental effects for human health. For this reason, it is essential for used/flat batteries to be disposed into battery collection containers and to be processed in recycling facilities.

When waste batteries are thrown into bodies of water or buried into the ground, the external casing of the battery will eventually erode or become pierced, causing the heavy metals and chemicals the battery contains to mix with the surrounding water or ground. For this reason, it is necessary to collect waste batteries separately and to dispose of them in waste battery collection containers. Disposing of waste batteries in such a way, and then recycling them as necessary, not only reduces the risk of having the various chemicals inside batteries mix with the underground waters and ground in landfill areas, but also allows the efficient use of natural resources through the recycling of reusable materials within batteries (6, 7).

The first step for ensuring a sustainable environment is raising individuals who are conscious, sensitive, and aware of environmental issues. Raising such individuals can only be achieved through the efforts of our teachers, to whom we entrust the education of future generations. Considering that a sustainable future will be made possible by the activities of our teachers, it is necessary for science education students – who will become the teachers of the future – to be knowledgeable regarding the collection of waste batteries and their effects on the environment. For this reason, student-centered methods and techniques, as well as effective

teaching materials, should be used in the environment-related classes which science teaching students attend during their education. In addition, these students (as well as the general public) should be informed about waste batteries through the visual and written media, and measures should be taken to ensure the active participation of students into the collection of waste batteries into waste battery collection containers to prevent them from having detrimental effects on the environment.

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