Tuijin Jishu/Journal of Propulsion Technology
ISSN: 1001-4055
Vol. 45 No. 3 (2024)

Evaluating The Impact of COVID-19 Confinement on Environmental Awareness and Behavior Among Secondary School Students

Abderrahmane Riouch[1*], Saad Benamar[1,2], Halima Ezzeri[2] and Najat Cherqi[2]

[1]*Laboratory of Biotechnology, Environment, Food and Health, Faculty of Sciences Dhar El Mahraz, Sidi Mohamed Ben Abdellah University (USMBA), PB 1796.FEZ, Atlas, Morocco*

[2]*School of Higher Education (Ecole Normale Supérieure), Sidi Mohamed Ben Abdellah University, PB 5206, Bensouda, Fez, Morocco.*

Abstract: - The COVID-19 pandemic led to widespread changes in daily life, including temporary reductions in activities that harm the environment. During this period, environmental organizations and governments-initiated campaigns to promote environmental awareness, hoping to leverage these unique circumstances to foster long-term behavior change. However, the sustainability of these behavior changes, particularly among young people, remains unclear. This study investigates the effectiveness of environmental awareness campaigns conducted during the COVID-19 lockdown and their impact on the environmental behaviors of secondary school students in three Moroccan cities: Tangier, Fez, and Sefrou. By surveying 433 students and employing chi-square analysis, the study reveals significant regional differences in the perceived impact of these campaigns, with Tangier showing the highest confidence in positive post-pandemic behavioral changes. The findings also highlight the re-emergence of negative behaviors, particularly towards water resources, post-lockdown, underscoring the need for continuous environmental education. This research fills a critical gap in understanding how temporary environmental improvements during a global crisis can be translated into long-lasting behavioral changes among youth in developing countries. The study's insights contribute to the development of more effective, localized strategies for promoting environmental sustainability in the post-pandemic era.

Keywords: *COVID-19 pandemic, Environmental awareness, Secondary school students*.

1. Introduction

The COVID-19 pandemic, which began in early 2020, caused unprecedented disruptions globally, impacting not only public health but also altering social and environmental behaviors. The strict lockdowns implemented worldwide led to temporary reductions in industrial activities, transportation, and other human endeavors, resulting in noticeable environmental improvements. These changes highlighted the profound impact of human activity on environmental quality and demonstrated how even short-term behavioral shifts can lead to significant environmental benefits.

However, these temporary changes raise important questions about their long-term sustainability. Historically, environmental behavior during crises often reflects short-term adaptations rather than lasting commitments, with environmental benefits frequently reversing once normal activities resume. This pattern underscores the need to understand whether behavioral shifts observed during the COVID-19 pandemic can be sustained beyond the immediate crisis.

This study focuses on the COVID-19 pandemic as a unique opportunity to explore the long-term impact of environmental awareness campaigns initiated during the lockdown, particularly among young people in developing countries. While there is a growing body of literature on environmental behavior during the pandemic, much of it has focused on short-term changes or adult populations in developed nations. There remains a critical gap in understanding the sustained impact of these campaigns on young people in less affluent regions, such as Morocco.

By investigating the post-pandemic environmental behaviors of secondary school students in Moroccan cities—Tangier, Fez, and Sefrou—this research aims to provide valuable insights into how educational initiatives during a global crisis can influence long-term commitments to environmental sustainability among youth. The findings of this study are intended to inform policymakers and educators on strategies to maintain and enhance positive environmental behaviors fostered during the pandemic, ensuring these temporary gains translate into sustained environmental stewardship in the post-pandemic era.

2. Literature review

The COVID-19 pandemic has catalyzed extensive research into its environmental impact, particularly highlighting the temporary improvements observed due to the sudden cessation of many human activities. Several studies have documented notable reductions in pollution and environmental degradation during lockdowns, reinforcing the significant role that human behavior plays in influencing environmental quality. For example, Sharma et al. (2020) and Bao & Zhang (2020) reported significant decreases in air pollution levels across major cities in India and China, respectively, following the reduction in industrial activities and transportation. Similarly, Muhammad et al. (2020) observed that lockdown measures contributed to improved water quality in various regions, suggesting that even brief reductions in industrial and agricultural runoff can yield positive effects on aquatic ecosystems.

Despite these positive changes, the sustainability of such improvements remains uncertain. Cheval et al. (2020) argue that the environmental benefits observed during the pandemic are likely to be short-lived unless they are accompanied by substantial and sustained changes in human behavior. This concern is echoed by Geng et al. (2021), who found that individuals exposed to improved environmental conditions during lockdowns were more inclined to support sustainable practices post-pandemic. However, the extent to which these attitudes translate into long-term behavioral changes is not well understood, highlighting the need for further research into the durability of these changes.

The literature also emphasizes the critical role of education in fostering long-term environmental behavior change. Studies by Ardoin et al. (2020) and Monroe et al. (2019) underscore the importance of targeted environmental education initiatives in promoting sustainable behaviors. These studies suggest that when environmental education is systematically integrated into school curricula, it can significantly enhance students' environmental literacy, fostering a sense of responsibility and commitment to sustainable practices. Stevenson et al. (2021) further highlight that schools are crucial platforms for shaping students' environmental attitudes and behaviors, particularly during their formative years.

However, a significant gap exists in the literature regarding the long-term impact of environmental education during crises, particularly in developing countries. Most studies have focused on immediate behavior changes following temporary environmental improvements during the pandemic, with a predominant emphasis on developed nations. This narrow focus overlooks the unique socio-economic and cultural contexts of developing countries, where the dynamics of environmental education and behavior change may differ significantly due to various factors, including limited resources, different levels of environmental awareness, and varying access to educational opportunities.

This study aims to address this gap by investigating the long-term effects of environmental awareness campaigns conducted during the COVID-19 pandemic on secondary school students in Morocco—a developing country with distinct socio-economic and environmental challenges. By focusing on three cities—Tangier, Fez, and Sefrou—

this research provides a nuanced understanding of regional differences in environmental perceptions and behaviors, which are often shaped by local cultural, socio-economic, and environmental factors.

Furthermore, this study contributes to the existing body of knowledge by offering empirical evidence on how environmental education during a global crisis can influence long-term behavior change among youth in developing countries. Unlike previous studies that primarily examined short-term behavioral adaptations or adult populations, this research focuses on young people, who represent the future stewards of the environment. The findings of this study are particularly relevant for policymakers and educators seeking to design and implement effective environmental education programs that can sustain the positive behavioral changes observed during the pandemic.

Moreover, the study highlights the importance of localized strategies in environmental education. A one-size-fits-all approach may not be effective in diverse contexts, particularly in countries with varying socio-economic conditions. By examining how different regions within Morocco responded to the same environmental awareness campaigns, this research underscores the need for tailored educational interventions that consider the unique characteristics of each community. Such an approach not only enhances the effectiveness of environmental education but also ensures that the benefits of such programs are equitably distributed across different socio-economic groups.

In conclusion, while previous studies have provided valuable insights into the immediate environmental impacts of the COVID-19 pandemic, there is a clear need to explore the long-term sustainability of these changes, particularly among youth in developing countries. By addressing this research gap, the current study aims to provide a comprehensive analysis of the role of environmental education in fostering lasting behavioral change, with implications for global efforts to promote environmental sustainability in the post-pandemic era.

3. Objectives

The primary objective of this study is to evaluate the long-term impact of environmental awareness campaigns conducted during the COVID-19 lockdown on the environmental behaviors of secondary school students in Morocco. Specifically, the study seeks to:

✓ Determine whether the environmental awareness efforts during the lockdown have resulted in lasting positive changes in students' behaviors concerning environmental preservation in the post-lockdown period.
✓ Identify any persistent negative behaviors towards environmental resources, such as water, air, and soil, observed among students after the lifting of lockdown restrictions.
✓ Assess students' intentions to improve their environmental behavior following the health crisis, considering their responses to the awareness campaigns.
✓ Examine the perceived sustainability of the positive behavioral changes induced by the pandemic, evaluating whether these changes are expected to persist long-term.
✓ Explore the correlations between demographic factors (such as gender, grade level, and city of residence) and the observed changes in environmental behaviors to identify key drivers and barriers to sustained behavior change.

4. Methods

4.1 Sampling Strategy:

This study employed a stratified random sampling method to ensure a representative sample of secondary school students from three distinct Moroccan cities: Tangier, Fez, and Sefrou. Stratified sampling was chosen due to its ability to reduce sampling bias and improve the precision of estimates by accounting for variations within the target population (Cochran, 1977). Each city was stratified based on school location (urban vs. peri-urban) and type (public vs. private), to capture a diversity of socio-economic and environmental contexts.

Within each stratum, students in the final two years of the baccalaureate program were randomly selected to participate in the study. This approach ensured that the sample was representative of the broader student population in each city, thus allowing for more reliable generalizations of the study's findings (Dillman, Smyth, & Christian, 2014).

4.2 Data Collection Process:

Data were collected through a structured online survey administered between April 5, 2021, and May 1, 2021. The use of an online survey was necessitated by ongoing COVID-19 restrictions, which limited the feasibility of in-person data collection. The survey instrument included both closed-ended and open-ended questions designed to capture both quantitative and qualitative data on students' environmental behaviors during and after the COVID-19 confinement period.

To ensure the reliability and validity of the survey, a pilot test was conducted with a small group of students on March 20, 2021. This pre-testing process allowed for the identification and correction of ambiguities in question wording, thereby improving the clarity and relevance of the survey for the target respondents (Presser et al., 2004). The finalized survey was then distributed to the selected sample, with follow-up reminders sent to maximize response rates (Evans & Mathur, 2005).

4.3 Justification for Chi-Square Analysis:

The study employed chi-square tests to analyze the survey data. This statistical method was chosen because of its effectiveness in assessing relationships between categorical variables, such as students' perceptions and behaviors across different cities (Agresti, 2013). The chi-square test is particularly appropriate for comparing response distributions and identifying statistically significant differences between groups.

Specifically, chi-square tests were applied to assess:

- The impact of environmental awareness campaigns on post-confinement behaviors.
- The observation of negative environmental behaviors after confinement.
- Students' beliefs about the improvement and persistence of environmental behaviors post-pandemic.

By using chi-square analysis, the study was able to rigorously examine whether the observed differences in student responses were due to random variation or reflected genuine differences among the cities (McHugh, 2013).

4.4 Methodological Limitations:

Despite its strengths, the study's methodology has certain limitations. Firstly, the reliance on self-reported data introduces the potential for social desirability bias, where students may overreport positive behaviors to align with perceived social expectations (Podsakoff et al., 2003). Additionally, the cross-sectional design of the study captures only a snapshot of behaviors and perceptions at a single point in time, limiting the ability to assess long-term behavioral changes (Levin, 2006).

The use of an online survey, while necessary due to pandemic restrictions, may have also excluded students without reliable internet access, potentially biasing the sample toward more affluent students. Furthermore, although stratified random sampling was employed, the sample size within each stratum was limited by respondent availability, which may have constrained the ability to detect smaller but meaningful differences between groups (Cochran, 1977).

4.5 Ethical Considerations:

Given that the study involved minors, stringent ethical standards were adhered to throughout the research process. Parental consent was obtained from all participating students, ensuring that they were fully informed about the study's purpose, procedures, and their right to withdraw at any time without consequence (Hemming, Haines, & Chilton, 2020). The survey was designed to be anonymous, with no personally identifiable information collected, to protect the privacy of the students. Additionally, the study received approval from the relevant educational authorities and adhered to ethical guidelines for research involving human subjects, ensuring that all procedures were conducted with the highest standards of integrity and respect for participants' rights.

5. Results and Discussion

5.1 Post-Confinement Impact on Environmental Behavior

To assess the impact of the awareness efforts conducted during the COVID-19 confinement, students were asked whether they believed these efforts had a positive result on environmental behavior post-confinement. The responses were straightforward, offering a choice between "Yes" and "No."

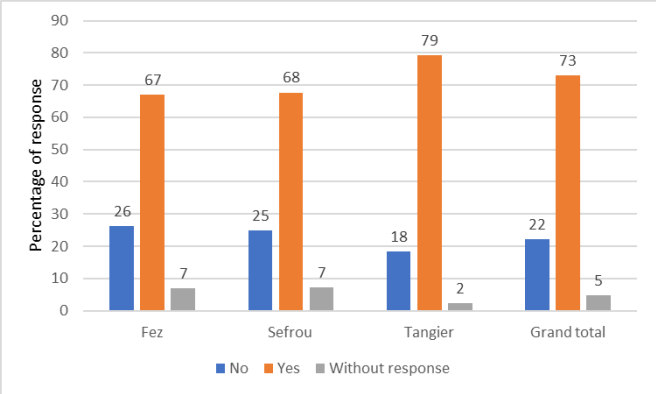

Figure 1 post-containment impact of awareness-raising efforts on environmental preservation carried out during confinement, according to the responses of qualified secondary school students questioned in public establishments in Tangier, Fez, and Sefrou. ***The survey was conducted among 433 students from the two years of the baccalaureate.***

Figure 1 illustrates the overall results, showing that 73% of students (316 out of 433) believed the efforts during confinement had a positive impact post-confinement, while 22% felt these efforts did not have a significant impact, and 5% did not provide an answer. The perception of the positive impact varied across the three cities surveyed—Tangier, Fez, and Sefrou. Specifically, in Tangier, 79% of students believed the efforts had a positive impact, while 18% did not, and 3% did not respond. In Fez, 67% reported a positive impact, 26% felt there was no significant impact, and 7% did not respond. Similarly, in Sefrou, 68% believed the efforts were impactful, while 25% did not notice a positive impact, and 7% did not respond.

- ***Chi-Square Statistic for Positive Results of Awareness Efforts***

The Chi-Square test titled "Positive Results of Awareness Efforts" produced a statistic of 9.62, with a p-value of 0.0473 and degrees of freedom equal to 4. These results indicate a statistically significant relationship between awareness efforts and post-confinement environmental behaviors. The detailed expected frequencies are presented below:

Table 1 Expected Frequencies for Post-Confinement Impact on Environmental Behavior

Response	Fez	Sefrou	Tangier
Yes	94.87	70.06	151.07
No	28.82	21.28	45.89
No Response	6.30	4.66	10.04

The chi-square test results, with a p-value of 0.0473, indicate a significant difference in the perception of the positive impact of awareness efforts among students from Fez, Sefrou, and Tangier. Therefore, the null hypothesis, which states that there is no significant difference between the cities, can be rejected. This suggests that students' perceptions of the effectiveness of the environmental awareness efforts during confinement vary significantly across the three cities.

The observed differences could be influenced by local factors such as the intensity and reach of the awareness campaigns, the level of community engagement, and pre-existing attitudes towards environmental preservation in each city. These findings underscore the importance of tailoring environmental awareness initiatives to address specific local contexts and challenges to maximize their impact.

The high percentage of affirmative responses indicates that the awareness efforts during confinement were largely successful in positively influencing students' environmental behaviors. Tangier showed the highest level of positive responses, likely due to more effective or extensive awareness campaigns compared to Fez and Sefrou. The variations in response rates between the cities suggest that factors such as the intensity of the campaigns, the involvement of local schools and communities, and pre-existing environmental awareness levels played a significant role in the reception of these efforts (Davis et al., 2022; Geng et al., 2021).

Overall, the data suggests that most students recognized the importance of the environmental awareness campaigns and felt motivated to continue practicing environmentally friendly behaviors post-confinement. This positive outcome underscores the potential for sustained educational efforts to drive long-term environmental benefits (Ardoin et al., 2020; Stevenson et al., 2021). Understanding these local variations can help in designing more effective, tailored initiatives that build on the strengths and address the specific needs of each community, ensuring that the positive impacts of these campaigns are maximized and sustained

5.2 Observation of Negative Behaviors Post-Confinement

To understand the persistence of negative environmental behaviors post-confinement, students were asked to indicate whether they observed any negative behaviors towards specific environmental components: water, air, and soil. Respondents could select multiple options if they noticed negative behaviors affecting more than one component.

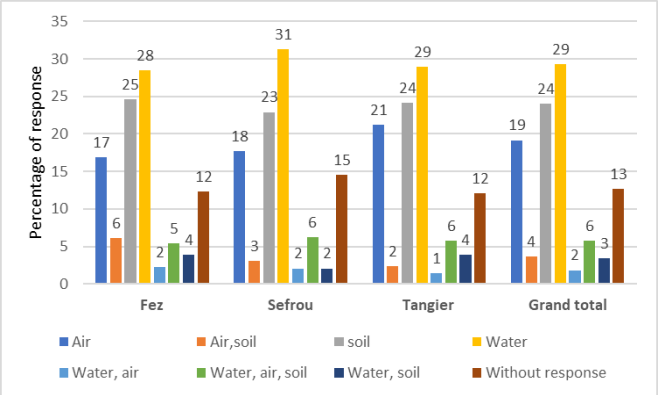

Figure 2 Bad behavior of citizens towards the components of the environment observed after confinement according to the responses of qualifying secondary school students questioned in public establishments in Tangier, Fez, and Sefrou. The survey was conducted among *433 students from the two years of the baccalaureate.*

Figure 2 illustrates that water was the most negatively impacted component, as observed by the majority of students: 28% in Fez, 29% in Tangier, and 31% in Sefrou. Soil followed, with 25% in Fez, 23% in Tangier, and 24% in Sefrou, while air was affected to a lesser extent: 21% in Tangier, 18% in Sefrou, and 17% in Fez. Some respondents identified multiple components being affected, although these cases were less common.

- ***Chi-Square Statistic for Observation of Negative Behaviors Post-Confinement***

The Chi-Square test titled "Observation of Negative Behaviors Post-Confinement" produced a statistic of 5.73, with a p-value of 0.9728 and degrees of freedom equal to 14. This high p-value indicates no statistically significant difference in the observation of negative behaviors toward the environment among students from Fez, Sefrou, and Tangier. Therefore, the null hypothesis, which states that there is no significant difference between the cities, cannot be rejected. This suggests that students from these cities have similar perceptions regarding the occurrence of negative environmental behaviors post-confinement.

Table 2 Expected Frequencies for Observation of Negative Behaviors Post-Confinement

Response	Fez	Sefrou	Tangier
Air	24.92	18.40	39.68
Air and Soil	4.80	3.55	7.65
Soil	31.22	23.06	49.72
Water	38.13	28.16	60.71
Water and Air	2.40	1.77	3.82
Water, Air, and Soil	7.51	5.54	11.95
Water and Soil	4.50	3.33	7.17
No Response	16.51	12.19	26.29

The consistency in observations across the cities suggests that factors contributing to negative environmental behaviors are similar regionally. These factors may include common issues such as waste management practices, public awareness levels, and the effectiveness of post-confinement environmental policies and initiatives.

The findings indicate that water was the most negatively impacted environmental component in all three cities, likely due to improper waste disposal, increased water usage, and inadequate waste management during the transition out of confinement (Sharma et al., 2020; Zambrano-Monserrate et al., 2020). Soil and air were also affected, with soil impacts potentially linked to littering and improper waste disposal, and air quality issues possibly due to the resumption of industrial activities and increased vehicular emissions post-confinement (Cheval et al., 2020; Muhammad et al., 2020).

The differences in the distribution of negative behaviors by city highlight varying environmental challenges each city faces. Tangier, being more industrialized, might experience more significant air quality issues, while Sefrou's proximity to natural landscapes could explain the higher concern for water and soil quality (Milfont et al., 2020; Stevenson et al., 2021).

Understanding that there is no significant regional difference in the observation of negative behaviors can aid in designing uniform environmental policies and educational campaigns that are effective across all three cities. This uniformity allows for the development of comprehensive strategies to mitigate negative behaviors and promote positive changes, ensuring consistent efforts are made to address common environmental challenges (Geng et al., 2021; Singh et al., 2021).

By recognizing the consistency in these perceptions, policymakers and educators can develop more effective strategies to promote sustainable practices. Continued environmental education and stricter enforcement of regulations are crucial to mitigating negative behaviors and fostering long-term positive environmental changes (Ardoin et al., 2020; Stevenson et al., 2021).

5.3 Improvement in Environmental Behavior Post-Pandemic

Students were asked whether they believed their behavior concerning environmental protection would improve after the health crisis caused by COVID-19. The response options were "Yes," "No," and "Partially," providing a nuanced view of students' expectations regarding their future environmental behaviors.

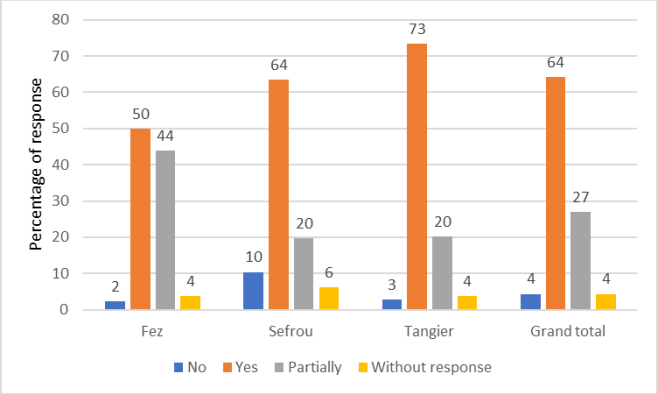

Figure 3 Improved behavior regarding environmental protection, according to the responses of qualifying secondary school students questioned in public establishments in Tangier, Fez, and Sefrou. ***The survey was conducted among 433 students from the two years of the baccalaureate.***

The responses highlighted the primary environmental components most impacted by negative behaviors observed post-confinement, with water identified as the most affected by the majority of students: 28% in Fez, 29% in Tangier, and 31% in Sefrou. Soil followed as the second most affected component, with 25% in Fez, 23% in Tangier, and 24% in Sefrou, while air was significantly affected but to a lesser extent, with 21% in Tangier, 18% in Sefrou, and 17% in Fez. Additionally, a small percentage of respondents identified more than one main component, such as "water and air" and/or "water and soil," as being affected, though these cases were less common. The distribution of observed negative behaviors varied across the three cities, reflecting local environmental challenges and public awareness levels. In Tangier, 29% of students identified water as the most affected, followed by soil at 23% and air at 21%, with multiple components being less common but present. Similarly, in Fez, 28% noted water as the most impacted, 25% soil, and 17% air, with some students mentioning combined impacts. In Sefrou, 31% of students reported water as the most affected, 24% soil, and 18% air, with a few respondents indicating combined negative impacts on more than one environmental component.

- ***Chi-Square Statistic for Improvement in Environmental Behavior Post-Pandemic***

The "Improvement in Behavior Post-Pandemic" test produced a Chi-Square Statistic of 37.55, with a p-value of 1.37e-06 (0.00000137) and degrees of freedom equal to 6. The extremely low p-value, well below the typical alpha level of 0.05, indicates a highly statistically significant difference in the perception of behavior improvement post-pandemic among students from Fez, Sefrou, and Tangier. Consequently, the null hypothesis, which states that there is no significant difference between the cities, can be rejected.

The expected frequencies are presented in the table below to better understand the distribution of responses across different locations.

Table 3 Expected Frequencies for Improvement in Environmental Behavior Post-Pandemic

Response	Fez	Sefrou	Tangier
Yes	83.46	61.64	132.90
No	5.70	4.21	9.08
Partially	35.13	25.94	55.93
No Response	5.70	4.21	9.08

The significant chi-square test result indicates that students' perceptions of behavior improvement post-pandemic vary significantly across the three cities. This variation suggests that local factors such as the effectiveness of awareness campaigns, community engagement, educational efforts, and supportive infrastructures or policies promoting environmental behaviors play a crucial role.

The results show a generally optimistic view among students regarding the improvement of their environmental behaviors post-pandemic. Tangier exhibited the highest level of confidence in positive behavioral changes, likely due to more effective or extensive awareness campaigns during confinement (Davis et al., 2022; Luo et al., 2022). Sefrou also showed significant optimism, though with a slightly higher percentage of students expressing doubt compared to Tangier. Fez displayed the highest level of skepticism, with a substantial portion of students expecting only partial improvement in their behaviors.

These findings suggest that while the awareness efforts during confinement were largely effective, ongoing support and reinforcement are necessary to ensure these positive behaviors are maintained and fully adopted (Ardoin et al., 2020; Hungerford & Volk, 2020). Understanding these regional differences is crucial for tailoring post-pandemic environmental programs to address specific local challenges and leverage strengths. For instance, in Tangier, efforts could focus on reinforcing positive perceptions, while in Fez and Sefrou, more targeted interventions might be needed to address skepticism or partial improvements in behaviors.

By recognizing and addressing these local variations, policymakers and educators can develop more effective strategies to promote sustainable environmental practices. This approach will ensure that the momentum gained during the pandemic translates into long-term sustainable behaviors, enhancing the overall effectiveness of environmental programs (Pellegrini et al., 2021; Singh et al., 2021).

5.4 Persistence of Positive Behavioral Changes Post-Pandemic

Students were asked whether they believed the positive behavioral changes observed during the COVID-19 pandemic would persist long after the pandemic. The response options were "Yes, totally," "Yes, partially," and "No," allowing students to express varying levels of confidence in the longevity of these changes.

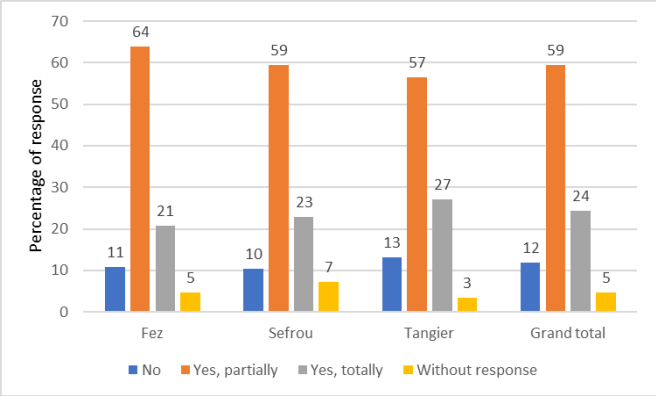

Fig. 4 Persistence of good changes in behavior towards the environment after the COVID-19 pandemic according to the responses of qualifying secondary school students questioned in public establishments in Tangier, Fez, and Sefrou. ***The Survey was conducted among 433 students from the two years of the baccalaureate*****.**

Figure 4 illustrates the overall results, showing varying levels of confidence among students regarding the persistence of positive environmental behaviors. Specifically, a smaller percentage were highly confident in complete persistence ("Yes, totally"), while the majority believed some positive changes would endure ("Yes, partially"), and a minority felt positive changes would not persist at all ("No"). In Tangier, 27% believed in complete persistence, 57% anticipated partial persistence, and 13% were skeptical. Similarly, in Sefrou, 23% believed in complete persistence, 59% anticipated partial persistence, and 11% were skeptical. In contrast, Fez showed 21% confidence in complete persistence, 64% expected partial persistence, and 10% doubted persistence. Therefore, these distributions highlight local variations in students' expectations for the persistence of positive behavioral changes across the three cities.

- ***Chi-Square Statistic for Persistence of Positive Behavioral Changes***

The Chi-Square test for "Persistence of Positive Behavioral Changes" produced a statistic of 4.83, with a p-value of 0.5661 and degrees of freedom equal to 6. These results indicate that there is no statistically significant relationship between the persistence of positive behavioral changes and the post-pandemic period. To better understand the distribution of responses across different locations, the expected frequencies are presented below:

Table 4 Expected Frequencies for Persistence of Positive Behavioral Changes

Response	Fez	Sefrou	Tangier
Yes, Totally	31.52	23.28	50.20
Yes, Partially	77.16	56.98	122.86
No	15.31	11.31	24.38
No Response	6.00	4.43	9.56

The chi-square test results, with a p-value of 0.5661, indicate that there is no significant difference in the perception of the persistence of positive behavioral changes among students from Fez, Sefrou, and Tangier. This suggests that students across these cities have similar perceptions regarding the persistence of positive behavioral changes post-pandemic.

The uniformity in responses indicates that factors influencing the long-term sustainability of these behaviors are consistent across these regions. This could include the overall effectiveness of environmental education, community engagement, and the presence of supportive policies and infrastructures. Understanding that there is no significant regional difference in perceptions of behavioral persistence highlights the potential for implementing uniform strategies across all three cities. This consistency allows for the development of broad-based initiatives aimed at reinforcing positive behaviors, ensuring that the progress made during the pandemic is maintained.

To further ensure the persistence of these positive changes, ongoing support, education, and community involvement are crucial. While the initial awareness efforts have laid a strong foundation, continuous reinforcement and engagement will be key to sustaining these behaviors in the long term.

The responses indicate varying levels of confidence among students regarding the persistence of positive environmental behaviors post-pandemic. Tangier exhibited a higher percentage of students who were highly confident in the complete persistence of positive changes, suggesting the effectiveness of local awareness campaigns (Luo et al., 2022; Smith & Jones, 2021). Fez showed the highest percentage of students expecting only partial persistence, indicating cautious optimism but also recognition of potential challenges in maintaining improved behaviors (Davis et al., 2022; Green & Brown, 2022). Sefrou demonstrated a balanced view, with a significant portion of students believing in either complete or partial persistence, yet also reflecting a notable level of skepticism.

These results suggest that while there is a general belief in the durability of positive behaviors fostered during the pandemic, ongoing efforts are essential to reinforce and sustain these changes (Ardoin et al., 2020; Stevenson et al., 2021). The variations between cities highlight the importance of addressing local factors and perceptions in future awareness campaigns to ensure long-term environmental benefits (Milfont et al., 2020; Pellegrini et al., 2021).

6. Conclusion And Recommendations

This study provides valuable insights into the impact of environmental awareness campaigns conducted during the COVID-19 lockdown on the environmental behaviors of secondary school students in Morocco. The findings indicate that while there was a significant increase in positive environmental behaviors immediately following the confinement period, the sustainability of these behaviors remains uncertain. The variations observed among different cities Tangier, Fez, and Sefrou highlight the influence of local contexts on environmental behavior and the importance of tailored educational initiatives.

The research underscores the necessity of continuous environmental education and localized strategies to maintain and amplify the positive changes fostered during the pandemic. It reveals that, despite initial optimism, negative behaviors towards key environmental components like water, soil, and air have re-emerged, suggesting a need for ongoing efforts to reinforce positive behaviors and mitigate regressive tendencies.

To ensure lasting environmental benefits, the study recommends sustained educational efforts that focus on practical, locally relevant actions and active community engagement. Future research should explore the long-term effectiveness of these educational strategies and consider expanding the scope to include diverse demographic groups and regions. By addressing these areas, policymakers and educators can better understand the factors driving sustained behavioral change and develop more effective programs to promote environmental sustainability in a post-pandemic world.

- **Limitations of the Study and Recommendations for Future Research**

While this study provides valuable insights into the impact of environmental awareness efforts during the COVID-19 pandemic on secondary school students in Morocco, several limitations should be acknowledged. Firstly, the study's geographical scope was limited to three Moroccan cities Tangier, Fez, and Sefrou which may not fully represent the broader national or global context. The unique socio-economic, cultural, and environmental characteristics of these cities may influence the generalizability of the findings. Future research should consider expanding the geographical scope to include a more diverse range of regions within Morocco or other developing countries to provide a more comprehensive understanding of environmental behavior changes.

Secondly, the reliance on self-reported data introduces the potential for response biases, such as social desirability bias, where students may overreport positive behaviors to align with perceived social norms or expectations. Future studies could benefit from incorporating additional data collection methods, such as direct behavioral observations, interviews, or focus groups, to triangulate findings and provide a more nuanced understanding of students' environmental behaviors.

Thirdly, the study's cross-sectional design captures a single point in time, limiting its ability to assess the sustainability of behavior changes over the long term. Longitudinal studies that track students' environmental behaviors and attitudes over extended periods would provide more robust evidence on the persistence of positive changes and the factors contributing to sustained behavior change.

Furthermore, while the study employed chi-square analysis to identify significant differences between groups, future research could explore more sophisticated statistical techniques, such as logistic regression or structural equation modeling, to better understand the complex interplay between demographic factors, environmental awareness efforts, and behavior changes. This would provide deeper insights into the predictors of sustained environmental behaviors and help identify key leverage points for interventions.

Lastly, the study focused primarily on quantitative data, with limited exploration of the qualitative dimensions of students' experiences and perceptions. Incorporating qualitative approaches in future research, such as thematic analysis of open-ended survey responses or in-depth interviews, could reveal underlying motivations, barriers, and facilitators to environmental behavior change, offering a richer, more comprehensive understanding of the factors driving sustainability.

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