Journal of Material Cycles and Waste Management (2024) 26:175–183
https://doi.org/10.1007/s10163-023-01816-3

ORIGINAL ARTICLE

Role of knowledge and attitude of public and private school students for plastic pollution awareness, usage, and management in Lahore, Pakistan

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Received: 9 December 2022 / Accepted: 14 September 2023 / Published online: 24 October 2023

Abstract

To identify the knowledge and attitude of public and private school students for plastic pollution awareness, usage, and management, a questionnaire-based study was conducted among 300 students among fourteen different schools in Lahore, Pakistan. In general, 47.3% of the selected population knows plastic waste. However, the mean knowledge score in public and private schools was 46.5% and 60%, respectively. The parent's education showed a positive response to the student's awareness about plastic pollution ($p < 0.05$), while the age of the student showed no significant impact on their attitude. The study also indicated that 50.7% of students in private and 46.7% of students in public schools considered reusing and recycling as the most preferred method for reducing plastic waste. Moreover, 24% of students in private and 20% of students in public sector were also willing to support environmental campaigns by paying money. All these statistics conclude that private school students showed a more positive attitude than public school students. Common waste management practice adopted in both type of schools was the transportation of waste to the dumping site followed by open dumping of the waste in the vicinity which contradicts the statistics based on the knowledge of students.

Keywords Plastic pollution · Awareness · Management · Public and private schools

Introduction

Plastics are synthetic or semi-synthetic materials of large molecular masses that are derived from hydrocarbons such as natural gas and crude oil. Plastic is largely used for packaging followed by various plastic products [1]. These products are dumped in landfills and they persist in the environment for hundreds and thousands of years [2]. According to a survey from 1950s to 2015, 12% of plastic was incinerated and only 9% was recycled while the remaining 79% was either stored in landfills or was disposed off directly into the environment. Approximately 40% of plastic packaging goes to landfills and about 32% of waste is either not collected at all or is illegally dumped or mismanaged [1]. In addition, there are no appropriate facilities, and lack of awareness among people, they simply do not care about the consequences of illegal dumping [3]. This improper management results in serious threats to both marine and terrestrial organisms [4]. Oftentimes, it has various negative effects on wildlife which include deaths through entanglement or ingestion of plastics. On an average, at least 36% of seabird species, 86% of sea turtles, and 23% of marine mammals are affected every year globally. Microplastic debris is ingested by the fishes because of their resemblance with phytoplankton on which the fish feeds. These ingested particles then cause several health effects as they reduce the stomach capacity, cause internal bleeding and injuries, block the intestines, and hinder the growth of the organisms [5]. Some other sub-lethal effects of plastic waste and plastic pollution on

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marine organisms include reduced capturing and swallowing capability of food particles, loss of sensitivity, the inability to escape from predators, reproductive deformities, mobility loss, and other body conditions [6]. Moreover, this illegal dumping destroys the aesthetics of the area, damages the groundwater quality, and causes pollution of land, soil, and air and directly or indirectly affect the living beings including humans.

In Pakistan, 624,200 tons of plastic are produced annually. These are then used in 6000 industries that manufacture plastic products. Plastic is used in almost every industry in developing countries like Pakistan because it is cheap, durable, and easily available. Out of the total amount of plastic, nearly 164,332 tons of plastic waste ends up in the Indus River annually [7]. In Pakistan, 250 million tons of waste is produced, a large amount (65%) is plastic. Further, there are countless threats, in cities due to illegal waste dumping, and piles of plastic waste. In recent years, Pakistan has witnessed an unenviable surge in plastic pollution. According to UNDP, about 3.3 million tons of plastic waste is generated each year in Pakistan and disposed of untreated in landfills and water bodies throughout the country. If this waste is disposed off collectively, it will make a pile 16,500 m in height which is twice the height of K2 (8611 m) [8]. At present, 55 billion single-use non-biodegradable plastic bags are being used throughout the country with an increase of 15% in usage [9]. According to Oklahoma State University, one student in 9 months of school period generates about 67 pounds (30.39 kg/person) of waste using disposable plastic products during lunchtime alone [10]. These single-use non-biodegradable bags end up in open garbage dumps, landfills, and municipal systems and making the environment dirty for decades. It blocks the sewerage or drainage system and provides a breeding site for many disease-causing organisms like mosquitoes and causes a pungent odor. These blocked systems cause many diseases like malaria, cholera, typhoid, diarrhea, etc.

Although littering plastic wastes is the ultimate cause of pollution, in this study, we target a step behind in the cycle: plastic utilization. The lack of research in this field raises many questions regarding the knowledge of society about this issue and whether they are willing to change their patterns of plastic consumption. Awareness has a significant effect on the behavior of people. It is obvious, that if we increased awareness about plastic pollution, it will change public's attitude toward plastic utilization, disposal, environmental problems, consequences, and long-term impacts. Though the public cannot contribute significantly to making the law and policies, to that end, students are the future leaders, policy makers, industry developers, and backbone of a country, they can fight against plastic pollution and are presumed to raise awareness regarding this emerging dilemma [11, 12]. Thus, educating the students is an essential tool that can be employed to overcome the threatening plastic pollution.

On one point, plastic products are massively consumed in schools by students [10]. On the other side, in the Pakistan schooling system, no subjects are taught regarding environmental awareness and possibly very small number of students have adequate knowledge about plastic waste utilization and disposal. It is also possible that most of the students are unaware of its harmful impacts. Considering the background information, this study aims to assess the knowledge, and attitude of students regarding plastic utilization, disposal, and management in both public and private schools in Lahore, Pakistan. This research highlights the actions of students and administration regarding plastic waste disposal and recommends the best possible solutions to overcome plastic pollution. This survey can be the starting point for private initiatives and future governmental plannings for plastic waste awareness, reduction, recycling, and management.

Methodology

Study area

Lahore is a metropolitan city. It is the second largest and most populated city of Punjab, Pakistan. The total area of Lahore is 1772 km^2. The land area of Lahore is 404 km^2. Lahore is located at 31° N and 74° E. According to the demographics of 2017, the population of Lahore is 11.13 million with about 52% men and 47% women. Lahore is also the capital city of Pakistan in terms of educational institutes and constitutes both private and public schools [13].

Study design

For selecting schools, the online sources were explored to consider the list of best schools (in terms of education, student number and facilities) in Lahore, Pakistan. From the available list of best schools in Lahore city, Pakistan, public schools ($n=7$) and private schools ($n=7$) were selected at random. The duration of data collection was from January to March 2022. According to Pakistan Economic Survey (2020–2021), approximately 8.3 million students are enrolled in secondary grades all over Pakistan [14]. Thus, the target population of this study was secondary grade students, mainly 6, 7, and 8th grade of age 11–15 years. So far, due to lack of information about the proportion of students enrolled in private and public schools, the percentage of the students was assumed equal at both levels. To calculate the least sample size, the following formula was used (Eq. 1).

$$n = \frac{4P(1-P)}{ME^2} \quad (1)$$

Here n is the sample size, P is the expected prevalence, and ME is the margin of error. At 95% confidence level, ME is considered a minimum (4%) [15] and P is considered 85% according to a similar study conducted in Sharjah, UAE [11]. Considering available information, 300 participants were chosen as the sample population (public schools; $n = 150$ and private schools; $n = 150$). All the target population from each school was distinguished based on gender, age, and parents' education. Further, the administrative staff was also approached to ask them about the management of the selected schools.

Instrument of the study

The questionnaire (see the supporting information) was developed based on previous survey-based studies regarding environmental awareness, plastic utilization, plastic pollution to check the cost, resources, and feasibility of the research [11, 12, 16–18]. The questionnaire was thoroughly revised and verified by consulting literature [11, 12, 18]. The reliability of the content of the questionnaire was evaluated by 7 professionals. In the process of content validation, 20 questions remained unchanged, 8 were modified, 1 question was shifted to the management section from the knowledge section, and 2 new questions were added. In the second phase, the test–retest reliability was also estimated by correlating the scores of the questionnaire filled by the same participants twice, and the correlation was 0.972. Further, the team went into different schools after earning consent by the schools, the questionnaire was distributed between the participants, and they were guided throughout the collection process about all the concerns.

Each questionnaire had 32 questions for the students related to demographics, utilization/generation, awareness/knowledge, management, and attitudes toward plastic waste. A portion was also present at the end to investigate the waste management practices at the school administration level. The questionnaire was divided into six sections. The first section covered the background and demographics of the participants. The second section had questions related to the utilization of plastic waste. The third section presented questions related to awareness/knowledge about plastic pollution. The fourth section covered questions related to management of the plastic waste. The responses were categorized into *yes, no, and maybe*. Total scores of utilization, knowledge, and management were out of 4, 9, and 14, respectively. These scores were then converted into a percentage for analyses. The fifth section involved attitudes and general practices of the partakers. The attitude was determined using a 5-point Liker scale. The scale rank was 1 to 5 with *1* being "*Strongly agree*" and *5* being "*Strongly Disagree*." The sixth section consisted of questions to be answered by the administration and academic staff about the waste management process adopted by the school.

Ethical consideration and consent

Ethical consideration was also considered. Informed consent was taken from all the selected schools and participants. The sampling population was informed about the objective of the research before the distribution of questionnaires. The privacy and confidentiality of the collected information were also ensured. The collected information was stored along with the forms of consent and was treated with strict secrecy and confidentiality.

Data analysis

The collected information and data were compiled in MS Excel 2020 spreadsheet. To identify the utilization of plastic in both public and private schools, first, the descriptive frequencies were found using IBM SPSS statistics 22 and then correlation was applied to compare the various demographical parameters with knowledge, utilization, management, and attitude scores of the students. The correlation was significant at a level of 0.05. Multiple linear regression was also used to evaluate the effect of knowledge scores on plastic waste generation and utilization trends. One-way ANOVA and Kruskal–Wallis test were also performed to highlight the significant variation ($p < 0.05$) in the scores of private schools and public schools. Several responses from the students were also correlated to recommend the best solutions for the reduction and management of plastic pollution.

Results

Demographics of the selected participants

The questionnaire-based survey was self-administered among 300 students from private middle schools and public middle schools in Lahore, Punjab, Pakistan. The response of students was 100%. First the background information, i.e., demographics of the selected participants was collected which is depicted in Table 1.

Knowledge about the plastic pollution

Most students (62.7%; $n = 188$) agreed that plastic waste can harm the environment and human health (Fig. 1). Overall, the percent mean knowledge score of both schools was 53.2 ± 9.422. Considering private schools, 76.7% of

Table 1 Demographics of the selected participants

Variable category		Total scores	Public	Private
Gender	Male	37.3% ($n=188$)	58.7% ($n=88$)	66.7% ($n=100$)
	Female	62.7% ($n=112$)	41.3% ($n=62$)	33% ($n=50$)
Parent's education*	Yes	84% ($n=252$)	68% ($n=102$)	100% ($n=150$)
	No	16% ($n=48$)	32% ($n=48$)	0% ($n=0$)
School type	Private	50% ($n=150$)	100% ($n=150$)	100% ($n=150$)
	Public	50% ($n=150$)		
Age	11–13	86% ($n=258$)	80% ($n=120$)	92% ($n=138$)
	14–15	14% ($n=42$)	20% ($n=30$)	8% ($n=12$)

*The response was collected "yes" even when one of the two parents were educated. The intermediate level of parent's education was considered to be "educated"

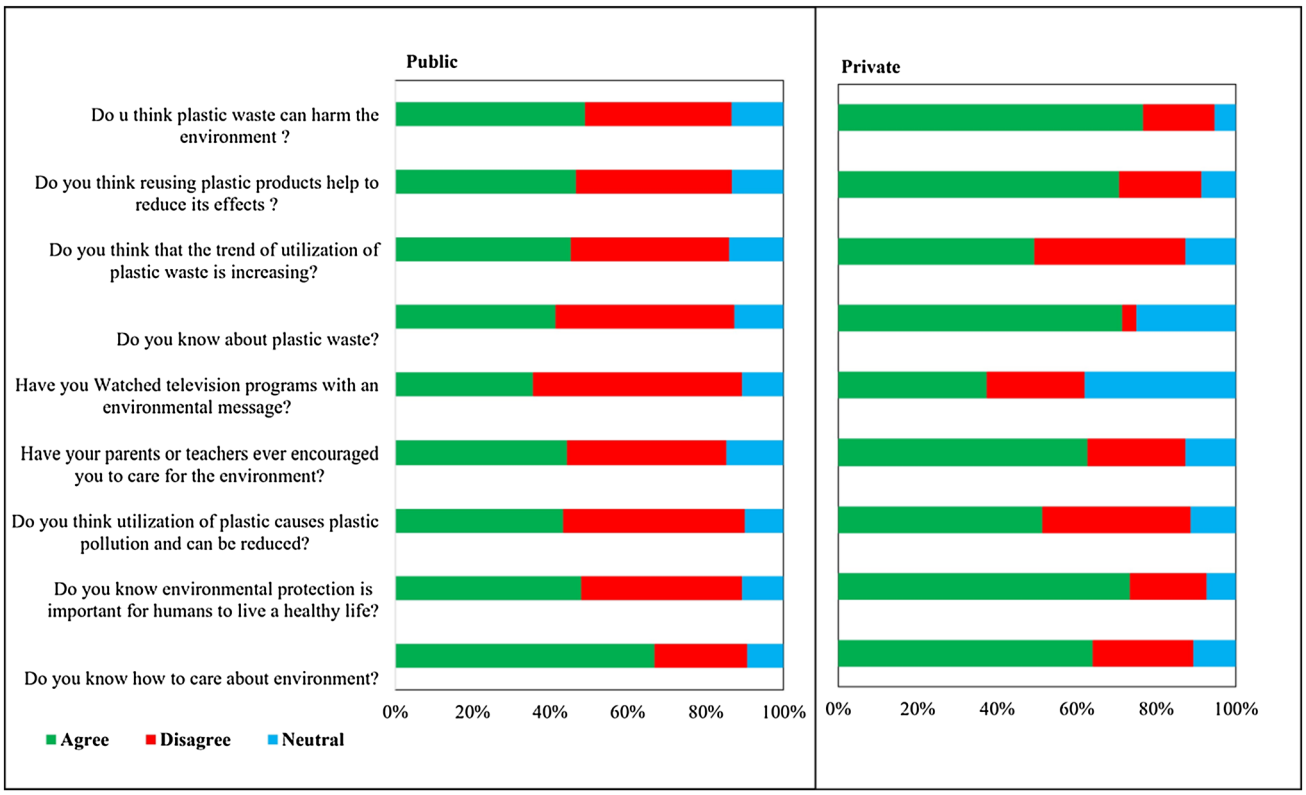

Fig. 1 Recorded responses of knowledge about environmental protection and plastic pollution in both type of schools

the students were aware of plastic pollution with a percent mean knowledge of 60 ± 39.085. However, in public schools, the awareness of harmful impacts of plastics was 48.7% with mean percent knowledge scores of 46.52 ± 8.42. One-way ANOVA showed a significant difference of knowledge scores ($p < 0.05$) between the public and private schools. Kruskal–Wallis test also supported the results of ANOVA with significant variation in knowledge scores ($p < 0.05$) at the selected types. Moreover, the correlation and regression analysis highlighted that school types have a significant correlation with the knowledge of students ($p = 0.000$ and $r = 0.255$).

Correlation further emphasized that parents' education had an impact on the knowledge of students about plastic pollution ($p = 0.005$, $r = 0.148$). In private schools, 62.7% of the students agreed that their teachers and parents encourage them to protect the environment from plastic waste while in public schools, only 44% of students agreed that their superiors tell them to care for the environment. Furthermore, the students at public (35.3%) and private schools (37.3%) chose

electronic media as the best source of knowledge about environmental problems, which can impact the thinking of the students. The knowledge scores were further correlated with age and gender of the selected individuals. When compared with age, it showed positive but non-significant correlation ($p=0.070$, $r=0.085$). However, significance correlation of the knowledge score ($p=0.002$, $r=0.170$) was observed with both genders. Overall, linear regression analysis significantly predicted knowledge scores ($F=7.798$, $p=0.000$ and $R^2=0.096$) of all the selected variables, i.e., school type, parents' education, and gender (Table 2).

Trend of plastic utilization

Overall, 77% of students were using plastic-wrapped food items (Fig. 2). Majority of the students (52%) agreed that their parents frequently use plastic bags for shopping purposes. It was observed that public school participants were using more plastic bottles as compared to those in private schools. But, on the other side, about 35.3% of the private school participants were using more than 10 plastic packed products (like candies) a day as compared to public school students (32%). Hence, the utilization of plastics in both types of schools was the same. One-way ANOVA was applied to justify this frequency of utilization. The results showed non-significance ($p>0.05$) variation in the utilization of plastic products between the groups. Kruskal–Wallis test also supported the findings of ANOVA and showed that the utilization of plastics is the same across the types of school ($p>0.05$). There was no significant correlation between utilization scores and school type ($p=0.446$; Table 2). Also, there was no significant correlation of utilization observed with gender, age, and parent's education ($p>0.05$).

Attitude of students to reduce plastic waste

After knowledge, utilization, and management of plastic waste, the next aim was to investigate the attitude of students. The attitude of the students for plastic waste reduction and management was higher in the private sector

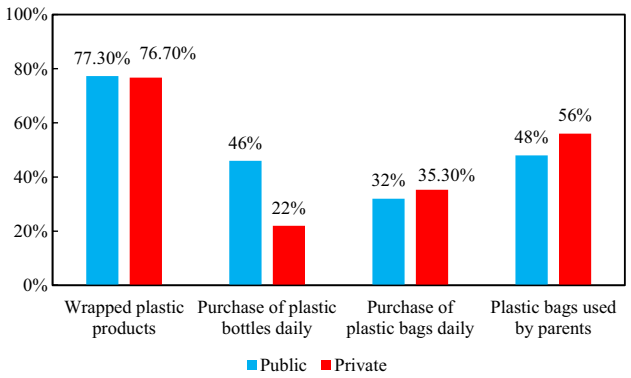

Fig. 2 Trend of utilization of plastic waste

(54.1%) as compared to public schools (42.5%) except one question related to joining an environmental campaign (Fig. 3). For a particular question, the public school students (26%) were more enthusiastic to join the environmental campaigns than private schools (13.3%). The attitude of all the students was also correlated with selected questions from the utilization, awareness, and management sections. The private schools (53.3%) and public school students (41.3%) knew about plastic pollution but their observed attitude toward plastic waste utilization was irrespective of their knowledge scores ($p>0.05$). However, they depicted a positive attitude toward the reduction of plastic pollution, i.e., a significant correlation ($p=0.001$) was noticed between knowledge and willingness of students to spread awareness about plastic pollution to their friends and family. They were even willing to reuse and bring their cloth bags while shopping ($p<0.05$) and were enthusiastic to join future campaigns related to environmental protection ($p=0.000$). There was also a significant correlation between the knowledge of students and their inclination to pay money to support environmental campaigns ($p=0.000$). Furthermore, the students who have attended environmental seminars or whose parents educated them about plastic pollution showed a significantly high level of knowledge ($p<0.01$).

Table 2 Correlation of different variables with utilization, knowledge score, management, and attitude of selected participants about plastic pollution

Variables	Knowledge		Utilization		Management	
	p	*B* (95% CI*)	*P*	*B* (95% CI)	*p*	*B* (95%CI)
Gender	**0.002**	0.714	0.293	0.079	0.076	0.375
Parent's education	**0.005**	0.301	0.056	-0.380	**0.021**	0.436 s
School type	**0.000**	-1.050	0.446	-0.096	**0.003**	-0.716
Age	0.070	0.479	0.389	0.052	**0.025**	0.770

The correlation was significant at 0.05 level, represented with bold values

*CI is confidence interval

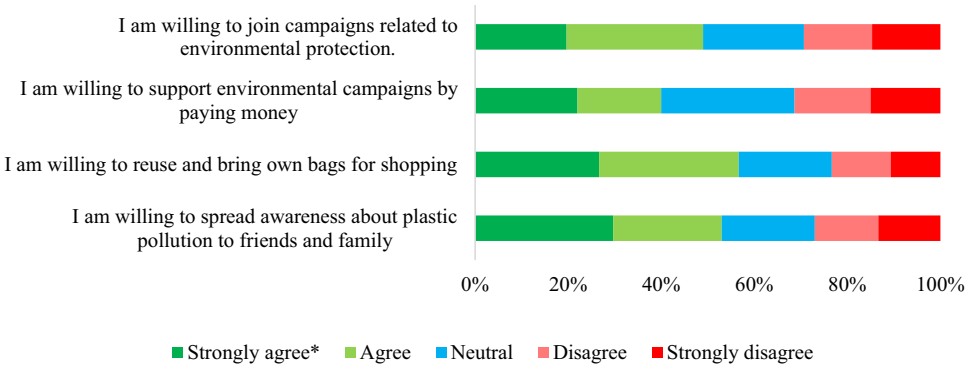

Fig. 3 Attitude of students for reduction of plastic pollution (*the mean scores of positive attitude toward plastic pollution were based on the response 'Strongly agree'. Based on assumption, the mean recorded positive attitude was 25.2%)

Plastic waste management practices—a mutual responsibility

At students' level

According to the hierarchy of plastic waste management, first, the perception of students related to a reduction of plastic waste was considered. A total of 63% students desired to save the environment from plastics and 55.3% thought that plastic pollution is an urgent threat. Moreover, 41.7% of students were thinking of ways to reduce plastic waste and 27.3% of them were helping in the reduction of plastic pollution. Second, the perception of students related to the reuse of plastic products was well-thought-out. The respondents who bought food in plastic bags did not throw them away after the first use, instead 62% of the students reused these plastic bags. Moreover, half of the participants considered bringing and reusing their eco-friendly bags for shopping.

The respondents also considered recycling as the best way to manage plastic pollution. In private schools and public schools, 50.7% and 39.3% of students, respectively, thought that recycling can reduce plastic waste significantly. Lastly, questions related to the disposal of plastic waste were asked. In general, most of the students (55.3%) use dustbins to dispose of plastic waste. In private schools, 62.7% of students and 47.3% of students in public schools disposed of waste in dustbins.

When correlation was applied between the management practices of students with their parent's education, it was found that parent's education also had an impact on students' perception of managing plastic waste ($p = 0.021$ and $r = 0.117$). The results of correlation also showed the significance of management with student age and school type (Table 2). However, a non-significant correlation between management and gender ($p > 0.05$) was observed.

At administration level

During this survey, management practices at the administration level were also considered, and administrative and academic staff were approached to investigate plastic waste management practices adopted in the respective schools. In public schools, most of the teaching staff knew about the plastic pollution in their schools. However, they were unsure of what was done to the waste after collection. On the other hand, in private schools, teachers were aware of management practices that were done to remove plastic waste from the schools. According to the survey, 21.4% of teachers in private schools said that plastic waste was openly dumped. Hence, when a comparative analysis was made, it was seen that in both private schools and public schools, transportation was the best-considered management practice followed by open dumping. The responses of the administration are recorded in Fig. 4.

Discussion

Knowledge about plastic pollution: role for plastic waste awareness

The mean knowledge scores showed poor background about plastic pollution of both private schools and public school students. If we compare the mean knowledge score of students in Lahore (46.52% in public schools and 60%

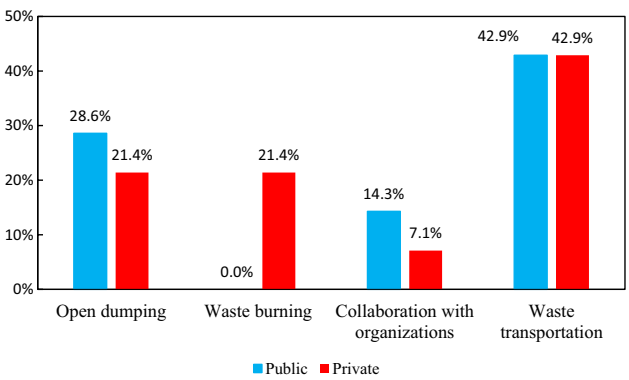

Fig. 4 Plastic waste management practice

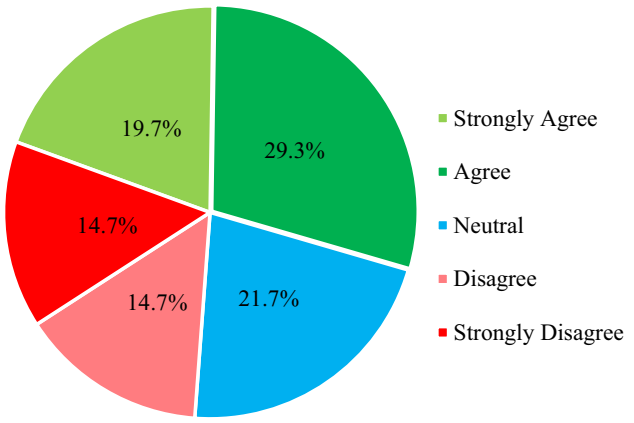

Fig. 5 Responses to the question Am I willing to join campaigns related to environmental protection'

in private schools), it is much lower than the students in Singapore (71%), Hungary (74%), and Malaysia (74.4%) [11]. This gap in knowledge among students gives rise to another important question whether the students are aware of environmental issues and their effects. In the current study, the student's attitude was positive toward awareness campaigns and the students were more inclined toward joining these campaigns instead of taking environment-related courses (Fig. 5). The possible reason is that awareness campaigns engage the students in a more interactive manner instead of the old and traditional ways of teaching [11]. According to the literature, the increase in awareness among students is an important step to shift the behavior, attitude, and willingness to save the environment. Several studies done in Sharjah and Istanbul showed that the participants who were aware of environmental issues showed a desire to take initiative either on their own or by joining different campaigns [11, 19] However, this should not stop the school-based learning that students require to not only increase their knowledge but also change their attitudes and behaviors to deal with plastic pollution.

In conclusion, staff should engage students in learning exercises by planning interactive seminars and campaigns. School administration can also invite municipal committees in schools to promote eco-friendly activities like recycling and using alternatives to plastic. Participants had their share of significant internet and media usage too but little knowledge about environmental issues comparatively. Based on the observations, another way to educate students is by utilizing media platforms including television, press, social media, etc. These platforms should be used efficiently to spread awareness that reaches a large amount of academic audience, i.e., by running blogs and sites related to environmental studies in the premises of schools.

Knowledge about plastic pollution: an implication for plastic waste management

A total of 47.3% of participants agreed to the fact that plastic utilization is increasing rapidly (Fig. 6) and there is a need to reduce the utilization of plastics to protect the environment. Pakistan produces an estimated amount of 624,200 tons of plastic annually which poses harmful effects on the environment and human health [20]. According to the recorded observations, decreasing the availability of plastics, using alternatives, and reusing and recycling plastic products seem to be the most preferred methods of reducing plastic waste by the participants (58.7%). Despite this fact, most of the students (62.7% private schools; 47.7% public) still dispose of plastic waste in dustbins instead of recycling. Based on personal observation during a visit to the schools, the waste was dumped in a single dustbin and segregation was not maintained. There was also the unavailability of recycle bins in schools. This suggests the introduction of recycling bins in the schools to manage and decrease plastic pollution by less expenses. The installation of plastic vending machines, which provide coins in exchange for plastics, is another way to encourage the students and overall society to engage in recycling activities.

Observations regarding certain plastic products were also recorded. The students were ready to reuse the plastic bottles instead of disposing of them after first use. A total of 28.7% and 27.3% of participants from private schools and public schools, respectively, were willing to bring their environment-friendly bags for shopping which suggests that a levy on plastic bags would be an effective and important method to reduce plastic waste production with the people supporting this idea [21].

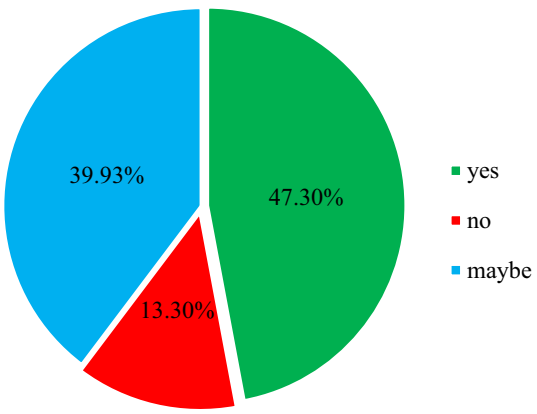

Fig. 6 Responses of participants to the question 'Whether the utilization of plastic is increasing'

Recommendation for plastic waste management in schools of Pakistan

Based on the observations and collected data, transportation is the commonly adopted method to dispose of waste in both public schools (42.9%) and private schools (42.9%). Other possible ways of management include waste burning, open dumping, and collaboration with different waste management organizations. Open dumping is the second-best choice for schools to dispose of waste as it is generally an inexpensive and simple method. However, it is harmful for the environment and may affect the groundwater, soil, air, and the aesthetics of the area [22, 23]. The openly disposed waste produces a pungent odor which makes it difficult for residents to breathe in that air. In Pakistan, the dumping process is unplanned which damages the environment [24]. Similarly, the open burning of waste releases several pollutants including toxins and carcinogens to the atmosphere and is a prevalent cause of air pollution [25]. Breathing in such atmospheres can result in health problems like diseases of the lungs, heart, and even carcinogenic risk [26]. Around the globe, metropolitan cities utilize a great number of plastics with no proper management which results in massive waste production and negative impacts on the environment and human health [27]. Similarly, in Lahore, large amount of waste is produced on daily basis with no proper management. Moreover, citizens do not abide by the rules and regulations that are needed to be fulfilled to minimize environmental pollution. The high cost of management coupled with a lack of awareness among the citizens results in increased plastic pollution. This can be the key reason for the increasing amount of plastic pollution in schools too. Considering the situation in Pakistan, collaboration with different waste management companies that ensure the proper and safe disposal of plastic waste could be the best choice for waste disposal in schools. Furthermore, all these findings suggest that awareness campaigns, installation of labeled recycle bins, plastic vending machines, use of paper bags, and collaboration with waste disposal companies could be the best methods to address the plastic pollution in Lahore city, Pakistan in an eco-friendly manner.

Conclusion

In the current study, it was observed that irrespective of the knowledge of students about plastic pollution in both public and private schools, the utilization of plastics remained the same. However, students showed a positive response to reducing this pollution in the near future by engaging themselves in various eco-friendly campaigns and activities. Based on these observations, in the future, students should be provided better opportunities to take part in activities regarding the protection of the environment. Moreover, the process of learning about plastic waste and the environment should start at the primary level and students should be encouraged to get themselves involved in various active lectures and activities. Public schools and private schools should also promote this type of education and extracurricular activities. The municipality should also provide better management of plastic waste to reduce this growing plastic problem.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s10163-023-01816-3.

Acknowledgements The authors acknowledge the administrative staff of selected schools in Lahore, Pakistan for facilitating the survey. The authors would like to appreciate the institution, i.e., College of Earth and Environmental Sciences, University of Punjab, Lahore, Pakistan for providing the resources.

Authors contributions SM (conceptualization, methodology, formal analysis and investigation, editing, writing—original draft preparation), AA (conceptualization, methodology, formal analysis and investigation, editing, writing—original draft preparation), MM (visualization, conceptualization, methodology, formal analysis and investigation, writing—review and editing, funding acquisition, resources, supervision), AUS (conceptualization, visualization, reviewing, editing), AQ (conceptualization, visualization, reviewing, resources), SRA (conceptualization, visualization, reviewing), HFUS (conceptualization, visualization and reviewing, editing).

Funding The authors declare that no funds, grants, or other support were received during the preparation of this manuscript.

Availability of data and materials Datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Conflict of interest The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. Furthermore, the authors declare no conflict of interest.

Ethical approval Informed consent was taken from the selected participants.

Consent for publication Not applicable.

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