

Efficacy of Animated Audio-Visuals in Raising Awareness Levels: A Case Study of Solid Waste Management in Dharmapuri, Tamil Nadu

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masscomhod@uoc.ac.in

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Pranavakumar R *

Assistant Professor, Department of Visual Communication, Kumaraguru College of Liberal Arts & Science, KCLAS, Coimbatore

Abstract

Social awareness creation through mass communication employs myriad tools like posters, banners, radio, television, animated cartoons, advertisements, social media. Animation has pitched in for propagation of messages in recent times and its effectiveness needs to be researched. Population explosion and current living standards has led to over production of solid waste all over the World. Improper disposal of solid waste, particularly domestic waste has been instrumental in polluting the environment and health hazards. Among many modalities of solving the problem, creation of awareness about segregation at source and disposing it separately in designated colored bins gain importance. This paper was a part of the outcome of the research work carried out by the author at the doctoral level. One of the objectives included, issues pertaining to solid waste management explained through animated audio visuals and to understand the efficacy of audio versus animated video as the tool of multimedia among school students. Inferences confirmed that visuals tools like the animated videos had a better impact in creation of awareness among the students asserting the fact the selection of tools played a major role in the success of any program and visuals are better performing than audios.

Keywords

Solid waste, Color bins, animated video, multimedia tool

Introduction

Solid waste generation and safe disposal forms a major issue in environment and health sector of any country or area. Solid waste produced in a given area arises from industry, commercial, agricultural and residential sectors. Globally USA stands first in per capita solid waste production, though developing countries have a major share in total solid waste generation. Improper disposal of solid waste has led to severe damage to the environment like pollution of water bodies, fallow land and air pollution. Toxic solid waste forms a major concern as it leads to poisonous water and food and in turn multiple diseases in human and animals. As population increases and life style modification ensues, abundant waste is bound to be generated and only a concerted effort

* Correspondence: Email: pranavmail1988@gmail.com

to create awareness among the stakeholders regarding segregation at source and proper scientific disposal would help in saving the environment and health of the people.

The World Bank (Figure 1) report reiterates the fact that 2.01 billion tonnes of solid waste is generated globally as on 2016 and the maximum from East Asia and Pacific region, 468 million tonnes per year. Waste generated per person stood at 0.74 kg per day, ranging from 0.11 to 4.54 kg in the year 2016. Looking into the future, by 2030 the same region is predicted to generate more waste than others- 602 million tonnes. In 2050 also it stands first as the highest generator of waste, 714 million tonnes with South Asia coming next- 661 million tonnes. Notwithstanding, the current scenario which is dismal due to dumping waste and its ill effects on nature and human health, the future prediction looks more threatening. People understanding the negative fallout of solid waste should take up the matter in perspective and control the generation of waste. There are several modalities to control like reduce, reuse and recycle waste, segregate waste as source, dispose waste separately and treat waste scientifically to prevent any hazardous effects. Proper awareness creation among the population is necessary to implement such measures. In such a scenario, mass communication with its plethora of media tools come into play in spreading the message. Only when the stakeholders, the people of the area participate there can be a change and for such attitude change they need to understand the problem in its entirety.

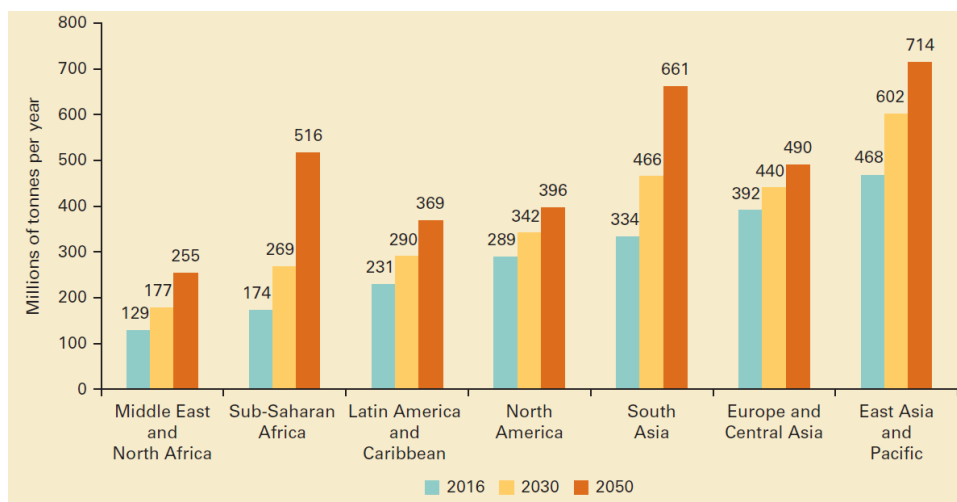
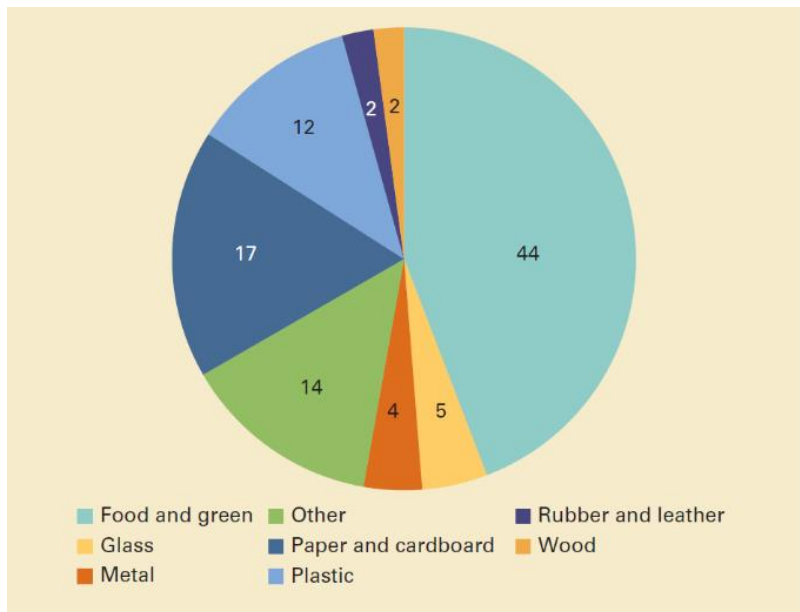


Figure 1: Solid waste generation – a projected view- World Bank 2016

Categories of Domestic solid waste

Biodegradable waste such as food and green form 44 percent of the total waste produced and this could be totally treated without any negative impact on environment. People should be able to identify such biodegradable waste, collect it separately in a bin (green color) and dispose it. This would enable waste collectors of the Government or NGOs to compost easily and produce manure. Knowledge about the list of biodegradable wastes, how it can be managed through local or home composting or if disposed to be collected separately and placed for the waste collectors to collect. The color code of bins could help both the stakeholders and facilitators to proceed with their work easily. If all are mixed and dumped then there is a need for human intervention to separate it manually and dispose. This would lead to health hazards in workers and need more time and man power for such activities, while disposal



with segregation at generation point would negate such difficulties.

Figure 2: Categories of solid waste- World Bank 2016

Non-biodegradable waste comprises all other than green waste like paper, cardboard, cloth, metal, glass, rubber, leather, wood, plastic and toxics. Most developed countries follow 5 bins to separate the above categories so that management becomes easy. Paper and cardboard 17 percent, plastic 12, glass 5, metal 5, rubber and leather 2 and wood 2 are the categories of non-biodegradable waste in the global level according to the World Bank report (Figure 2). All countries aim at reduction of waste production with proper

disposal without creating any health hazards and damage to environment. To achieve this there need to be a concerted effort by the citizens and Government in managing solid waste in a proper manner.

Track of past studies on this issue at the global level

Solid waste management strategies and taking the message to people, vary from place to place leading to diversity in the methods adopted by different countries. Studying the research papers of previous studies that analyzed the efficacy of different methods of solid waste management would help develop scientific perspective. Besides, each country follows a method and the past studies threw insights of engaging multimedia tools for creation of awareness. In addition, the color bins used to dispose waste, its efficacy and preference to color were also studied by various researchers. Reviewing these research papers pertaining to solid waste management has provided inputs regarding the successful and unsuccessful methods, effectiveness of a program, lacunae in solid waste management and further scope of approach. Studies pertaining to analyzing the effectiveness of each mass communication tool to create awareness among households regarding waste disposal are many. A brief review presented as under may be a pointer for solid waste management practitioners to learn the dos and don'ts. A few studies reviewed are listed below.

Justice Kofi Debrah et.al. (2021) studied the awareness level among students in many developing countries pertaining to waste disposal and concluded that environmental education at the level of school teaching created more awareness. This depended on the level of awareness among the teachers, their method of passing the message to the student and their effort to nurture the students to follow the practices through awards and accolades. Practical experiments, activity-based classes, regular inputs about the healthy habits, along with proper inputs to teachers through workshops and conferences are mandatory to create awareness among young students and sustainable waste management practices.

Rugamba Amani et.al. (2018) studied the impact of broadcast media (TV & Radio) in creating awareness on solid waste management among the residents of the city Kigali Rwanda. A sample of 385 people was taken and 51.7 percent accepted the role of media to make them understand waste segregation. Colored bins were provided to dump waste according to its category but were seldom followed due to lack of awareness among the people in that city. More than half of the respondents in the study found the broadcast medias effective

in making them understand the importance of waste segregation and proper disposal.

The study conducted in Malaysia by Shay Wei Choon et.al. (2017) with about 400 respondents showed that half of them lacked knowledge about solid waste management, age and education influenced the recycling and reuse methods followed, lifestyle had an impact on waste generation and minimization. In short, an effective education on waste management was found to be the need in creating a clean environment through scientific waste disposal.

Hwongwen Ma et.al. (2011) highlighted an integrated multimedia analysis to manage solid waste as against the traditional methods. The framework to be set for waste management would be more effective if all parameters are integrated in the model and the decision making as to concentrate on which sector to be finalized. The regulatory methods arrived upon through traditional methods of single medium (air, water and land) approach may leave some lacunae while multimedia approach with all sectors incorporated might be more efficient in identifying the lags and leading to better solutions

The paper written by Kellow Pardini et.al. (2018) analysed the automation process of waste management in cities and towns. Development of proper IoT (Internet of Things) infrastructure would in the long run help to manage waste efficiently. With IoT tracking of waste, collection and proper disposal becomes possible and thereby sustainable and efficient waste management made possible.

Rajkumar Joshi et.al. (2016), Authors of the paper reiterate the fact there is poor quality of waste management in India due to low awareness among people of a developing countries like India. People also think 'not in my backyard', and lack the intent to participate in the management program. Most places waste management falls in the hand of unorganized sector and thereby improper disposal and subsequent health hazards. Active participation of the stakeholders, public private partnership and use of appropriate technology need to be incorporated for a holistic waste disposal. Awareness creation among the people regarding segregation and proper disposal would be the first step in this direction.

Abishek Law et.al. (2020). The need for a fourth bin to dispose medical waste from house during the pandemic situation has been emphasized in this article. Disposal of gloves, masks, syringes, PPE kits and like items are currently generated in houses due to home quarantine in COVID situation. A separate bin, a fourth one to throw the used medical waste would help the sanitary

workers immensely as they need not get exposed to the disease through waste if disposed separately.

The author, Jessica McAllister (2015), discussed the constraints in municipal solid waste disposal in developing countries. Lack of education and awareness was found to be one of the major factors that influenced improper waste disposal in developing countries. Environmental degradation due to dumping waste, segregation at source, recycling, disposal in colored bins to facilitate collectors of waste need to be informed to the people and make them understand its importance. Only through community participation the problem of solid waste management could be managed.

Authors, Nattapon Leebai et.al. (2021), studied the improvement in waste collection in Thailand through trash bin design, color and setting location. 889 respondents were taken as sample and data collected from them analyzed and found location, unit color and noticeability of trash bins affect the waste collection strategies. Color preference, least preferred colors, noticeable location had an impact on waste disposal leading to a conclusion that proper awareness could be created through appropriate design and setting location of trash bins.

Karen B Schloss et.al. (2018) analyzed how color was interpreted by people as ‘one color associated with multiple concepts and multiple colors associated with one’ concept are possible. ‘People simply match objects with their most strongly associated color’. The study suggested using colors intuitively appropriate to the audience to facilitate communication through visual medium.

The researchers, Ashley Andrews et.al. (2012), studied recycling program through three types of recycling collection units. Location, change in signage or type of bin used were the three variables tested and the results showed change in signage alone had no significant effect in correct trash dumping but a combined strategy of three color bins with signage and accessible location led to more accuracy in dumping waste properly.

Julie A Bzostek et.al. (1999), conducted research to find the response time to a warning label showed Icon and color produced a faster response and people preferred red icon as it signified danger in cases of warning labels. Though this experiment was not done in solid waste disposal-colored bins, it reiterates the fact that color codes if appropriate would attract the users and help in the long run to match a color to a product.

A web survey by Ioanna K Kalatzi et.al. (2015), on the color preference of the recycling bin to dispose plastic water bottles among students of Democritus University of Thrace , Greece was conducted and the results showed yellow as the most preferred color for recycling plastic water bottles. Some preferred closest available bins rather than color. Conclusion is that both color and positioning of the bins would motivate proper disposal of used water bottles among students.

The above studies, though not exhaustive, gave a vivid picture about the difficulties in solid waste management, the efficacy of different methods used in various countries, appropriate color bins to use, level of education influencing the practice, multi-media tools to create awareness, recent advances in solid waste management like IoT and color preference of people to certain objects. However, there were a few studies to show the appropriate multi-media tool for the selected project, which tool suits which group, what is the degree of efficacy. In this backdrop, the author's doctoral research work addressed these issues and the results obtained were included in this paper.

Domestic Solid waste disposal

The process of waste management falls under six categories. 1) Generation of waste, 2) segregation of waste, 3) disposal in separate-colored bins, 4) collection of waste, 5) scientific recycling and recovery, 6) landfilling. Awareness creation pertaining to waste disposal among the people need to address the first three categories and the last three would be carried out by the Government or other service providers. People should be made to realize the hazards of dumping waste without proper segregation that it would lead to pollution of their water, food and soil and finally diseases and death. Next is to impinge on reducing and recycling the waste so as to minimize their waste generation. Above all they need to be educated in segregation and proper disposal according to the type of waste.

Developing country like India still practices two bins, in most of its States. An extra third bin to dispose hazardous waste like sanitary napkins, medical waste, diapers, toxic chemicals, batteries and so on is the next step and some States like Karnataka follow this procedure. Segregation and separate disposal of appropriate waste in correct bins need the understanding and participation of the people. They should gain knowledge about its importance and the benefits that would ensue due to such practices, consequently environment would be protected. Creation of awareness among the people could be done through various methods suitable to the stakeholders' age, education and socioeconomic status.

Awareness creation among the people – household, commercial complexes, industrialists and agriculturists- could be done only with the mass communication program. Such mass communication methods to create a desired effect could be multi various pertaining to the target to be reached. Focusing on domestic waste or household waste disposal, inputs given to the people through various tools of mass communication need to be studied to find an effective one. There is always diversity in the target people owing to age, education, gender, socio-economic status, religious and cultural differences. Owing to this the question arises about the tool for awareness creation- as to which tool being suitable for which group of households.

Color code bins for waste disposal

One among the various methods to follow proper waste disposal is to provide color to the bins in which segregated waste is disposed. Each country follows different color code for waste disposal. In European Union 5 (Figure 3) bins are used for waste disposal, green for kitchen waste, yellow for metal, red for plastics, blue for paper and white for non-recyclable. The color may vary from country to country but such segregation has been in practice to facilitate waste management. The chart (Figure 4) shows the color codes used in different regions of the world to dispose waste separately after segregation. It reiterates the fact that color code differs according to the service providers in each country or locality.

In the context of a developing country like India, (Figure 5), usage of color bins for waste disposal has not gained practice barring certain areas of the country. In Tamil Nadu such practice exists in most urban areas but rural areas lack knowledge and therefore the practice not in vogue. Conventionally green color is allotted to organic waste (biodegradable), kitchen waste and other wet waste that could be made into manure through composting. The recyclable nontoxic (non-biodegradable) waste like paper, cardboards, cloth ,thicker plastics should be put in blue bins. Hazardous waste like thin plastic papers, napkins, diapers, batteries, glass toxic chemicals should be dumped in red bins/ black bins.



Figure 3: Color coded bins in European Union



Figure 4: Color code for Recycle bins in developed countries.

	Australia (Standards)	New Zealand (Standards)	United Kingdom (No formal standards but common colours below)	United States (No formal standards but common colours below)
General Waste	Red	Red	Black or Grey	Black
Mixed Recycling (Commingled)	Yellow	Yellow	Blue	Blue
Food Waste	Burgundy	Lime Green (Food Waste & Combined Food/Garden)	Brown	Green
Garden Waste/ Organics	Lime Green	Dark Green (Garden Waste only)	Brown	Green
Paper/Card	Blue	Grey	N/A or not known (Would probably go into Mixed Recycling)	N/A or not known (Would probably go into Mixed Recycling)
Glass	N/A (Would go into Mixed Recycling)	Blue	N/A or not known (Would probably go into Mixed Recycling)	N/A or not known (Would probably go into Mixed Recycling)

Figure 5: Three color bins in Tamil Nadu



Material and methods

As part of the research work done by the author, awareness among children regarding solid waste management by segregation of waste at source and disposal through colored bins was studied. School children in the district of Dharmapuri, Tamil Nadu were the respondents and their understanding about the scientific disposal of waste was analyzed by testing their knowledge through interview schedule. Here animated videos regarding ill effects of dumping waste and methods to segregate and dispose in proper colored bins were presented. The knowledge about the color code for disposing biodegradable (green color bin), non-biodegradable (blue color bin) and hazardous waste (red color bin) was imparted through audio recording and the questionnaire was filled. Later the same message was shown through animated videos and similar questions asked. Marks were entered in SPSS data analysis software and analyzed to find out the impact caused by animated videos regarding the awareness about the color codes for different bins for disposing waste.

Creation of awareness regarding solid waste disposal among rural students of age 11 to 14, in Tamil Nadu through audio and animated video was compared as part of the research work and the results analyzed. School students of Panchayat union middle schools of classes 6,7 and 8 were selected as respondents and about 528 sample collected. They were made to listen to audio regarding segregation of solid waste and disposal into specific-colored bins and its health benefits. The first half of the questions pertaining to this was filled up and later animated videos pertaining to scientific solid waste disposal were played and the same questions were repeated and filled up. The scores of the students were analyzed through SPSS statistical tool and a positive enhancement in the knowledge regarding color code of bins used for solid waste disposal was evinced. Information about what goes into each bin and health and environmental benefits of such practice was also given through audio and animated videos to the students in an attempt to broaden their awareness. Respondents answer to each color code showed there was an increase in percentage of correct color choice after watching the animated videos than before. Subsequently Paired sample T test to compare the scores obtained by the respondents before and after watching the videos was carried out and showed a statistically significant enhancement in their knowledge about the appropriate color codes for each type of waste.

Animated model engaged

Animated audio visuals pertaining to solid waste disposal in color designated bins was used to spread the message to the school children.

1. Recycle right-solid waste management YouTube. theIMGstudio
2. Solid waste management- YouTube Denisse Kate Almanon

Though many routine and ordinary videos of solid waste management were available, only children friendly animated videos with Tamil translation, were engaged for the study as the respondents were school children. Among the animated videos, the above two were found to be more suitable to send the intended message – using three color bins to segregate waste and dispose separately. An audio message was played first to introduce the idea and further how to segregate and dispose waste, as a next step, these videos were played to the student respondents and data was collected through scoring.

Results and discussion

Biodegradable waste in green bins

There is no universal color code for trash bins pertaining to the segregated waste but green has been in use in most countries for disposing green waste or biodegradable waste. “Green colored bin can be used to dump biodegradable waste like wet/organic material including cooked food/leftover food, vegetable/fruit peels, egg shell, rotten eggs, chicken/fish bones, tea bags/coffee grinds, coconut shells and garden waste including fallen leaves/twigs or the puja flowers/garlands.” The sample respondents being school students in rural Tamilnadu were seldom exposed to such color code and disposal strategies. They were introduced to this concept through audio and animated videos and their level of understanding measured through scoring.

From Figure 6 and Figure 7, it can be construed that there was a positive improvement in the respondents score regarding using green color bins to dispose biodegradable waste. Nearly 100 percent answered ‘yes’ to the green color bin to dispose green waste after viewing the animated visuals. The number responding with “no” as answer after hearing the audio has considerably decreased after watching the videos.

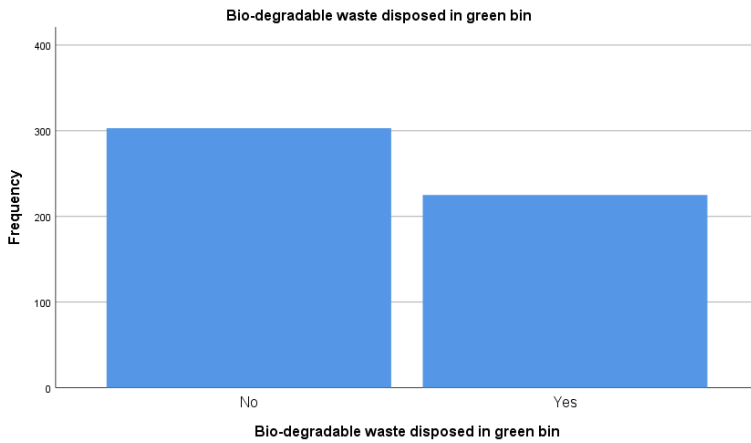


Figure 6: Awareness of using green bin to dispose biodegradable waste after hearing audio.

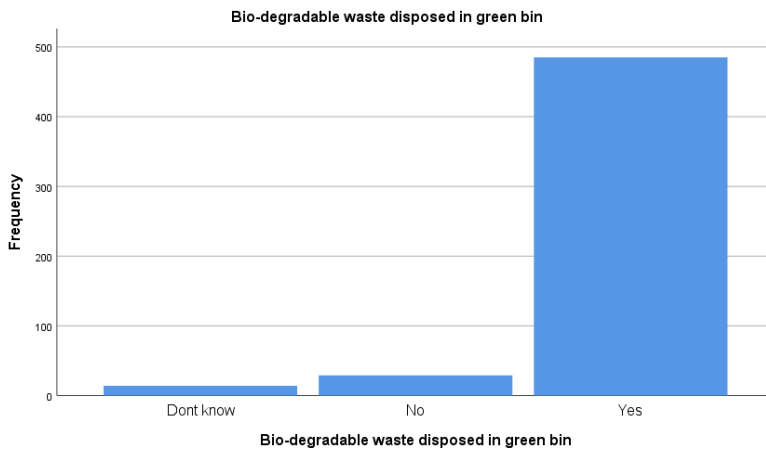


Figure 7: Awareness of using green bins to dispose biodegradable waste after watching animated video.

Non-biodegradable waste in blue bins

Blue bins have been in use in many places in Tamil Nadu to dispose non-biodegradable waste, though the color may vary from place to place. “The blue colored bin is used for segregating dry or recyclable left over. This category includes waste like plastic covers, bottles, boxes, cups, toffee wrappers, soap or chocolate wrapper and paper waste including magazines, newspapers, tetra packs, cardboard cartons, pizza boxes or paper cups/plates. Metallic items like tins/cans foil paper and containers and even the dry waste including cosmetics,

hair, rubber/thermocool (polystyrene), old mops/dusters/sponges”. What all go into the blue bin was explained in the audio and video and blue color was selected for the same. Children were able to understand the color code easily and score high after watching the animated videos. Figure 8 and Figure 9 clearly depict the increase in awareness regarding the color code and items that end in blue bin among school children after viewing the animated videos. The positive response was only near 100 numbers after audio and increased to nearly 400 numbers after watching the animated videos.

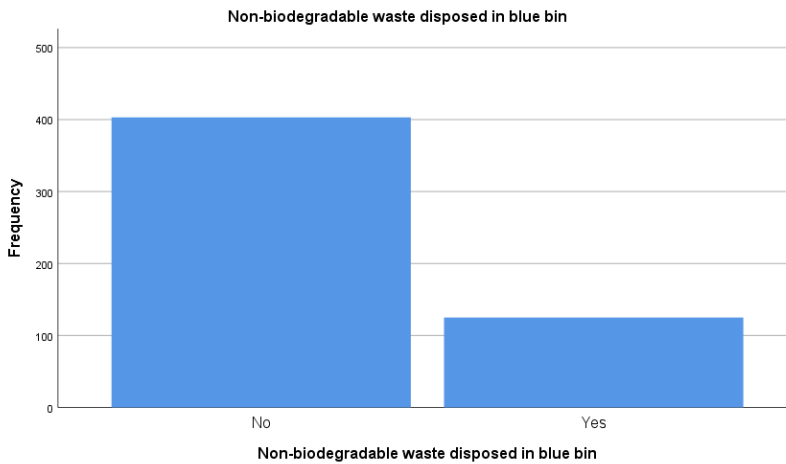


Figure 8: Awareness of using blue bin to dispose non-biodegradable waste after hearing audio

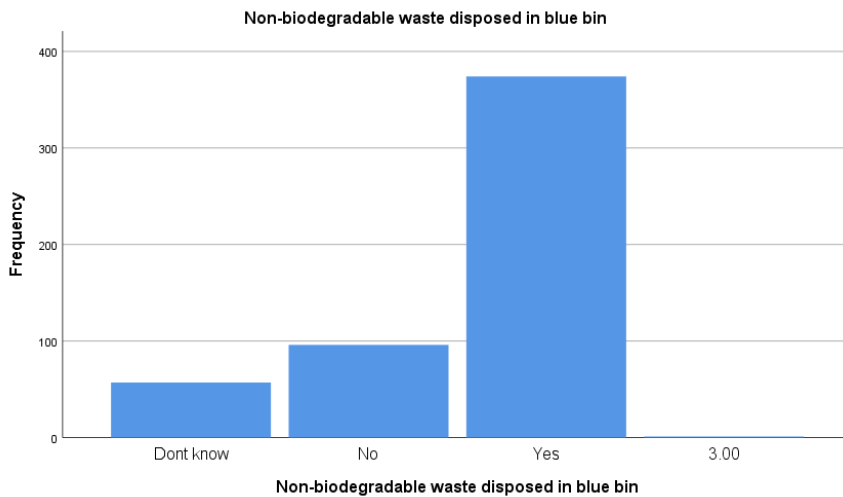


Figure 9: Awareness of using blue bin to dispose non-biodegradable waste after watching animated videos

Hazardous waste in red/black bins

People tend to dump all waste other than green ones in a bin, necessitating an introduction of third bin to dispose hazardous waste. Knowledge regarding the trash that falls into the category as non-biodegradable and hazardous need to be inculcated as it would be hard even for adults to understand. “Red or in places Black bin, make up for the third category, which is used for domestic hazardous waste like sanitary napkins, diapers, blades, bandages, CFL, tube light, printer cartridges, broken thermometer, batteries, button cells, expired medicine etc.” The color of bin being red denotes danger and so easier to understand that hazardous waste to be dumped into it.

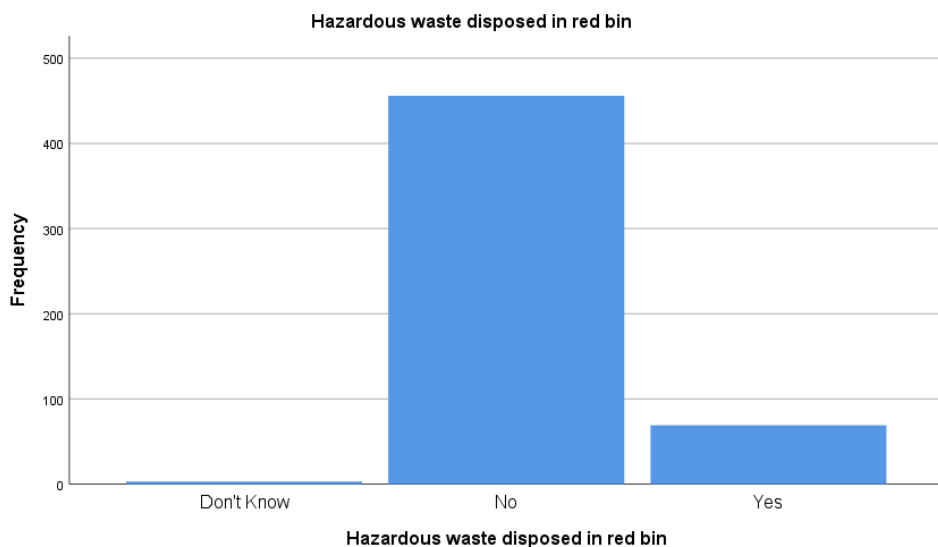


Figure 10: Awareness of using red bin to dispose hazardous waste after hearing the audio

From the Figure 10 and Figure 11, it is evident that the respondents were able to understand the color of bin for hazardous waste is red as the correct scores after watching the animated videos increased from less than 100 to nearly 400. There is also a considerable reduction in answering ‘no’ from 400 to 100. Thus, the enhancement in understanding the color code and what goes into what color bin was brought about by videos better than audios.

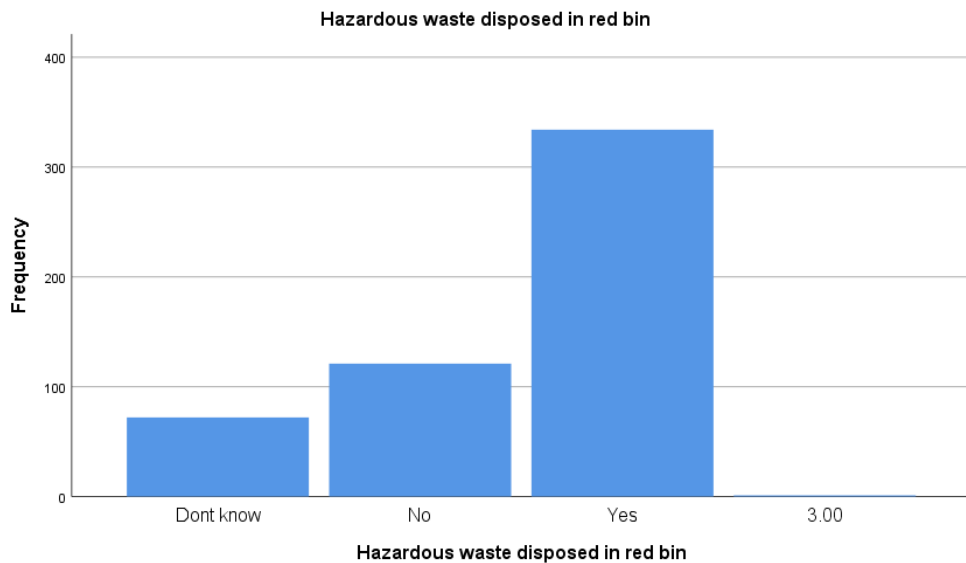


Figure 11: Awareness of using red bin to dispose hazardous waste after watching the animated videos.

Paired Sample T test.

In paired sample T test – can compare the means of two measurements taken from the same individual or group or objects. The scores collected through survey before and after watching the animated videos were from the same group of students and hence Paired sample T test was selected to analyze the data. On the other hand, Students T test is engaged to find how significant is the differences between two groups, two samples are statistically independent.

As part of Paired sample t test analysis null and alternative hypothesis were framed.

H₀ – Null Hypothesis- There is no significant difference in the pre and post animated video input in understanding the color code of bins for segregated waste disposal

H₁- Alternative Hypothesis- There is a significant difference in the pre and post animated video input in understanding the color code of bins for segregated waste disposal

The result (Figure 12) showed rejection of null hypothesis as the “p” value in all three cases was less than 0.05, confirming that there was a statistically significant improvement in the knowledge of color codes among the student

respondents after watching the animated videos about the scientific waste disposal methods. Among the colors, using green bins had more correct input as biodegradable waste or green waste had created a color code already in the minds of people. Red considered as danger also had better results as hazardous waste create a danger signal in the mind of the people and so color compliance would be more. Blue had a moderate response among the respondents as it could not be connected to any particular waste disposed in that bin.

		Paired Differences					df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Bio-degradable waste disposed in green bin - Bio-degradable waste disposed in green bin	-.46591	.60263	.02623	-.51743	-.41439	-17.765	527	.000
Pair 2	Non-biodegradable waste disposed in blue bin - non-biodegradable waste disposed in blue bin	-.36742	.74528	.03243	-.43114	-.30371	-11.328	527	.000
Pair 3	Hazardous waste disposed in red bin - Hazardous waste disposed in red bin	-.37500	.77405	.03369	-.44118	-.30882	-11.132	527	.000

Figure 12: Paired Samples Test relating to scores obtained before and after watch the animated videos

The current pandemic situation necessitates introduction of a fourth bin for medical waste. As more people need to quarantine at homes, medical waste generated in houses are on the increase and must be disposed separately as they are more hazardous than what goes into red bin. Probably black bin could be designated to collect medical waste from houses and be destroyed by proper incineration.

Conclusion

Solid waste management is a continuum, warranting a concerted effort among all stakeholders, the Government, and the public at large. Imparting the

knowledge of using color bins to segregate domestic waste through animated visuals and its impact was carried out as part of the doctoral research work of the author. Also, the importance of segregation of waste as biodegradable, non-biodegradable and hazardous and dumping in designated color bins was demonstrated through the videos. Discussion in the preceding pages confirmed that visuals inputs had an edge over audio messages among sample respondents of school students. To put things in perspective, there was a definite enhancement in their knowledge after viewing animated videos pertaining to solid waste disposal as confirmed through the statistical analysis. The results indicated that usage of appropriate multimedia tool taking into consideration the age, social economic and educational status of the audience would create desired results. The significance of the results denoted the importance of selection of suitable tool to impart social awareness to people. Amidst myriad tools of multimedia, choosing a relevant tool for creation of social awareness is the need of the hour. Such selection would improve the desired results for any project, and it will be a pointer to similar target-based research studies.

Note: The p-value gives the probability of observing the test results under the null hypothesis. The lower the p-value, the lower the probability of obtaining a result like the one that was observed if the null hypothesis was true. In paired sample t test the null hypothesis is that the average of differences between the paired observations in the two samples is zero. If the calculated P-value is less than 0.05, the conclusion is that, statistically the mean difference between the paired observations is significantly different from zero. Interpreted that null hypothesis is rejected. Ref: SPSS Paired sample T test, Kent State University, libguides.library.kent.edu

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