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Governing Waste Culture in Elementary School: Training Students for Responsible Citizenship

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ABSTRACT

Objective: Waste management, as one of the major environmental challenges, requires the development of responsibility and lawfulness among citizens from childhood and adolescence. The aim of the present study was to investigate the effect of Waste Culture Management Training (WCMT) on the responsibility and legality of adolescent citizens.

Methods: This study was a quasi-experimental research with a pre-test-post-test design and a control group. The statistical population consisted of all 6th-grade male students in Tehran's District 11 during the academic year 2023-2024. From this population, 30 students were selected via convenience sampling and were randomly assigned into two 15-person groups: experimental and control. The instruments used included the Responsibility and Lawfulness Scale (Alipour and Jalali Farahani, 2006) and the Waste Culture Management Protocol. The experimental group underwent eight 60-minute sessions of Waste Culture Management Training, after which a post-test was administered to both groups. Data analysis was performed using Analysis of Covariance (ANCOVA).

Findings: The results of the multivariate analysis of covariance (MANCOVA) showed that the difference in the mean scores of responsibility and lawfulness after the Waste Culture Management Training, compared to the control group, was significant ($P<0.01$). The training led to an increase in responsibility and legality ($P<0.01$).

Conclusion: The findings of this research confirm the effectiveness of Waste Culture Management Training in strengthening the mechanisms of responsibility and lawfulness among citizens. Based on the obtained evidence, Waste Culture Management Training can be used as an efficient interventional method in the educational, pedagogical, and environmental domains..

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Introduction

Adolescence is a critical developmental period characterized by profound physical, emotional, cognitive, and social changes, typically occurring between the ages of 10 and 19 years (World Health Organization [WHO], 2025). During this stage, individuals experience significant transformations that shape identity formation, interpersonal relationships, and decision-making processes, thereby laying the foundation for the transition into adulthood (Falahi, Narimani, & Atadokht, 2013) .

Given the complexity and sensitivity of this period, adolescents face various challenges, including peer pressure, mental health concerns, and academic stress, which necessitate targeted research and well-designed educational policies and practices (Hagberg, 2023). Among the fundamental competencies that should be fostered during adolescence are responsibility, acceptance, and lawfulness. Responsibility is a multidimensional construct encompassing the ability to make choices, exercise autonomy, and accept accountability for the consequences of one's actions. It is widely recognized as a cornerstone of adolescent development and an essential prerequisite for independence (Harji, 2021). Responsibility manifests in several domains, including personal, social, and academic responsibility. Personal responsibility refers to self-care and decision-making related to individual well-being, while social responsibility involves concern for others and active participation in societal welfare. Academic responsibility, in turn, reflects commitment to learning activities and educational obligations. Understanding these distinct yet interconnected dimensions enables educators and policymakers to identify specific areas in which adolescents may encounter difficulties (Kaya et al., 2024). Empirical evidence indicates that higher levels of responsibility among adolescents are associated with improved academic performance, healthier interpersonal relationships, and positive social outcomes (Amini Tehrani & Ali Akbari, 2014).

Another essential concept that requires systematic cultivation during adolescence is lawfulness, which plays a pivotal role in regulating social behavior and maintaining social order. Lawfulness refers to individuals' understanding of, respect for, and adherence to legal norms and regulations governing behavior within a society. In adolescents, lawfulness involves the development of legal awareness, moral reasoning, and the capacity to navigate legal and social expectations as they approach adulthood (Dang & Zeb, 2022). According to Gächter et al. (2025), lawfulness encompasses the ability to comprehend legal obligations and recognize the consequences of non-compliance. Education serves as a central mechanism for fostering law-abiding behavior, as programs focused on legal literacy, civic education, and ethics have demonstrated effectiveness in enhancing adolescents' respect for the rule of law. Research suggests that adolescents who participate in law-focused educational initiatives exhibit lower levels of delinquent and antisocial behaviors (Faisal, 2022). Consequently, promoting lawfulness is essential for preparing informed, responsible citizens capable of making constructive contributions to society .

In parallel with social and legal challenges, rapid population growth, unplanned urban expansion, unsustainable consumption patterns, increased advertising, and the widespread use of plastic packaging have intensified problems related to urbanization and solid waste management. Today, waste management is regarded as an advanced interdisciplinary field and an integral component of modern urban governance. It encompasses processes such as waste generation, collection, transportation, disposal, and recycling, all of which require coordinated efforts among multiple institutions, particularly educational systems. Managing such a complex system cannot rely solely on traditional approaches; instead, effective waste management must begin with education, especially at the school level (Mohammadpour Zarandi & Tabatabaei Mazdabadi, 2024). Waste management culture, as one of the fundamental pillars of sustainable

development, is shaped differently across countries depending on their economic, social, and cultural contexts. Comparative analyses of countries such as Japan, Germany, Sweden, South Korea, and Brazil provide valuable insights into the determinants of successful waste management practices. Japan, as a global pioneer in this field, has achieved a municipal waste recycling rate of approximately 20% through strong educational policies and early-age culture-building initiatives (Organisation for Economic Co-operation and Development [OECD], 2023). In Japanese schools, students are actively involved in collecting and separating waste, a practice that has led to the deep institutionalization of waste separation norms within society. This educational approach is reinforced by strict waste disposal regulations that require citizens to comply with detailed guidelines (Abobaker et al., 2022).

Similarly, Germany has successfully reduced waste generation through the implementation of a pay-for-disposal system, whereby households are charged based on the volume of waste they produce. This financial incentive mechanism has positioned Germany among the countries with the lowest waste generation rates in Europe (Azizi, Salimi, & Tanhayee, 2025). Moreover, extensive public education campaigns and active citizen participation have strengthened the culture of waste separation nationwide (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, 2023). Sweden, recognized as a global leader in waste-to-energy technologies, recycles or converts more than 99% of its household waste into energy. The Swedish waste management model is grounded in comprehensive public education and high levels of citizen engagement, facilitated through efficient waste collection systems and sustained awareness campaigns (Sandy & Roseland, 2024). South Korea has also achieved significant reductions in waste generation by implementing a volume-based waste fee system, commonly known as the "waste tag" system. According to the South Korean Ministry of Environment, this policy has reduced waste generation by approximately 20% over the past decade, complemented by school-based education programs and nationwide public campaigns (Lee et al., 2024). Educating adolescents about waste management culture is therefore essential for fostering responsible environmental behavior and law-abiding citizenship. Waste management culture can be defined as the collective attitudes, beliefs, values, and practices of individuals and communities regarding waste reduction, reuse, recycling, and environmental protection (Altsch & Huber-Homer, 2023). This culture also entails an understanding of the environmental consequences of waste generation and improper disposal. According to the World Bank (2023), global waste generation is projected to increase by approximately 70% by 2050, reaching 3.4 billion tons annually. This alarming projection underscores the urgent need to educate younger generations about sustainable waste management practices to mitigate environmental degradation.

Adolescents, as future decision-makers and active members of society, play a crucial role in shaping social norms related to environmental responsibility. By instilling values and behaviors associated with effective waste management during adolescence, societies can significantly enhance sustainability and reduce their ecological footprint (Naniello & Dungey, 2024). Empirical studies have demonstrated that waste management education contributes to the development of responsible citizenship and strengthens adherence to environmental laws and regulations (Wu, Zhou, & Zhai, 2022; Masoudi, Selajgeh, & Kamali, 2014). Accordingly, given the pivotal role of adolescents in shaping future societal behaviors and the lasting impact of education during this developmental stage, the primary concern of the present study is the lack of effective educational interventions in the field of waste management that are capable of simultaneously fostering individual responsibility and adherence to environmental regulations among students. Alarming evidence regarding low levels of responsibility among adolescents (Merzliakova & Bibarsova, 2022) and the prevalence of legal violations related to waste

management (Azami et al., 2023) indicates that existing educational programs have often failed to translate awareness into sustained behavioral change (UNESCO, 2023). This shortcoming is particularly concerning given that improper waste management poses serious threats to public health and environmental sustainability (World Bank, 2023). Therefore, the present study aims to investigate the impact of waste management culture education on citizens' responsibility and law-abiding behavior, with a specific focus on adolescents. The primary aim of this study is to investigate the impact of structured waste management culture education on enhancing adolescents' responsibility acceptance and lawfulness, addressing a critical gap in environmental and civic education. Despite increasing awareness of environmental issues, many adolescents exhibit low levels of personal accountability and limited adherence to regulations, which can hinder the development of responsible and law-abiding citizens. This research seeks to identify effective educational strategies that not only raise knowledge and awareness but also foster sustainable behavioral change, bridging the gap between theoretical understanding and practical action. Ultimately, the study aims to provide evidence-based guidance for schools, municipalities, and policymakers to design interventions that cultivate civic responsibility, ethical decision-making, and compliance with social and environmental norms among young people.

Research Method

Research Design and Participants:

The present study was conducted using a quasi-experimental design with a pre-test–post-test and a control group, aiming to examine the effectiveness of waste culture management training on responsibility and law-abiding behavior among elementary school students. The statistical population included male sixth-grade students enrolled in public elementary schools in District 11 of Tehran during the 2024–2025 academic year (1403–1404). From this population, 30 students were selected through convenience sampling based on predefined inclusion criteria and were subsequently randomly assigned to an experimental group (15 students) and a control group (15 students). Participation criteria required students to be between 11 and 12 years of age, to provide informed consent (with parental approval), and to have no history of psychological or pharmacological treatment for at least one year prior to the study. Students who withdrew from the study, were absent from more than two training sessions, or failed to complete either the pre-test or post-test questionnaires were excluded from the final analysis.

Procedure

After obtaining official permission from the Department of Education, one public elementary school in District 11 of Tehran was selected. The objectives, significance, and implementation process of the research were explained to the school principal, after which two sixth-grade classes were identified. One class was assigned as the experimental group and the other as the control group, with 15 eligible students selected from each class. Following the completion of informed consent forms, both groups participated in the pre-test assessment. The experimental group then received the Waste Culture Management Training (WCMT) intervention, which was delivered in eight weekly group sessions, each lasting 60 minutes, while the control group received no intervention during this period. Throughout the training process, student participation, attendance, and completion of assigned activities were closely monitored. Each session began with a brief review of the previous session's content and discussion of completed tasks, followed by new instructional activities focusing on waste reduction, separation, recycling, environmental responsibility, and compliance with environmental regulations. Upon completion of the intervention, a post-test was administered to both groups under the same conditions as the pre-test.

Research Instruments

Data collection was carried out using the Responsibility, Acceptance, and Lawfulness Scale (RLS) developed by Alipour and Jalali Farahani (2006). This scale consists of 50 items designed to assess individuals' levels of responsibility and adherence to social and legal norms. Responses are recorded on a five-point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (5), yielding total scores between 50 and 250, with higher scores indicating greater responsibility and law-abiding behavior. The RLS measures two overarching dimensions responsibility/acceptance and lawfulness—and includes several subcomponents such as autonomy, discipline, trustworthiness, professionalism, organization, and progressivism. Previous research has supported the content and construct validity of the scale (Alipour & Jalali Farahani, 2006; Esmailnejad et al., 2015). Moreover, Esmailnejad et al. (2015) reported a Cronbach's alpha coefficient of 0.92, demonstrating excellent internal consistency and reliability of the instrument. In the present study, the scale was considered an appropriate and reliable tool for assessing changes in responsibility and law-abiding behavior among elementary school students.

Validity and Reliability

The Waste Culture Management Training (WCMT) program was implemented as a structured educational intervention designed to position schools as active catalysts for responsible citizenship. The content of the program was developed based on principles of environmental education, responsible citizenship, and social learning theory, with a specific focus on linking everyday waste-related behaviors to broader concepts of responsibility and legal compliance. To ensure content validity, the training protocol was reviewed by experts in educational sciences and environmental education, who evaluated the relevance, clarity, and developmental appropriateness of the session objectives and activities. Their feedback was incorporated to refine the instructional materials and ensure alignment with the cognitive and social characteristics of sixth-grade students. Construct validity was further supported by the theoretical alignment of the program with established models emphasizing the role of schools in shaping civic responsibility and pro-environmental behavior. The reliability of the intervention was ensured through the use of a standardized session structure, consistent implementation by the same instructor, and systematic monitoring of student engagement across all sessions. Additionally, the use of a highly reliable outcome measure (RLS) strengthened the overall methodological rigor of the study.

Data Analysis

Data were analyzed using SPSS version 26. Descriptive statistics, including means and standard deviations, were calculated to summarize participants' scores, while inferential statistical analyses were conducted to examine differences between the experimental and control groups across pre-test and post-test stages.

Table 1. Content of waste culture management training sessions

Assignment	Meeting content	Goal	Meeting
Recording household waste production in one day	-Display contrasting images of clean and polluted nature -Introduction to three categories of waste (wet, dry, hazardous) with real examples -Group activity " : Smart Categorisation " game (separating garbage images into virtual bins(-Final discussion with key questions	Familiarity with the concept of waste base and its types	First
Using a three - piece bag instead of nylon	-Introducing sustainable alternatives (wooden toothbrushes , three - piece suits , etc(.	Emphasis on the importance of waste	Second

and reporting the experience (written)) or painting(	-Role play " : Smart Shopping " exercise -Interactive activity : Building" Waste Reduction Champions " by writing a personal commitment	reduction and the principle of" reduce consumption"	
Designer A guide poster for correct waste separation at home with standard colors	-Training in standard bucket color coding with a mock- up or real sample -Group game " : Separate competition" -Inspection and evaluation of a group of bins in the school	Practical training on waste separation and the colors of waste bins	Third
Continuing creative projects at home and building another useful tool with family help	-Display of samples of recycled products -Practical workshop : making new tools from waste materials at different stations (paper , plastic , metal) -Explanation of the recovery steps for each material by groups	Familiarity with the endless possibilities of creative play	Fourth
Interview with a local vendor about waste disposal methods in the store and record keeping	-Explain local and national laws in simple language -Role - playing activity " : Environmental Court" -Group discussion : Strategies for encouraging people to obey the laws	Familiarity with waste management laws and environmental laws	Fifth
Implementing a group project in the school environment during the week (e.g., installing signboards(	-Motivating by showing successful examples of other campaigns -Forming groups and presenting ideas to impact the school community -Setting up a simple action plan for the selected idea	Playing an active role in promoting a waste culture (group project)	Sixth
Prepare a creative report of the visit (painting , essay , interview , video)	-Preparation before the visit -Scientific visit (in person) (or virtual) from a recovery center Group discussion and explanation of the different stages of the process after the visit	Seeing the recovery process in action	Seventh
Writing a letter or drawing for parents to explain the most important lessons learned from the course	-Key Points Review Contest -Presenting the results of group projects -Awarding the certificate of " Little Environmental Ambassador" -Signing a personal commitment letter	Reviewing lessons learned , appreciating and creating lasting commitment	Eighth

Findings:

Based on the demographic data, the mean age and standard deviation of participants in the experimental group were 11.40 (SD = 0.51), and in the control group were 11.47 (SD = 0.74), indicating that the two groups were comparable in terms of age. Table 2 presents the descriptive statistics (mean and standard deviation) for the pre-test and post-test scores of responsibility acceptance and lawfulness in both experimental and control groups.

Table 2. Mean and Standard Deviation of Pre-test and Post-test Scores in Experimental and Control Groups

Variable	Group	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD
Responsibility Acceptance	Experimental	38.53	2.53	52.47	2.61
	Control	38.87	2.20	39.87	1.64
Lawfulness	Experimental	61.67	2.94	74.67	3.18
	Control	62.47	2.26	62.47	2.33

As shown in Table 2, the mean score of responsibility acceptance in the experimental group increased from 38.53 in the pre-test to 52.47 in the post-test. In contrast, the control group showed almost no meaningful change. Similarly, lawfulness scores increased noticeably in the experimental group, while remaining nearly unchanged in the control group. These differences suggest the positive impact of the training intervention.

Table 3. Kolmogorov–Smirnov Test Results for Normality of Research Variables

Variable	Group	Stage	Z	Sig.
Responsibility Acceptance	Experimental	Pre-test	0.119	0.200
	Experimental	Post-test	0.121	0.200
	Control	Pre-test	0.163	0.200
	Control	Post-test	0.155	0.200
Lawfulness	Experimental	Pre-test	0.142	0.200
	Experimental	Post-test	0.167	0.200
	Control	Pre-test	0.152	0.200
	Control	Post-test	0.154	0.200

The Kolmogorov–Smirnov test results indicate that the significance levels for all variables were greater than 0.05 ($p > 0.05$), confirming that the data were normally distributed.

Table 4. Levene's Test for Homogeneity of Variances

Variable	F	df1	df2	Sig.
Responsibility Acceptance	2.584	1	28	0.119
Lawfulness	1.124	1	28	0.298

evene's test results show that the significance values for responsibility acceptance ($p = 0.119$) and lawfulness ($p = 0.298$) were greater than 0.05, indicating homogeneity of variances. Therefore, the assumption of equal variances was met. Additionally, regression slope homogeneity was tested and found to be non-significant ($p > 0.05$). Box's M test ($F = 1.502$, $p = 0.212$) confirmed the homogeneity of covariance matrices. Therefore, all assumptions for conducting Multivariate Analysis of Covariance (MANCOVA) were satisfied.

Table 5. Multivariate Tests of Between-Subjects Effects

Test	Value	F	Hypothesis df	Error df	Sig.	Eta Squared
Pillai's Trace	0.915	134.468	2	25	<0.01	0.915
Wilks' Lambda	0.085	134.468	2	25	<0.01	0.915
Hotelling's Trace	10.757	134.468	2	25	<0.01	0.915
Roy's Largest Root	10.757	134.468	2	25	<0.01	0.915

The results of the multivariate analysis of covariance indicate a statistically significant difference between the experimental and control groups on at least one dependent variable after controlling for pre-test scores ($p < 0.01$). The large effect size ($\eta^2 = 0.915$) suggests a strong overall impact of the intervention.

Table 6. Analysis of Covariance (ANCOVA) Results

Variable	Sum of Squares	df	Mean Square	F	Sig.	Eta Squared
Responsibility Acceptance	1151.637	1	1151.637	229.216	<0.01	0.898
Lawfulness	1080.695	1	1080.695	152.904	<0.01	0.855

The ANCOVA results, controlling for pre-test scores, indicate that waste management culture training had a significant effect on responsibility acceptance ($F = 229.216$, $p < 0.01$) and lawfulness ($F = 152.904$, $p < 0.01$). Based on the eta squared values, the intervention explained 89% of the variance in responsibility acceptance and 85% of the variance in lawfulness, indicating a very strong practical effect. In conclusion, waste management culture training was highly effective in improving responsibility acceptance and lawfulness among adolescent citizens.

Summary and Conclusion

The present study aimed to examine the impact of waste management culture training on adolescents' responsibility acceptance and lawfulness. The findings demonstrated that the intervention had a statistically significant and substantial effect on both variables. After controlling for pre-test scores, students in the experimental group showed a marked increase in responsibility acceptance and compliance with rules compared to the control group. The effect sizes were large, indicating that the training program was not only statistically significant but also practically meaningful. These results suggest that structured waste management education can function as a powerful developmental tool for strengthening civic responsibility and adherence to social regulations among adolescents.

The findings of this study are consistent with the results of Fayshal (2022), Wu et al. (2022), and Masoud et al. (1401), who reported that environmental education programs significantly enhance responsible behavior and legal awareness among young people. Similar to their findings, the present research confirms that when environmental education is delivered in a structured and participatory manner, it produces measurable cognitive and behavioral changes. The consistency across these studies may be attributed to the shared emphasis on experiential learning, awareness-building, and participatory engagement as core components of environmental training.

From a cognitive perspective, waste management training appears to enhance students' understanding of the consequences of irresponsible behavior. By clarifying environmental damage, legal penalties, and broader social impacts, the program strengthened students' moral reasoning and rule awareness. This aligns with research by Wu et al. (2022), which demonstrated that environmental law education increases adolescents' legal consciousness and willingness to comply with regulations. However, while Wu et al. primarily emphasized legal knowledge acquisition, the present study extends these findings by demonstrating that responsibility acceptance also increases alongside legal compliance, suggesting an integrated development of moral and civic identity.

The findings can also be interpreted through the lens of Bandura's Social Learning Theory. Students' active participation in waste separation and recycling activities provided modeling opportunities, reinforcement, and mastery experiences. Similar findings were reported by Salimi, Azizi, Srisarajivakul, and Sajadi (2025), who found that environmental engagement enhances internalized responsibility through experiential learning. The present study confirms this mechanism and further suggests that repeated behavioral practice across school and home contexts contributes to the institutionalization of responsible behavior. This strengthens previous research by showing that environmental training not only raises awareness but also stabilizes behavioral patterns.

At the emotional level, participation in practical waste projects increased students' sense of belonging and intrinsic motivation. This aligns with Fayshal (2022), who emphasized the role of emotional engagement in sustaining environmental responsibility. However, unlike some prior studies that focused primarily on attitude change, the present research demonstrates measurable behavioral compliance, indicating that emotional involvement translated into observable lawful conduct.

Regarding lawfulness, the findings are also consistent with Kohlberg's (1971) theory of moral development. Adolescents, typically positioned within the conventional or "social contract" stage, are motivated to follow rules when they understand their function in maintaining social order. The training program clarified legal frameworks related to waste management, thereby reinforcing rule-following as a socially meaningful behavior. This is consistent with Wu et al. (2022), who reported increased positive attitudes toward law adherence following environmental legal education.

Nevertheless, some divergence from prior research is noteworthy. Certain studies have reported moderate rather than large effect sizes in environmental education programs. The stronger effects observed in the present study may be attributed to the interactive, practice-based structure of the intervention, the integration of cognitive, emotional, and behavioral components, and the contextual relevance of waste management to students' daily lives. This suggests that implementation quality and contextual adaptation play a decisive role in program effectiveness.

Overall, the results of this study indicate that waste management culture training is an effective educational strategy for promoting responsibility acceptance and lawfulness among adolescents. The intervention influenced students at cognitive, emotional, and behavioral levels, leading to both attitudinal change and behavioral compliance. The large effect sizes demonstrate the strong practical value of integrating structured environmental education into school curricula.

These findings highlight the importance of designing participatory, experience-based environmental education programs that not only increase awareness but also cultivate civic responsibility and legal commitment. Waste management training, when systematically

implemented, can contribute to the development of responsible, law-abiding citizens and support broader societal goals related to environmental sustainability and social order.

Despite its strengths, this study had limitations, including limited control over intervening variables such as intelligence and parental education level, and the absence of long-term follow-up assessment. Future research should employ longitudinal designs to evaluate the sustainability of effects and should include more culturally and geographically diverse samples .

In conclusion, integrating waste management culture education into formal educational systems and municipal programs can serve as a strategic investment in cultivating responsible and law-abiding future citizens.

The present study demonstrated that waste management culture training can significantly enhance adolescents' responsibility acceptance and lawfulness. The findings indicated that students in the experimental group showed substantial improvements in both variables compared to the control group. These results highlight that structured, participatory, and practice-based educational interventions can effectively foster responsible and law-abiding behaviors. The training influenced students cognitively, emotionally, and behaviorally, indicating that responsibility and compliance are not merely knowledge-based, but are shaped through integrated experiences that connect awareness, motivation, and repeated practice.

From a cognitive perspective, the training increased students' understanding of the environmental and legal consequences of improper waste disposal. By clarifying the link between personal actions and broader societal impacts, students developed a deeper awareness of why responsible behavior is necessary. These findings are consistent with Wu et al. (2022) and Salimi et al. (2025), who reported that environmental education enhances adolescents' awareness and promotes adherence to laws and socially desirable behaviors. However, the current study extends previous research by demonstrating that this cognitive development also translates into actual behavioral change, as students practiced responsible waste management in both school and home environments.

Emotionally, participation in practical waste separation and recycling activities strengthened students' intrinsic motivation and sense of belonging to their community and environment. This aligns with Bandura's social learning theory, which emphasizes the role of modeling, reinforcement, and direct experience in behavioral acquisition. The current study shows that students not only adopted responsible behaviors themselves but also encouraged peers to do the same, reflecting the social amplification of positive behaviors. These findings indicate that emotional engagement and active participation are critical components in internalizing responsibility and lawful behavior.

Practical Recommendations

Based on the findings of this study, waste management culture training was shown to effectively enhance adolescents' responsibility acceptance and lawfulness. Therefore, one of the most important practical recommendations is the integration of environmental education programs with a focus on waste management culture into the school curriculum. These programs should be delivered in an interactive and participatory manner, enabling students to engage actively with the concepts of responsibility and adherence to rules. Hands-on projects such as waste separation, recycling activities, and group-based initiatives can strengthen intrinsic motivation, a sense of social belonging, and the internalization of responsible behaviors, ensuring that such practices become part of students' daily lives.

In addition to schools, municipalities and local authorities can play a vital role by collaborating with educational institutions to implement waste management education at the community level. Workshops, awareness campaigns, and participatory activities in public spaces can help

adolescents understand that responsible behavior and compliance with regulations are not merely school requirements, but essential elements of civic life and environmental stewardship. Such initiatives can contribute to the development of active citizenship and reinforce law-abiding behavior across society, highlighting the role of social institutions in sustaining these behaviors.

Moreover, it is recommended to design multidisciplinary and integrated programs that combine practical, cognitive, ethical, and legal dimensions of environmental education. For example, teaching students about the social and environmental consequences of irresponsible behavior, introducing relevant environmental laws, and providing problem-solving opportunities through group activities can deepen learning and strengthen both responsibility and lawfulness. Experiential learning combined with discussion and reflection fosters cognitive and emotional development, increasing the likelihood that responsible and law-abiding behaviors are sustained in real-life contexts.

Finally, it is essential to implement continuous evaluation and follow-up mechanisms to assess the sustainability and long-term effects of waste management culture training. Using assessment tools in schools and communities, educators and policymakers can identify strengths and weaknesses in the programs and provide complementary or corrective interventions. This ensures that educational initiatives are not one-time events but allow students sufficient opportunities to practice and consolidate responsible and law-abiding behaviors over time, reinforcing their role as active and conscientious citizens.

Regarding lawfulness, the training improved students' comprehension of relevant environmental regulations and the consequences of violations. This aligns with Kohlberg's (1971) theory of moral development, which posits that adolescents in the conventional stage of moral reasoning are motivated to comply with laws to maintain social order. By clarifying both the legal frameworks and their social significance, students developed a more positive attitude toward adherence to rules, consistent with findings by Wu et al. (2022) that legal education fosters both awareness and compliance among adolescents. Unlike some prior studies, this research demonstrates that responsibility and lawfulness can be simultaneously strengthened when education integrates cognitive understanding, practical engagement, and moral reasoning.

Overall, the findings suggest that waste management culture training is a highly effective educational strategy for cultivating responsible and law-abiding citizens. The large effect sizes observed indicate that the program had strong practical significance, with approximately 85–89% of the variance in responsibility and lawfulness explained by the intervention. This demonstrates the potential of environmental education programs not only to improve knowledge and attitudes but also to institutionalize long-term behavioral changes in adolescents.

Finally, integrating waste management culture education into formal school curricula and municipal programs could serve as a strategic tool for developing civic responsibility, promoting legal compliance, and supporting environmental sustainability. Such interventions contribute to the formation of socially conscious citizens who understand the impact of their actions, adhere to laws, and actively engage in promoting positive behaviors in their communities. In sum, this research underscores the importance of combining cognitive, emotional, and behavioral approaches in education to cultivate a culture of responsibility and lawfulness among future generations.

Limitations of the Study

Despite the significant contributions and findings of this research, several limitations should be considered when interpreting the results. First, the study focused solely on a sample of adolescents selected from specific schools and regions, which may limit the generalizability of the findings. Cultural, social, and educational contexts vary widely across regions, and it is possible that the effectiveness of waste management culture training on responsibility and lawfulness may differ in other populations or demographic groups. Future research should therefore include more diverse samples from different geographic and socio-economic backgrounds to strengthen external validity. Second, while the study employed rigorous training and structured interventions, it was not possible to fully control intervening variables such as participants' prior knowledge, family background, intelligence, or parental involvement in environmental and legal education. These factors may have influenced the extent to which students adopted responsible and law-abiding behaviors. Although pre-test scores were used as covariates in the analysis, residual effects from these uncontrolled variables may still exist, potentially affecting the accuracy of the observed outcomes. Third, the study design did not include a long-term follow-up, which limits our understanding of the sustainability of the behavioral changes. While immediate post-test results indicated significant improvements in responsibility and lawfulness, it remains unclear whether these behaviors will persist over time without continued reinforcement or practice. Longitudinal studies are therefore recommended to evaluate the durability and stability of the intervention's effects.

Ethical considerations

Ethical and confidentiality considerations have been observed in compiling this article.

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Conflict of interest

According to the authors, there are no conflicts of interest in this article.

Authors' Contributions

This article is taken from the Master's thesis in Educational Leadership, New Sindh , at Islamic Azad University, South Tehran Branch. It is.

Research Limitations

Due to the lack of formal and documented promotion of organizational effectiveness in schools, the possibility of utilizing experiences and conducting comparisons among findings is constrained.

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