

# Wet wipes in green ecosystems of Chernihiv, Ukraine

Nataliia Tkachuk , Dariia Zahryva 

**Purpose.** To assess the pollution of recreation areas in Chernihiv with wet wipes and raise schoolchildren's awareness of the related environmental problems. **Design / Method / Approach.** Direct counting of wet wipes on 100 m<sup>2</sup> in summer and autumn 2024. A socio-pedagogical study of schoolchildren's awareness was conducted through a lecture and an online questionnaire before and after the lecture. **Findings.** Wet wipes were found as litter in recreation areas, indicating a low level of public awareness of their environmental impact. The smallest number of wet wipes was recorded in well-maintained or rarely visited areas. The highest (7 wipes/100 m<sup>2</sup>) was found in frequently visited but uncleaned areas without trash bins. The lecture "EcoSecrets of Wet Wipes" resulted in a positive shift in students' perceptions, making them more aware of wet wipes as environmental pollutants containing hazardous substances and microplastics. **Theoretical Implications.** The findings expand the understanding of the environmental hazard posed by wet wipes and emphasize the need to mitigate their negative impact, particularly by educating schoolchildren about wet wipe pollution. **Practical Implications.** Raising awareness among children about responsible wet wipe use and the need to enhance their biodegradability and environmental safety. This supports the achievement of Sustainable Development Goals by promoting more conscious consumption habits. **Originality / Value.** This study is the first ecological assessment of urban pollution caused by wet wipes in Ukraine and the first socio-pedagogical study on schoolchildren's awareness of this issue. **Research Limitations / Future Research.** Further educational and awareness-raising activities among school and university students regarding the environmental hazards of wet wipes, aligned with Sustainable Development Goals. **Article Type.** Applied Research.

## Keywords:

wet wipes, sustainable materials, Sustainable Development Goals, environmental education

**Мета.** Оцінити забруднення зон відпочинку м. Чернігова вологими серветками та привернути увагу школярів до екологічних проблем, пов'язаних з цим. **Дизайн / Метод / Підхід.** Прямий підрахунок вологих серветок на 100 м<sup>2</sup> влітку та восени 2024 р. Проведено соціально-педагогічне дослідження обізнаності школярів шляхом лекції та онлайн-анкетування до та після лекції. **Результати.** Вологі серветки виявлені як сміття в зонах відпочинку, що свідчить про низький рівень поінформованості населення про їх екологічний вплив. Найменша кількість вологих серветок зафіксована в упорядкованих або маловідвідуваних місцях. Найбільше (7 серветок/100 м<sup>2</sup>) було виявлено в часто відвідуваних, але неприбраних місцях без смітєвих баків. Результатом лекції «Екосекрети вологих серветок» став позитивний зсув у сприйнятті студентів, підвищення їх усвідомлення вологих серветок як забруднювача навколишнього середовища, що містить шкідливі речовини та мікропластик. **Теоретичне значення.** Отримані дані розширюють розуміння екологічної небезпеки, яку становлять вологі серветки, і підкреслюють необхідність пом'якшення їхнього негативного впливу, зокрема шляхом навчання школярів щодо забруднення вологими серветками. **Практичне значення.** Підвищення рівня обізнаності дітей щодо відповідального використання вологих серветок та необхідності підвищення їх здатності до біологічного розкладання та екологічної безпеки. Це сприяє досягненню Цілей сталого розвитку шляхом сприяння більш свідомим споживчим звичкам. **Оригінальність / Цінність.** Дане дослідження є першою в Україні екологічною оцінкою забруднення міст вологими серветками та першим соціально-педагогічним дослідженням обізнаності школярів з цієї проблеми. **Обмеження дослідження / Майбутні дослідження.** Подальші освітні та просвітницькі заходи серед учнів шкіл та студентів щодо екологічної небезпеки вологих серветок відповідно до Цілей сталого розвитку. **Тип статті.** Прикладне дослідження.

## Ключові слова:

вологі серветки, стійкі матеріали, Цілі сталого розвитку, екологічна освіта

## Contributor Details:

Nataliia Tkachuk, Cand. Sc. (Biol.), Assoc. Prof., T.H. Shevchenko National University "Chernihiv Colehium": Chernihiv, UA, [n.tkachuk@chnpu.edu.ua](mailto:n.tkachuk@chnpu.edu.ua)

Dariia Zahryva, schoolgirl, Chernihiv Gymnasium No. 32: Chernihiv, UA, [zagriva2011@ukr.net](mailto:zagriva2011@ukr.net)

Today, the issues of environmental friendliness of materials, a conscious attitude to their use and disposal, occupy an important place in solving the tasks of achieving the Sustainable Development Goals (Kobayashi & Nakajima, 2021; Gu, 2024). At the same time, attention to safety and biodegradability is directed to hygiene products that are used both in everyday life and in medicine, in particular wet wipes (Shruti et al., 2021; Allison et al., 2023). The media and environmental campaigns have paid significant attention to the plastic crisis, but practices regarding single-use plastics have remained largely unchanged (Rudman & Rudman, 2021). The production and use of wet wipes are increasing every year (Ramya & Amutha, 2021). Calculations by Turkish researchers showed that if children continue the practice of using their parents' wet wipes, the number of wet wipes used daily, which is currently around 210 million, will increase to over 250 million between 2040 and 2060 (Köklü et al., 2023). Reducing the impact of human activities is only possible through the joint commitment of all sectors involved (Martín-Jaime et al., 2021). Young people have great potential to act as agents of change and raise awareness about environmental issues (Torres et al., 2019). The implementation of preventive environmental education programs can shape individual behavior and increase people's ability and motivation to adopt behaviors and attitudes conducive to caring for and respecting the environment (Torres et al., 2019). The significant deficit in environmental education regarding vital aspects of citizens' daily behavior determines the negative impact of most actions on sustainability (Alonso-Sainz, 2021). In other words, the preventive aspect of environmental education is important, as it affects the root of sustainability problems, and correcting their consequences can be very expensive from an economic point of view and even lead to irreversible changes in ecosystems (Martín-Jaime et al., 2021).

Ultimately, safety of wet wipes for environmental and human health due to potential risks of exposure to wetting solutions containing hazardous compounds (Siegert, 2011; Tkachuk & Zelena, 2023), low biodegradability (Shruti et al., 2021; Allison et al., 2023) has not been resolved. With the unconscious attitude of some citizens towards the disposal of wet wipes, they end up in the environment and are considered pollutants (Hu et al., 2022; Bach et al., 2025). A number of environmental problems are associated with the production and use of wet wipes: their accumulation in the environment, water and soil pollution; increased greenhouse gas emissions; increased microplastic content in the environment (Ó Briain et al., 2021; Shruti et al., 2021; Zhang et al., 2021; Tkachuk et al., 2024). Currently, there are no scientific publications devoted to the problem of pollution of the territories of Ukrainian cities with wet wipes, and this study fills this gap to a certain extent and is relevant. The purpose of the study was to assess the pollution of recreation areas in Chernihiv with wet wipes and raise schoolchildren's awareness of the related environmental problems. The study determined the number of wet wipes in the green zones of the Chernihiv city and conducted a socio-pedagogical study of the awareness of schoolchildren about environmental problems associated with wet wipes. At the same time, during the questionnaires conducted before and after the lecture on environmental problems associated with wet wipes, the intensity of students' use of wet wipes, changes in their attitude towards wet wipes, and understanding of environmental problems associated with wet wipes were found out. The results obtained have important practical significance, as they contribute to the conscious attitude of children to the use of wet wipes and the understanding of the need to improve their biological and environmental safety, which, in turn, supports the achievement of the Sustainable Development Goals.

## Materials and Methods

### **Estimation of the number of wet wipes that have become garbage in recreation areas of Chernihiv residents**

The territory selected for the study covered some recreation areas (green ecosystems) of the Chernihiv city: the territory of Chernihivsky Val (Dytnets) 51°29'24"N 31°18'22"E; near the Strizhen River (the area of the military hospital 51°29'53"N 31°18'25"E and in the area of Yalivshchyna, the first dam 51°30'54"N 31°17'40"E); the courtyard of Chernihiv Gymnasium No. 32 51°30'23"N 31°16'37"E; in the Central Park of Culture and Recreation 51°29'59"N 31°19'22"E; in the park in front of Chernihiv City Polyclinic No. 3 51°29'52"N 31°17'17"E; in the park near the Central Department Store 51°30'00"N 31°17'08"E. The green areas selected for

the study are located in the city center, are actively visited by locals in the summer, and are safe for conducting such studies, as they have not been subjected to military influence, unlike green areas on the outskirts and outside the city. The method of assessing the contamination of the indicated territories with wet wipes by directly counting them in the most littered areas of the studied territory with an area of 100 m<sup>2</sup> was used (Zero Waste Scotland, 2018). The research was conducted in summer (August 2024) and autumn (October-November 2024). In addition to counting the number of wet wipes found, they and other garbage found in the studied areas were cleaned up and thrown into a trash can.

### **Socio-pedagogical research on the awareness of school youth regarding environmental problems associated with wet wipes**

In order to raise awareness among students about environmental problems associated with wet wipes, on November 18, 2024, a lecture-presentation "EcoSecrets of Wet Wipes" was held for students of grades 8-9 of Chernihiv Gymnasium No. 32 (T.H. Shevchenko National University..., 2024). The following methods were used during the lecture: story, conversation, posing a problem question, and anonymous questionnaire survey. Theoretical questions considered at the lecture: 1. Wet wipes - an environmental problem? 2. Wet wipes - an ornament of Chernihiv? 3. Ideal wet wipes - are there any? (Fig.1).

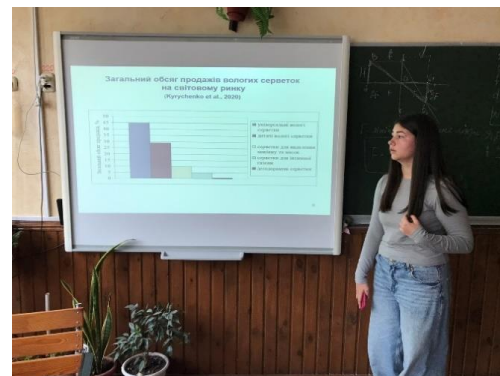


Fig. 1. During the lecture "EcoSecrets of Wet Wipes"

A week before and immediately after the lecture, an online survey was conducted using Google Forms - survey 1 and survey 2, respectively. The survey was conducted mainly with children aged 10 to 15 years: survey 1 - 130 respondents (84 females and 46 males); survey 2 - 46 respondents (33 females and 13 males). The questionnaire for survey 1 contained 9 questions, including questions with an extended answer form:

- Question 1: Indicate your age (answer options: up to 10 years; 10-12 years; 13-15 years; 16-17 years; 18-20 years; Other).
- Question 2: Indicate your gender (answer options: female; male).
- Question 3: Do you use wet wipes? (answer options: yes; no).
- Question 4: If you use it, how often do you use it? (answer options: 1-2 times a day; 3-5 times a day; 1-2 times a week; 3-5 times a week; 1-2 times a month; Other).
- Question 5: Have there been situations in your life when you threw wet wipes NOT into the trash can? (answer options: yes; no).
- Question 6: Do you agree that wet wipes do not cause environmental problems? (answer options: yes; no).
- Question 7: In your opinion, what environmental problems can there be when using wet wipes? (no answer options, open-ended answer form).
- Question 8: Do you agree that there is no difference between using a wet wipe or a handkerchief? (answer options: yes; no).
- Question 9: Write your question to the organizers regarding the eco-secrets of wet wipes, if any (no answer options, extended answer form).

The questionnaire for survey 2 contained 7 questions, including multiple-choice and open-ended questions:

- Question 1. Please indicate your age (answer options: up to 10 years; 10-12 years; 13-15 years; 16-17 years; 18-20 years; Other).
- Question 2: Please indicate your gender (answer options: female; male).
- Question 3: Did you participate in the first survey “EcoSecrets of Wet Wipes”? (answer options: yes; no).
- Question 4: Did you attend the presentation “EcoSecrets of Wet Wipes”? (answer options: yes; no).
- Question 5: What environmental problems are associated with the use of wet wipes? (multiple choice questions: environmental pollution; toxicity to living organisms; source of microplastics; increased greenhouse gas emissions; irrational use of resources).
- Question 6: Has your attitude towards wet wipes changed: (answer in the form of a rating from 1 (strongly disagree) to 10 (strongly agree)).
- Question 7: Explain why your attitude towards wet wipes has changed (or not changed) (no answer options, extended answer form).

## Results and Discussion

Due to the low level of awareness of the population regarding the environmental hazards of wet wipes, low environmental culture, wet wipes can get into the environment. Therefore, we investigated the number of wet wipes in the recreation areas of residents of Chernihiv. The obtained quantitative indicators are shown in Fig. 2.

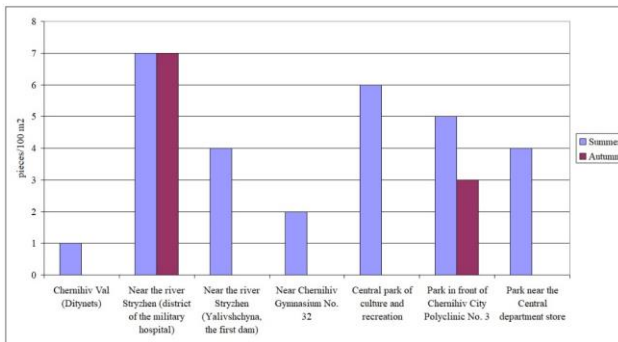


Fig. 2. Number of wet wipes in the territory of recreation areas in the city of Chernihiv (summer-autumn 2024)

It was found that both in summer and autumn, the territories least contaminated with wet wipes were Chernihivskiy Val (Dytynets) and courtyard of Chernihiv gymnasium No. 32 – 1/0 and 2/0 wet wipes per 100 m<sup>2</sup> of the studied territory, respectively. Obviously, the low number of wet wipes is associated with regular cleaning of the territory of Chernihivskiy Val and summer holidays in Chernihiv Gymnasium No. 32. An increase in the number of wet wipes in the form of garbage up to 4 pieces/100 m<sup>2</sup> was noted for the territories near the Strizhen River (Yalivshchyna, first dam) and the park near the Central Department Store. In these cases, the greater number of wet wipes found can be explained by the greater frequency of visits to these places by Chernihiv residents in the summer – the green zone near the Strizhen River and the playground in the park near the Central Department Store. An even larger number of wet wipes was found in the park in front of Chernihiv City Polyclinic No. 3 (5 pieces/100 m<sup>2</sup>) and in the Central Park of Culture and Recreation (6 pieces/100 m<sup>2</sup>). It is obvious that these areas are also actively visited in the summer, but their cleaning is probably carried out irregularly and of poor quality. On September 20, 2024, the territory of the Central Park of Culture and Recreation was cleaned by volunteers under the coordination of the public organization Let’s do it Ukraine (Gornova, 2024). A study of the number of wet wipes in this area after cleaning, carried out by us in October 2024, showed the absence of wet wipes, which is possibly due to the fact that in the fall there are much fewer visitors to the Central Park of Culture and Recreation than in the summer. A slightly smaller number of wet wipes was also noted in the fall and in the park in front of Chernihiv City

Polyclinic No. 3, which is also actively visited by Chernihiv residents in the fall.

The area most contaminated with wet wipes in both summer and autumn was the one near the Strizhen River in the area of the military hospital – 7 pieces/100 m<sup>2</sup> (Figs.2-3). Probably, during the war, the increase in the number of visitors to the hospital, residents of Chernihiv, who are attracted by the green area in the summer, as well as the lack of garbage cans led to this result.



a



b

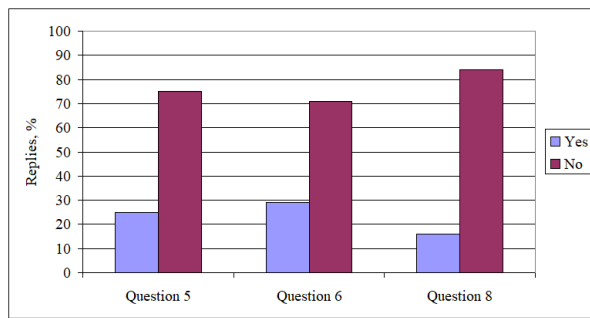
Fig. 3. Wet wipes found near the Strizhen River (area of the military hospital): a – August 2024; b – November 2024.

## Results of a socio-pedagogical study on the use of wet wipes

The results of the student survey on the use of wet wipes are presented, including an analysis of the responses of 130 respondents (survey 1) and 46 respondents (survey 2). It was found that among the pupils who participated in the survey of survey 1, the largest proportion was children aged 13-15 years (49.2% of respondents). It should be noted that the age group of 8–12 years is more appropriate as a target in environmental education (Martin-Jaime et al., 2021). This is an age at which families usually communicate well, allowing participants to exchange and transmit pro-environmental behaviors and values (Martin-Jaime et al., 2021). The authors note that students are able to influence the behavior of their parents, contributing to the transformation of values and habits, which overall contributes to sustainable management of sanitary waste. Every small aspect of a person's hygiene habits has a direct impact on the care and protection of the natural environment (Martin-Jaime et al., 2021). Increasing students' awareness will ensure the acquisition of new habits, behaviors, and attitudes in their families and immediate environment (Martin-Jaime et al., 2021). In particular, the study by Ablak and Yeşiltaş (2020) showed that talking with the family about relevant aspects of environmental education increases the level of environmental awareness of students and households. The distribution of respondents by gender was 64.6% female and 35.4% male. The majority of respondents (94.6%) answered positively to the question about their use of wet wipes. At the same time, approximately the same number of respondents answered that they use wet wipes 1-2 times a week (26.9%), 1-2 times a month (23.8%) and 1-2 times a day (21.5%). 12.3% of respondents use wet wipes 3-5 times a week, and 9.2% of respondents use them 3-5 times a day. 6.3% of respondents had their own answers, such as “whenever possible”, “whenever available, I use them”, “I use dry wipes”. Despite the fact that the vast majority of respondents often use wet wipes, most of the answers to the question “Have there been situations in your life when you threw wet wipes NOT into the trash can?” were “no” (75.4% of respondents) (Fig. 4).

It should be noted that the vast majority of respondents (70.8%) understand that wet wipes can cause environmental problems (Fig. 4), and primarily pollution of the environment (“nature”, “planet”, “earth”, “water”, “rivers”, “lakes”, “oceans”, according to the respondents), since they contain compounds that do not decompose. At the same time, the vast majority of pupils was not familiar with other environmental problems associated with the use of wet wipes. At the same time, the majority of respondents (83.8%) understand that there is a difference between using a wet wipe or a handkerchief (Fig. 4).

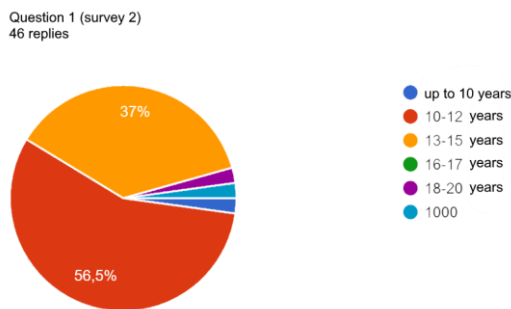




**Fig. 4. Distribution of answers to questions 5 (Have there been situations in your life when you threw wet wipes NOT into the trash can?), 6 (Do you agree that wet wipes do not cause environmental problems?) and 8 (Do you agree that there is no difference between using a wet wipe or a handkerchief?) of survey 1**

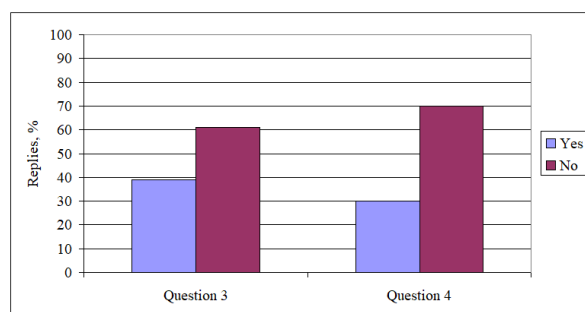
Regarding the topic of the survey, respondents were interested in the duration of decomposition of wet wipes in the environment, the composition and safety of the solution for wetting them, the possibility of manufacturing wet wipes that decompose quickly after use and do not harm the environment.

After the lecture “EcoSecrets of Wet Wipes” we conducted, a survey was also conducted (survey 2). In survey 2, the majority of respondents were aged 10 to 12 years (56.5%), although there were also children aged 13-15 (37% of respondents), under 10 years (2.2%), and young people aged 18-20 (2.2%) (Fig. 5).



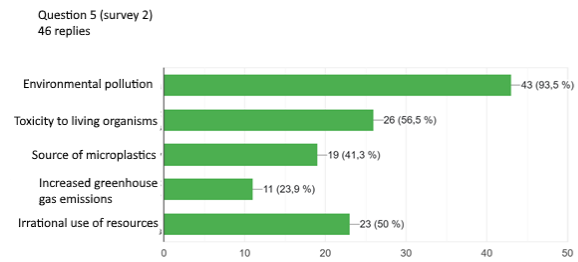
**Fig. 5. Distribution of answers to question 1 of survey 2: Please indicate your age**

Females were the majority of respondents – 71.7%, while males were 28.3%. According to survey 2, the majority of respondents (60.9% and 69.6%, respectively) indicated that they did not participate in survey 1 (Fig. 6) and did not attend the lecture-presentation “Eco-secrets of wet wipes” (Fig. 6).



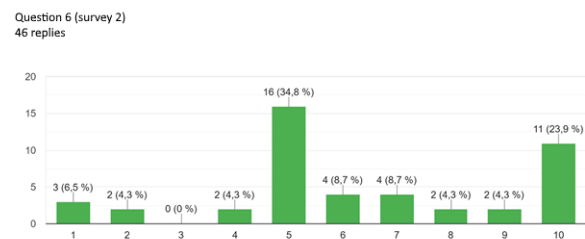
**Fig. 6. Distribution of answers to questions 3 (Did you participate in the first survey “EcoSecrets of Wet Wipes?”) and 4 (Did you attend the presentation “EcoSecrets of Wet Wipes?”) of survey 2**

Among the environmental problems associated with the use of wet wipes, 93.5% of respondents named environmental pollution, 56.5% - toxicity to living organisms, 50% - irrational use of resources, 41.3% - a source of microplastics, 23.9% - increased greenhouse gas emissions (Fig. 7).



**Fig. 7. Distribution of answers to question 5 of survey 2: What are the environmental issues associated with using wet wipes?**

23.9% of respondents completely agreed with the idea that their attitude towards wet wipes had changed, while 6.5% of respondents completely disagreed with this (Fig. 8).



**Fig. 8. Distribution of answers to question 6 of survey 2: Has your attitude towards wet wipes changed: [from 1 (totally disagree) to 10 (totally agree)]**

At the same time, the arguments in favor of changing the attitude towards wet wipes were that they pollute the planet (“environment”, “world”, “nature”), contain hazardous substances, and are a source of microplastics. The arguments in favor of maintaining the attitude towards wet wipes were that they are convenient (“cool”, “smell delicious”).

An environmental education lesson with Japanese school students included a lecture (on reducing the use of plastic products to save energy in daily life), a board game (the goal of which was to learn how to reduce plastic waste), and a worksheet for reflection (Kurokawa et al. 2023). A survey after this lesson showed a significant improvement in students' basic environmental knowledge and an increase in their concern about plastic waste, including wet wipes. At the same time, students who were nudged or stimulated during the worksheet session were more likely to refuse free wet wipes offered in stores, but not more likely to refuse plastic bottles. These results also indicated that interventions through environmental education can change students' pro-environmental behaviors only if the cost of behavioral change is low (Kurokawa et al., 2023).

The combination of field and socio-pedagogical research creates synergy: factual data allows us to assess the real state of pollution, and educational work promotes behavioral change, which in the long term can reduce the problem. This allows us not only to document the problem, but also to initiate its solution through the upbringing of an ecological culture (Vasylenko et al., 2021; El Az-zouzi et al., 2023; Tolochko, 2024).

Simultaneous field research (counting the pollution of the territory) and socio-pedagogical research (lecture and questionnaires of schoolchildren) within the framework of an ecological study of pollution of green areas with wet wipes has several important advantages:

1. Integrated approach to the problem. The combination of two types of research allows you to obtain both objective data on the degree of pollution of the territory and subjective perceptions of the problem among schoolchildren. This helps to assess not only the level of pollution, but also the level of awareness of it.

2. Possibility of data correlation. Thanks to simultaneous conduct, it is possible to compare actual data (the number of wipes in a certain area) with what students know and how they relate to the problem. For example, it is possible to find out whether littering is more common in places where children are less aware of the environmental consequences.

3. Effective educational interaction. When schoolchildren

simultaneously participate in an educational lecture and research, they see the problem with their own eyes, which makes learning more visual and influential. This contributes to the formation of environmental awareness.

4. Stimulating an active position. After the lecture, students can actively participate in the study (for example, help in counting pollution), which forms a responsible attitude towards nature and promotes environmental volunteerism.

5. Increasing trust in the results of the study. If the pollution is counted and the opinions of the participants are collected at the same time, this gives a more representative picture of the problem, which is important for further decisions on its solution.

In general, biological and ecological education of students plays an important role in the sustainable development of society (Vasylenko et al., 2021; Tkachuk & Zelena, 2022; Povidachyk & Hryn, 2024). Understanding by young people of the need to improve the biological and environmental safety of wet wipes, their conscious use and disposal will contribute to the achievement of the Sustainable Development Goals: Good health and well-being (Goal 3), Clean water and adequate sanitation (Goal 6), Industry, innovation and infrastructure (Goal 9), Sustainable development of cities and communities (Goal 11), Responsible consumption and production (Goal 12), Combating climate change (Goal 13), Protecting and restoring terrestrial ecosystems (Goal 15) (Fig. 9).

## Conclusions

Therefore, wet wipes were found in the form of garbage in the recreation areas of the residents of Chernihiv, which indicates a low level of awareness of the city's population regarding wet wipes as a source of environmental hazards. The smallest number

of wet wipes in recreation areas in Chernihiv is noted for areas that are thoroughly cleaned or almost not visited in summer or autumn. The largest number (7 wet wipes/100 m<sup>2</sup>) is noted for a green area that is actively visited, but is not cleaned regularly, and where there are no garbage cans. A positive result of the lecture-presentation "EcoSecrets of Wet Wipes" is a change in the attitude of some pupils towards wet wipes as polluting the environment, containing hazardous substances, and being a source of microplastics. We hope that children will approach the use of wet wipes more responsibly and realize the importance of improving their biological and environmental safety.



Fig. 9. Sustainable Development Goals relevant to environmental issues related to wet wipes

A further perspective is the need to continue raising awareness among students and schoolchildren about the environmental problems associated with wet wipes, given their environmental hazards and the achievement of the Sustainable Development Goals.

## References

- Ablak, S., & Yeşiltaş, E. (2020). Secondary School Students' Awareness of Environmental Education Concepts. *RIGEO*, 10, 445–466. <http://dx.doi.org/10.33403/rigeo.745951>
- Allison, T., Ward, B. D., Harbottle, M., & Durance, I. (2023). Do flushed biodegradable wet wipes really degrade? *Science of the Total Environment*, 894, 164912. <https://doi.org/10.1016/j.scitotenv.2023.164912>
- Alonso-Sainz, T. (2021). Educación para el desarrollo sostenible: Una visión crítica desde la Pedagogía. *Rev. Complut. Educ.*, 32, 249–259. <https://doi.org/10.5209/iced.68338>
- Bach, L., Strand, J., Salame, H., Simon, M., Fritt-Rasmussen, J., & Jensen, P. E. (2025). Wet wipes in untreated wastewater are a source of litter pollution to the arctic marine environment – a case study on the loads of litter and microplastics in wastewater effluents in Greenland. *Environmental Science: Advances*, 4(2), 223–234. <https://doi.org/10.1039/d4va00233d>
- El Azzouzi, A., Elachqar, A., & Kaddari, F. (2023). Integrating Environmental Education Into Physics Instruction: Insights From Teachers Regarding Students' Engagement. *Randwick International of Education and Linguistics Science Journal*, 4(3), 491–499. <https://doi.org/10.47175/rielsj.v4i3.787>
- Gornova, V. (2024). Chernihiv volunteers collected 85 bags of garbage in the Central Park of Culture and Recreation [in Ukrainian]. *Suspilne Chernihiv*. <https://tinyurl.com/44h442nm>
- Gu, W. (2024). Research on strategy optimization of sustainable development towards green consumption of eco-friendly materials. *Journal of King Saud University - Science*, (6), 103190. <https://doi.org/10.1016/j.jksus.2024.103190>
- Hu, T., Shen, M., & Tang, W. (2022). Wet wipes and disposable surgical masks are becoming new sources of fiber microplastic pollution during global COVID-19. *Environ. Sci. Pollut. Res. Int.*, 29(1), 284–292. <https://doi.org/10.1007/s11356-021-17408-3>
- Kobayashi, T., & Nakajima, L. (2021). Sustainable development goals for advanced materials provided by industrial wastes and biomass sources. *Current Opinion in Green and Sustainable Chemistry*, 28, 100439. <https://doi.org/10.1016/j.cogsc.2020.100439>
- Köklü, R., Ateş, A., Deveci, E. Ü., & Sivri, N. (2023). Generic foresight model in changing hygiene habits with the pandemic: use of wet wipes in next generations. *J. Mater. Cycles Waste Manag.*, 25, 74–85. <https://doi.org/10.1007/s10163-022-01515-5>
- Kurokawa, H., Igei, K., Kitsuki, A., Kurita, K., Managi, S., Nakamuro, M., & Sakano, A. (2023). Improvement impact of nudges incorporated in environmental education on students' environmental knowledge, attitudes, and behaviors. *J. Environ. Manage.* 325(Pt B), 116612. <https://doi.org/10.1016/j.jenvman.2022.116612>
- Martín-Jaime, J.-J., Velasco-Martínez, L.-C., & Tójar-Hurtado, J.-C. (2021). Evaluation of an Environmental Education Program Using a Cross-Sectoral Approach to Promote the Sustainable Use of Domestic Drains. *Sustainability*, 13(21), 12041. <https://doi.org/10.3390/su132112041>
- Zero Waste Scotland. (2018). *Litter Monitoring Methodology. Guidance for practitioners*. Zero Waste Scotland. <https://cdn.zerowastescotland.org.uk/managed-downloads/mf-hjcmjf3l-16811397520d>
- Ó Briain, O., Marques Mendes, A. R., McCarron, S., Healy, M.G., Morrison, L. (2020). The role of wet wipes and sanitary towels as a source of white microplastic fibers in the marine environment. *Water Res.*, 182, 116021. <https://doi.org/10.1016/j.watres.2020.116021>
- Povidachyk, O., & Hryn, O. (2024). The concept of sustainable development as the basis of continuous ecological training of future teachers [in Ukrainian]. *Scientific Bulletin of Uzhhorod University. Series: «Pedagogy. Social Work»*, (154), 154–157. <https://doi.org/10.24144/2524-0609.2024.54.154-157>
- Ramya, K., & Amutha, K. (2021). Eco-friendly wet wipes - A review. In *Proceedings of the International Conference on Advances in Technical Textiles (Sathyamangalam, Tamilnadu, India, October 2021)*. [https://www.researchgate.net/publication/355522200\\_Eco-Friendly\\_Wet\\_Wipes\\_-\\_A\\_Review](https://www.researchgate.net/publication/355522200_Eco-Friendly_Wet_Wipes_-_A_Review)
- Rudman, S., & Rudman, L. (2021). Reconfiguring the everyday: Plastic waste as performance art in addressing the incongruity between the 'talk' and the 'walk' in the plastic crisis. *Environ. Educ. Res.*, 27, 1487–1501. <https://doi.org/10.1080/13504622.2021.1947986>
- Shruti, V. C., Pérez-Guevara, F., & Kutralam-Muniasamy, G. (2021). Wet wipes contribution to microfiber contamination under COVID-19 era: An important but overlooked problem. *Environmental Challenges*, 5, 100267. <https://doi.org/10.1016/j.envc.2021.100267>
- Siegert, W. (2011). Preservative Trends in Wet Wipes. *SOFW-J.*, 137, 44–51. [https://www.researchgate.net/publication/232273400\\_Preservative\\_Trends\\_in\\_Wet\\_Wipes](https://www.researchgate.net/publication/232273400_Preservative_Trends_in_Wet_Wipes)
- T. H. Shevchenko National University "Chernihiv Colehium". (2024). *Eco-secrets of wet wipes and the Sustainable Development Goals* [in Ukrainian]. T. H. Shevchenko National University "Chernihiv Colehium". <http://chnpu.edu.ua/component/k2/item/4963-ekosekrety-volohykh-servetok-ta-tsili-staloho-rozvytku>

- Tkachuk, N. V., & Zelena, L. B. (2022). Experience in preparing students' scientific and research works of ecological and biological orientation in view of the goals of sustainable development [in Ukrainian]. *Ecological Sciences*, 1(40), 174-178. <https://doi.org/10.32846/2306-9716/2022.eco.1-40.32>
- Tkachuk, N., & Zelena, L. (2023). Evaluation of the toxicity of wet wipes based on the growth test with *Lepidium sativum* L. *Eng. Proc.*, 56, 5. <https://doi.org/10.3390/ASEC2023-15495>
- Tkachuk, N., & Zelena, L., & Novikov, Y. (2024). Wet wipes as a cause of environmental problems: a mini review. *Selected Papers of VI International Conference on European Dimensions of Sustainable Development (May 15–17, 2024, Kyiv, Ukraine)*, 88-94. <https://doi.org/10.24263/EDSD-2024-6-12>
- Tolochko, S. V. (2024). The influence of environmental problems of modern Ukraine on the formation of environmental competence of high school students [in Ukrainian]. *Pedagogical Academy: scientific notes*, (6), 1-29. <https://doi.org/10.57125/pedacademy.2024.05.29.04>
- Torres, H. R., Reynolds, C. J., Lewis, A., Muller-Karger, F., Alsharif, K., Mastenbrook, K. (2019). Examining youth perceptions and social contexts of litter to improve marine debris environmental education. *Environ. Educ. Res.*, 25, 1400–1415. <https://doi.org/10.1080/13504622.2019.1633274>
- Vasylenko, I. A., Nikolayenko, L. P., Ivanchenko, A. V., Gulyaev, V. M., Chuprynov, E. V., Skyba, M. I., Kovalenko, I. L. (2021). *Advanced education for sustainable development: a manual* [in Ukrainian]. Accent PP. <https://www.dstu.dp.ua/Portal/Data/5/7/5-7-b1.pdf>
- Zhang, Yu., Wen, Z., Lin, W., Hu, Yu., Kosajan, V., Zhang, T. (2021). Life-cycle environmental impact assessment and plastic pollution prevention measures of wet wipes. *Resources, Conservation and Recycling*, 174, 105803. <https://doi.org/10.1016/j.resconrec.2021.105803>