Reproducing feedback for environmental education in-class activities using large language models in virtual learning systems

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Abstract: *A large language model (LLM) is an artificial intelligence program that understands, reads, interprets, creates, and generates new texts from dense datasets. The program can self-monitor with countless data points and easily perform text correction and transformation operations. Due to its self-monitoring capability, LLM can also easily track the potential outcomes of a sequence. This study aims to utilize this deep learning method, capable of understanding human language, in the field of education to facilitate the work of academics and students. The study was conducted with undergraduate students in the Faculty of Education as part of the Environmental Education course, thus testing the LLM model in the field of environment and sustainability, a topic of great need in recent times. Five environmental and sustainability themes were distributed to 39 students, and the texts were reorganized using the necessary commands with the LLM. The results were validated and verified by the researchers. This engaging study was conducted with enjoyment by the students. The students' re-evaluation of the reorganized texts proved that learning was achieved as intended. The model's ability to provide feedback and corrections to each text individually further contributed to facilitating the work of academics and providing diverse perspectives.*

Keywords: AI, ChatGPT, Education, In-classactivities, LLM, Sustaianability.

1. Introduction

The digital transformations of the 21st century have a significant impact on the digital strategies, methods, techniques and tools used in education and training processes. With digitalization in education and training, artificial intelligence-based applications are increasingly preferred. In the field of education, Large Language Models (LLMs), known for their ability to understand, organize, and transform texts, are attracting attention in learning and teaching processes (Brown et al., 2020; Öztezcan, 2024; Polat, 2025; Yurdakul, 2024).

Artificial intelligence language models like LLMs can greatly support the written expression skills of both instructors and learners in the learning and teaching process due to their ability to create and analyze texts in an academic language that mimics the natural language used by humans. With these models, learners can correct spelling errors in the learning-teaching process and make the

text more fluent while maintaining its content integrity through given commands (Altıntop, 2023; Kasneci et al., 2023; Uzun, 2023). In this respect, LLMs serve as a tool that can help students express their thoughts in a more organized and understandable way.

The use of artificial intelligence in education can provide learners with rapid and individualized feedback through language models. In addition, it has the potential to reduce the workload faced by instructors in the measurement and evaluation process (Çavuş, 2024; OECD, 2021). In this context, the contribution of these technologies to learning depends on the quality of the interaction students have with AI-based language models. AI in education can offer learners rapid and individualized feedback through language models. Unquestioningly accepting AI outputs can lead to students remaining passive in the learning process (Altun, 2024; Zhai, 2022).

Therefore, current studies emphasize the need to use artificial intelligence as a supportive tool in education (Arslan & Arslan, 2025; Boztepe, 2025; Yıldız, 2025). The literature states that artificial intelligence should not be a system that replaces the student, and if it is used in the learning and teaching process, it should be positioned as an aid that supports the student's thinking (UNESCO, 2023). Thus, it should be such that it enables students to actively participate in the learning and teaching process, generate individual ideas, and preserve their critical thinking skills.

The rapid development of digitalization and artificial intelligence is also providing significant support to sustainability and environmental issues, which are of great importance to humanity, in the field of education. The Sustainable Development Goals (SDGs) determined by the United Nations aim to raise awareness among individuals about environmental problems through digitalization (UN, 2015). In this context, environmental education aims to develop students' awareness of environmental problems and enable them to produce solution proposals. According to the contemporary education system, supporting the strategies, methods, techniques, and tools used in environmental education courses with current technologies can increase the permanence of learning (Tuğaç, 2023; Yavaş, 2025).

There is an increase in research on the use of artificial intelligence and digital tools in education in the literature. However, applied studies examining the effect of LLMs on the learning-teaching process or classroom activities, especially on student texts, and the extent to which students actively participate in this process are limited. In this context, research on the use of LLMs, especially in courses requiring social awareness such as environmental education, may be needed.

In this research, large language models (LLM) were considered not as text generators, but as text editors and transformers. This research was conducted with undergraduate primary school teacher training students as part of the Environmental Education course. The students' texts on environmental and sustainability issues were revised with the support of LLM (Learning, Management, and Mathematics). The study examined how the texts changed in terms of language, content, and structure, as well as the students' approaches to this

process. In this respect, the research aims to present a practice-based approach to the controlled and conscious use of artificial intelligence technologies in educational settings from a pedagogical perspective.

1.1. Importance of the study

While research on artificial intelligence and large language models in education is increasing, activity-based findings on how these technologies should be pedagogically positioned in learning and teaching processes are limited. In particular, the lack of studies that address the impact of large language models on students' written output, along with their levels of cognitive participation in this process, is considered a significant gap in the literature.

This research is considered unique because it treats large language models as a helpful tool supporting students' thinking, organizing, and transforming processes. The fact that this research is conducted within the context of an environmental and sustainability-themed course is important in revealing the pedagogical potential of AI-supported applications in areas requiring social awareness. In this context, the research is expected to provide theoretical and practical contributions to instructional designs regarding the careful, conscious, and pedagogically sound use of artificial intelligence in the education and teaching process.

2. Purpose of the Study

The aim of this research is to examine the effect of artificial intelligence's large language models (LLMs) on the language, content, and structure characteristics of texts produced by students during an activity process within the scope of an environmental education course. In this research, LLMs were preferred not as text generators, but as text editors and transformers; the extent to which students actively and critically participated in the AI-assisted text editing process was investigated. In this context, this research aims to present activity-based findings on the controlled and conscious use of artificial intelligence technologies in educational environments, based on pedagogical principles. This research aims to evaluate the texts created by students within the scope of classroom applications carried out in the education and training process using large language models (LLMs). Accordingly, the following research questions were addressed in the research:

RQ1. How did student texts undergo a transformation in terms of language, content, and structure after the use of LLMs?

RQ2. How did the students' levels of intervention in the text vary in active-passive and critical-superficial contexts?

RQ3. What are the students' opinions on artificial intelligence and large language models after the application?

3. Method

3.1 Research model

This research, based on a qualitative philosophy and conducted on a descriptive basis, emerged from a systematic analysis of an in-class educational practice. It was hypothesized that the active use of artificial intelligence in the classroom would provide positive contributions for both students and academics/instructors. In this context, students were evaluated in both process and product-oriented ways during the application phase of the research.

3.2 Study group of the research

The research was conducted with 39 first-year undergraduate students in the Primary School Teaching program at the Faculty of Education, as part of the Environmental Education course. Students worked in groups of two, resulting in 19 groups in total; one student worked alone at their own discretion. This research marked the students' first encounter with and application of the LLM model. No specific selection criteria were set for the sample; data was collected based on voluntary participation in the classroom application due to ease of access. For ethical reasons, students were informed that the application would not be graded.

3.3 Research process

During the implementation process, students were given five different topics within the scope of Environment and Sustainability concepts, which are essential and strictly followed for "Our World" and "Our Common Future". Thus, the LLM model, used in accordance with the course content and learning outcomes, aimed to both increase students' sensitivity to the environment and sustainability and to facilitate the tasks of educators/academicians. In this way, the applicability of LLM to other courses and topics was also checked in the same process. The five topics parallel to the principle of sustainability, on which students were asked to express their knowledge and ideas, are as follows:
Topic 1. The problem of waste sorting in university campuses
Topic 2. Consumption of single-use plastics on campuses
Topic 3. The impact of social media on environmental education
Topic 4. The failure of theoretical knowledge to be translated into practice in environmental education
Topic 5. Ways to reduce electricity consumption on campus
In order to create synergy through brainstorming, students were first asked to form groups of two. Groups were asked to choose any of five topics and write a text on that topic, outlining their knowledge and ideas under the subheadings of "problem definition, current situation, and possible solutions." In the second phase of the study, students were instructed to transfer the generated texts as image files to an AI program of their choice and give the command, "Evaluate this text from

an environmental and sustainability perspective, point out any missing or incorrect points, and offer concrete suggestions for improvement." The AI then regenerated the texts based on these suggestions. As a final step, students were asked, in groups, to identify the differences between the old and new texts and to discuss the positive and negative aspects of the AI's assistance.

3.4 Data collection process and analysis

The data sources for this study are students' initial texts, post-command transformed texts, and student opinions. Prior to analysis, groups were coded as G1, G2, etc. Topics were coded as Topic 1, Topic 2, etc., as given in the section titled "Application Process". The analysis primarily focused on examining the direction of change in the texts. Furthermore, student intervention in the text was evaluated in terms of active-passive and critical-superficial contexts. Pattern-based evaluation analysis was adopted to identify recurring similarities in multiple examples.

3.5 The use of artificial intelligence in research

In this study, LLM was not used as a text generator; it was used as a text editor and converter. In this respect, artificial intelligence is not a tool that completes assignments for the student, but rather an aid and support that stimulates thinking. For the teacher, it is an application that saves time and facilitates learning from different perspectives. In this study, artificial intelligence was used by both students and researchers. Although all student groups were free to choose the type of artificial intelligence, they preferred ChatGPT. In addition to the students' handwritten ideas being converted with ChatGPT-LLM, the handwritten texts were converted to computer text by the researchers conducting this study using ChatGPT, and the article written in Turkish was translated into English using Google Translate. Two examples of student texts are included in Figure 1 for illustrative purposes.
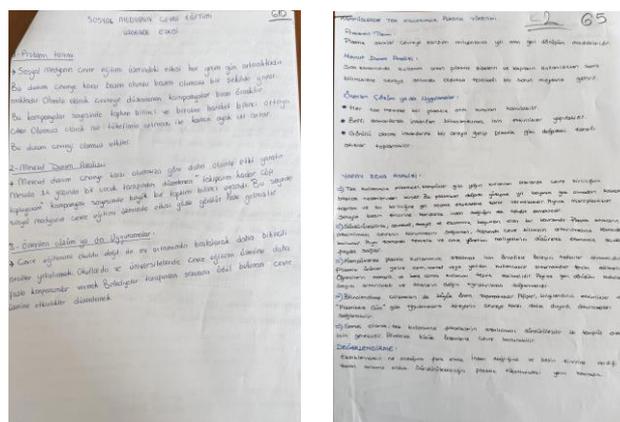

Figure 1. Examples of the first handwritten texts by student groups

4. Findings

Texts written by student groups according to their study topics were transformed using artificial intelligence (LLM). One selected example for each topic is presented in Table 1.

Table 1. Transformation of texts created by student groups using LLM

Topic	Group	Group Text	LLM Feedback
1	G1	**Problem Definition:** Waste is a major problem on university campuses, particularly affecting young people. Conscious young people suffer from this situation and need to separate their waste to overcome it. The number of waste sorting bins should be increased. Current Situation Analysis: The lack of waste awareness in our country, the inadequacy of organizations, and the failure of our leaders to address this issue are rendering the current situation ineffective. Suggestions and Solutions: Increase social organization, guide student clubs, teach waste management from a young age, raise awareness among families, and increase the number of designated bins for each type of waste in cities.	Waste sorting on university campuses is a significant problem in terms of the environ-ment and sustaina-bility. The lack of sufficient awareness about waste sorting, especially among students, prevents effective recy-cling. This leads to increased environmental pollution, faster depletion of natural resources, and economic losses. Currently, awareness campaigns regarding waste management are insuf-ficient, and relevant institutions and organizations are not playing an effective role. Collecting waste without sor-ting it constitutes a significant obstacle to sustainable envi-ronmental mana-gement on campuses.
2	G5	Problem Definition: Plastic waste consists of recyclable materials that take millions of years to decompose in the environ-ment. Current Situation Analysis: The recent increase in the	Single-use plastics are a major cause of environmental pollu-tion in heavily used areas like cam-puses. These plastics remain in nature for hundreds of years without decomposing, causing soil and water pollution and harming the ecosystem.

		use of plastic bottles and con-tainers, and their uncons-cious disposal into the environment after use, creates a very dangerous problem. Proposed Solutions or Appli-cations: Plastic waste bins can be placed every 100 meters. Events can be organized at certain times to raise aware-ness among people. People can be brought together to collect harmful waste such as plastic from nature.	They also threaten human health by entering the food chain through microplastics. Sustainability is a concept with environmental, social, and economic dimensions. Redu-cing plastic waste protects the environment and contributes to raising environmental aware-ness in society. It also provides economic benefits by reducing cleaning and waste manage-ment costs. To reduce plastic use on cam-puses, preventive measures should be taken first. Glass, metal, or reusable alternatives should be preferred instead of plastic products. Students should be encouraged to use water bottles and cloth bags. In addition, the number of recycling bins should be increased, and proper waste separation should be ensured. Awareness campaigns are also of great importance. Posters, informative events, and initiatives such as "Plastic-Free Day" can encourage individuals to behave more responsibly towards the environment. In conclusion, reducing single-use plastics is essential for a sustainable campus environ-ment. The environment can be protected with small measures.
3	G10	Problem Definition: The impact of social media on environmental education is increasing day by day. This situation reflects on the environment sometimes positively and sometimes	Your report is a good intro-ductory text that addresses the impact of social media on envi-ronmental awareness at a basic level. Using a concrete example like "I collect trash for 1 minute" makes the topic

		nega-tively. Positive examples include environmental campaigns. These campaigns create social awareness and a sense of collective action. Negati-vely, increased consumption leads to an increased carbon footprint. This negatively impacts the environment. Current Situation Analysis: The current situation has a more positive than negative impact on the environment. For example, a campaign organized by an 11-year-old child, "How many pieces of trash cans do I collect in 1 minute?", created signifi-cant social awareness. This demonstrates the visible impact of social media on environmental education. Sug-gested Solutions or Appli-cations: Starting environ-mental education at home rather than in school to raise more conscious generations. Giving more conferences on environmental education in schools and universities. Organizing environmental events with prizes by muni-cipalities.	understandable. However, it could be further improved. My suggestions: 1- Key Deficiencies: Digital Pollution: You should mention not only how social media increases consumption, but also the energy consumed by massive servers and the resulting e-waste (such as old phones, etc.), which are technical harms. Educational Balance: It would be more appropriate to present this holistically, starting at home and supported by scientific principles at school. 2- Strengths (Things to Protect): The inclusion of concrete exam-ples and the emphasis on awareness have increased the report's impact. Artıfıcıal Intellıgence Suggestions 1- Digital Cleaning: A sugges-tion to reduce unnecessary data usage through digital cleaning (deleting emails, watching low-resolution videos) could be added to the solution section. 2- Practical Training: Sugges-tions should be offered not only for conferences, but also for things like composting in schoolyards or zero-waste workshops.
4	**G13**	Information and Interpre-tation: This education ena-bles people to understand the environment and become aware of environ-mental pro-blems. Through this education, individuals gain respon-sibility for	Strengths: The topic is accurate and current. The report's sections (problem, current situation, solution) are well-organized. Examples of environmental problems from daily life are

		protecting the environment. Problem Definition: Problems arise due to people's insufficient knowledge about environmental education, leading to environmental pollution and the unconscious consumption of natural resources. Current Situation Analysis: Examples of water pollution include ships dumping fuel into the sea, smoke from factory chimneys causing air pollution, the construction of houses in riverbeds, and littering. These problems demonstrate the poor state of the current situation due to people's insufficient knowledge in education. Suggestions, Solutions, or Implementation: Efforts should be made to raise people's awareness. Organizing seminars and conducting practical training sessions are examples of solutions.	provided. Weaknesses and errors: The concept of sustainability is not clearly addressed (no mention of future generations or long-term impact). The problem definition is too general; it is unclear whether the problem is a lack of knowledge or a lack of behavior. The current situation analysis lacks data, comparisons, or concrete examples. The proposed solutions remain theoretical and lack detailed implementation. Recommendations for Improvement: The concept of sustainability should be clearly defined. The lack of environmental knowledge translated into behavior should be emphasized. Probability statements should be added to the current situation. Applied training, local projects, and behavior-oriented solutions should be proposed.
5	G17	Problem Definition: Unnecessary use of light on campus, 24/7 use of televisions or speakers in faculty cafeterias, constantly running machines in laboratories, computers in the library, ven-tilation in campus cafeterias, coffee machines. Current Situation Analysis: Currently, lighting and electrical appliances are often left on unnecessarily. Proposed Solutions or	Strengths: The main sources of electricity waste have been correctly identified (unnecessary lighting, devices left on) There is a current situation analysis. Heaters left on and lights used in the work area are listed. Focus on energy efficiency. Opening the door to more efficient solutions like ZED. Missing/ Erroneous Points: - Lack of numerical data; - Limited concept of sustain-

		Applications: Lighting systems could be energy-efficient. Equipment used in laboratories could be switched on and off as needed/when not in use.	ability; - Lack of economic dimension - Weak behavioral measures; - No mention of renewable energy. Concrete suggestions for impro-vement:* - Add measurable targets

The first research question of the study was defined as "How have student texts transformed in terms of language, content, and structure after the use of LLM?" The study observed that in all texts, the language of the texts was transformed in a more academic and fluent direction. Texts written in student language were developed with a scientific language, using carefully selected words and adhering to grammatical rules. In terms of content, while the information and interpretations given in all texts were accurate, a significant portion showed greater depth of meaning. The frequency of conceptual additions, deletions, or corrections was also noticeable, but similar transformations were observed repeatedly in text comparisons. Considering the structural characteristics of the texts transformed according to LLM, a significant portion of the texts were found to be consistent with the problem definition, current situation, and proposed solutions given at the beginning in terms of idea order and structure, and parallel changes were observed in the texts. The paragraph structure and the relationship between subheadings were expressed appropriately and consistently.

The second research question of the study was defined as "How do students' levels of intervention in the text vary in active-passive and critical-superficial contexts?" The prominent trends in students' intervention in the text are passive and superficial. It was understood that a significant majority of student groups did not intervene in the texts when expressing the LLM texts. It was frequently observed that students accepted the AI texts as they were after the command. Students trusted the texts transformed by the LLM and did not attempt to change or improve their own texts. A significant number of students accepted the texts without questioning the LLM, putting their own thoughts in the background. This situation can mostly be attributed to the students' passive and superficial approach to the LLM texts. The texts produced by the LLM were largely accepted. In addition, the fact that students accepted the text as it was rather than engaging in a critical structure indicates that they remained at a superficial level. Students did not significantly recreate the text; although they did not fully adopt the AI texts, they preferred to use minor word changes or semantic similarities. It was observed that with superficial intervention, the content remained constant, while the form changed to a certain extent. It would not be wrong to say that the students adopted an LLM-centric mindset at this point. The students' passive and superficial approaches are clearly seen in Table 1.

The third research question of the study was defined as "What are the students' opinions on artificial intelligence and large language models after the

application?" As the final stage of the study, students were asked to interpret the differences between the first text and the second text transformed by artificial intelligence. In the comparisons made between the student texts, positive common aspects such as "academic language improved, understandable language was used, concepts were understood more easily, and deeper explanations were provided" were noted. Most students stated that artificial intelligence and LLM improved their opinions. This trend should be considered together with the passive and superficial level of intervention of the students in the text, as stated in the previous sub-objective. The opinions of some randomly selected student groups are given below as an example.

Artificial intelligence used a more understandable language than we did, providing more comprehensive and detailed information. It gave us an 8/10, as it didn't provide much in terms of information compared to what we wrote (T1, G1).

We realized our shortcomings. We understood the harm it causes to human health and the food chain. We grasped the place of sustainability in plastic consumption (T2, G5).

Our definitions were incomplete and superficial, there was a lack of data analysis and research, it was an academically inadequate report, and our examples were not very explanatory (T1, G4).

We realized that we thought too traditionally, especially in the solution proposals section of the problem. When mentioning the people who could solve the problem, we generally focused on students. However, the university administration can also play an important role in solving the problem by making better plans (T5, G20).

The artificial intelligence generally liked everything in its writing, but I realized that I need to be more detailed, more conscious, and use more concrete data in my writing in the areas it found lacking. Therefore, I will pay more attention to writing more academically in my writings from now on (T4, G15).

The AI first told me where I went wrong. It pointed out our mistakes and shortcomings. It told us what we needed to pay attention to. It thoroughly enlightened us on this matter and gave us concrete suggestions on what to do (T3, G9).

5. Discussions, conclusions & reccomendations

To raise awareness and improve understanding among students regarding the SDGs (Sustainable Development Goals) implemented worldwide by United Nations resolutions, an in-class activities using artificial intelligence (LLM) was planned for undergraduate primary school teacher training students within the scope of the Environmental Education course. Five topics were presented to the students in this context. The texts written by the students were transformed and analyzed using LLM. It was observed that transforming the student descriptions of environmental and sustainability concepts presented in the Environmental Education course into a more organized text, correcting misinformation and

misconceptions, and transforming the language of the assignment into a more scientific language. At the end of the activity, students largely stated that the LLM and artificial intelligence improved their ideas, increased their knowledge, and made learning more enjoyable. Furthermore, this study also brought to the forefront the interesting use of the internet and telephones for students, thus encouraging the effective but accurate use of artificial intelligence. As academics/instructors, we firmly believe that LLM is a great convenience in educational life and that it will alleviate academic workloads through its contribution of both ideas and time. This research presents findings on the potential benefits of using large language models in a controlled and pedagogically sound manner in lessons, both for students and educators. In this respect, the research is considered to be a guide for instructional designs involving the use of AI-supported activities in different courses and educational levels.

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