Kashf Journal of Multidisciplinary Research
Vol: 02 - Issue 05 (2025)
P-ISSN: 3007-1992 E-ISSN: 3007-200X
https://kjmr.com.pk

TIPS FOR BENEFITS OF USING AI IN TEACHING AND LEARNING

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Article Info

Abstract

This paper explores the benefits of using Artificial Intelligence (AI) in teaching and learning environmental science. Environmental science is a multidisciplinary field that studies the natural world and human impact on the environment. Effective management of the environment requires understanding the components of the environment and their interactions. AI can enhance student learning outcomes, promote environmental awareness, and foster sustainable practices. The benefits of using AI in teaching and learning environmental science include personalized learning, intelligent tutoring systems, automated grading, enhanced engagement, and real-time feedback. AI can also be used to support teaching, including automated grading, personalized learning plans, and content creation. By leveraging these benefits, AI can help create a more effective, efficient, and enjoyable learning experience for students, while also supporting teachers in their critical role.

Keywords:

Environmental science, teaching, learning, AI, personalized learning.

Introduction

The environment encompasses the physical and biological systems that support life on Earth, including rocks, water bodies, vegetation, animals, and microorganisms. Effective management of the environment requires understanding these components and their interactions. Environmental science is an interdisciplinary field that studies the natural world and human impact on the environment. It draws on concepts from various disciplines, including: Geology, Geography, Ecology, Sociology, Economics, Hydrology, Chemistry, and Physic; and this field addresses issues such as: Environmental conservation, Sustainability, Climate change, Pollution, Resource management. By understanding the environment and environmental science, we can work towards mitigating environmental challenges and promoting a more sustainable future (Santra, 2016; Gada & Saka, 2024).

The interdisciplinary nature of environmental science is also emphasized, drawing on concepts from various fields such as geology, ecology, sociology, economics, and more. This approach enables a holistic understanding of environmental issues and the development of effective solutions. By recognizing the importance of global citizenship and environmental stewardship, environmental science can inform strategies for mitigating environmental challenges and promoting a more sustainable future (Santra, 2016). This paper explores the benefits of using Artificial Intelligence (AI) in teaching and learning environmental science.

Consequences of Human Intervention on the Environment

Human activities have significantly impacted the environment, leading to various consequences. Some of the key impacts include:

- Climate Change-Greenhouse gas emissions from human activities such as burning fossil fuels, deforestation, and land-use changes have contributed to climate change.
- Land Transformation-Human activities such as deforestation, urbanization, and agriculture have altered natural ecosystems, leading to loss of biodiversity and ecosystem disruption.
- Loss of Biodiversity-Human activities such as habitat destruction, overfishing, and pollution have contributed to the loss of biodiversity, threatening the health and resilience of ecosystems.
- Pollution-Human activities such as industrial processes, transportation, and waste management have led to pollution of air, water, and soil, posing risks to human health and the environment.
- Overpopulation-The growing human population has put pressure on natural resources, leading to issues such as resource depletion, food insecurity, and environmental degradation.
- Depletion of Resources-Human activities such as overfishing, overhunting, and unsustainable resource extraction have led to the depletion of natural resources, threatening the long-term sustainability of ecosystems (Santra, 2016).

However, the consequences of human intervention in the environment are far-reaching and have significant impacts on human health, economies, and ecosystems. Some of the key consequences include:

- Environmental Degradation-Human activities have led to environmental degradation, including soil erosion, water pollution, and loss of ecosystem services.
- Health Impacts-Environmental pollution and degradation have significant impacts on human health, including respiratory problems, cancer, and other diseases.
- Economic Impacts-Environmental degradation and resource depletion can have significant economic impacts, including loss of productivity, increased costs, and decreased economic opportunities.

- Social Impacts-Environmental degradation and resource depletion can also have significant social impacts, including displacement of communities, loss of cultural heritage, and decreased quality of life (Santra, 2016).

Nevertheless, the sustainable solutions to environmental problems are many. To mitigate the impacts of human intervention in the environment, it is essential to adopt sustainable solutions that balance human needs with environmental protection. Some of the key strategies include:

- Renewable Energy-Transitioning to renewable energy sources, such as solar and wind power, can reduce greenhouse gas emissions and mitigate climate change.
- Sustainable Land Use-Implementing sustainable land-use practices, such as agroforestry and permaculture, can reduce deforestation and promote ecosystem services.
- Conservation-Protecting and restoring natural ecosystems, such as forests, wetlands, and oceans, can promote biodiversity and ecosystem services.
- Sustainable Resource Management-Implementing sustainable resource management practices, such as sustainable fishing and forestry, can reduce resource depletion and promote long-term sustainability.
- By adopting sustainable solutions and reducing human impact on the environment, we can promote a healthier and more sustainable future for all (Santra, 2016).

Benefits of using AI in teaching and learning

By leveraging these benefits, AI can help create a more effective, efficient, and enjoyable learning experience for students, while also supporting teachers in their critical role (Altanmmami, 2023). Some benefits of using AI in teaching and learning:

- Personalized Learning- AI can help tailor learning experiences to individual students' needs, abilities, and learning styles.
- Intelligent Tutoring Systems- AI-powered systems can provide one-on-one support to students, offering real-time feedback and guidance.
- Automated Grading-AI can help teachers with grading, freeing up time for more hands-on, human interaction with students.
- Enhanced Engagement- AI-powered tools can make learning more interactive, immersive, and fun, increasing student engagement and motivation.
- Real-time Feedback- AI can provide immediate feedback to students, helping them track their progress and identify areas for improvement.
- Data-Driven Insights-AI can analyze large datasets to provide teachers with actionable insights on student performance, helping them refine their teaching strategies.
- Accessibility-AI-powered tools can help make learning more accessible for students with disabilities, language barriers, or other challenges.
- Scalability-AI can help reach a larger number of students, making high-quality education more accessible and affordable.
- Content Creation-AI can assist in creating customized learning content, such as adaptive assessments and learning pathways.
- Teacher Support-AI can help teachers with tasks such as lesson planning, content creation, and student assessment, freeing up time for more critical aspects of teaching (Katiyar et al., 2024; Apelehin et al., 2025; & Atah, 2025: Xiofan & Annamalai, 2025).

Ways of Using AI in learning Environmental Science

By leveraging these applications, AI can enhance student learning outcomes, promote environmental awareness, and foster sustainable practices. Some ways AI can be used in learning Environmental Science:

- Simulations and Modeling-AI-powered simulations can model complex environmental systems, allowing students to explore and understand the impacts of human activities on the environment.
- Data Analysis-AI can help students analyze large datasets related to environmental phenomena, such as climate change, deforestation, or pollution.
- Virtual Field Trips-AI-powered virtual reality can take students on immersive field trips to explore ecosystems, natural habitats, and environmental phenomena.
- Personalized Learning-AI can tailor learning experiences to individual students' needs and interests, helping them explore environmental topics in depth.
- Gamification-AI-powered games can teach environmental concepts and promote sustainable behaviors, making learning fun and engaging.
- Real-time Monitoring-AI can help students collect and analyze real-time data on environmental parameters, such as air quality, water quality, or weather patterns.
- Case Studies-AI can generate interactive case studies that allow students to explore real-world environmental issues and develop problem-solving skills.
- Virtual Labs-AI-powered virtual labs can provide students with hands-on experience conducting environmental experiments and investigations.
- Sustainability Planning-AI can help students develop sustainable plans and strategies for environmental conservation and management.
- Interdisciplinary Learning-AI can facilitate interdisciplinary learning by integrating environmental science with other subjects, such as biology, chemistry, and geography (Sadiq, 2019; ECD, 2020; Ayeni et al., 2024; Dumbuya, 2024; Hamane & Khalki, 2024; Wasehudin et al., 2024; Calvo, 2025).

Ways AI can be used to support teaching

By leveraging these applications, AI can help teachers streamline administrative tasks, enhance student learning, and focus on what matters most – teaching and mentoring students. Here are some ways AI can be used to support teaching:

- Automated Grading-AI can help teachers with grading, freeing up time for more hands-on, human interaction with students.
- Personalized Learning Plans-AI can help teachers create customized learning plans tailored to individual students' needs and abilities.
- Intelligent Tutoring Systems-AI-powered systems can provide one-on-one support to students, offering real-time feedback and guidance.
- Content Creation-AI can assist teachers in creating customized learning content, such as adaptive assessments and learning pathways.
- Lesson Planning-AI can help teachers plan lessons, identify knowledge gaps, and suggest relevant resources.
- Student Progress Tracking-AI can help teachers track student progress, identify areas where students need extra support, and provide targeted interventions.

- Virtual Teaching Assistants-AI-powered chatbots can provide support to students, answering questions and offering guidance on coursework and assignments.
- Data Analysis-AI can help teachers analyze student data, identifying trends and patterns that inform instruction and improve student outcomes.
- Resource Recommendation-AI can suggest relevant resources, such as videos, articles, and interactive simulations, to support teaching and learning.
- Professional Development-AI can provide teachers with personalized professional development opportunities, helping them stay up-to-date with best practices and new technologies (OECD, 2020; Paul et al., 2020; Popova, 2020; Khorunnisa et al., 2023; Katiyar et al., 2024; Madhu et al., 2024; Momen, 2024).

Traditional Teaching Methods

Lecture Method

The lecture method is a traditional teaching approach where an instructor delivers a structured presentation to a group of students, typically in a classroom setting. The lecturer presents information, explains concepts, and provides examples to convey knowledge to the students. Merits of this method include the followings:

- Efficient delivery of information-Lectures allow instructors to cover a large amount of material in a short amount of time.
- Expert knowledge-Lectures provide students with access to the instructor's expertise and knowledge.
- Inspiring and motivating-Lectures can be engaging and motivating, especially when delivered by an enthusiastic and charismatic instructor.
- Cost-effective-Lectures can be an efficient way to teach large groups of students (Kaur, 2024).

Consequently, the lecture method can be an effective teaching approach when used in conjunction with other methods, such as discussions, group work, and hands-on activities, to promote active learning and engagement.

Discussion Method

The discussion method is a teaching approach that involves students engaging in conversations and debates about a particular topic or issue, often facilitated by an instructor. This method encourages active learning, critical thinking, and collaboration among students. Merits of this method include the followings:

- Encourages critical thinking-Discussions promote critical thinking, analysis, and evaluation of ideas.
- Develops communication skills-Students develop their verbal and listening skills through active participation in discussions.
- Fosters collaboration-Discussions encourage students to work together, share ideas, and build on each other's perspectives.
- Promotes active learning-Students are actively engaged in the learning process, rather than passively receiving information.
- Develops problem-solving skills- Discussions help students develop problem-solving skills by exploring different perspectives and solutions (Lemu, 2005; Kaur, 2024).

Generally, the discussion method can be an effective teaching approach when facilitated effectively, and when combined with other teaching methods to promote a range of learning outcomes.

Field Trip Method

The field trip method is a teaching approach that involves taking students on a trip to a place outside the classroom, such as a museum, historical site, factory, or natural environment, to provide hands-on learning experiences. Merits of this method include the followings:

- Hands-on learning-Field trips provide students with direct experiences and hands-on learning opportunities.
- Real-world connections-Field trips help students connect theoretical concepts to real-world applications.
- Increased engagement-Field trips can be engaging and motivating, making learning more enjoyable and interactive.
- Develops observation skills-Field trips encourage students to observe and take note of details in a real-world setting.
- Enhances retention-Field trips can improve knowledge retention by providing students with memorable experiences.
- Promotes socialization-Field trips provide opportunities for students to interact with peers and teachers in a different setting.
- Broadens perspectives-Field trips can expose students to new ideas, cultures, and environments, broadening their perspectives (Kaur, 2024).

Generally, field trips can be a valuable addition to the learning experience, providing students with unique opportunities for hands-on learning and real-world exploration.

Demonstration Method

The demonstration method is a teaching approach where an instructor shows students how to perform a specific task, procedure, or experiment, often through a step- by-step presentation. Merits of this method include the followings:

- Clear understanding-Demonstrations provide students with a clear understanding of complex procedures or concepts.
- Visual learning-Demonstrations engage students' visual senses, making learning more effective.
- Step-by-step guidance-Demonstrations provide students with step-by-step guidance, reducing confusion and errors.
- Practical application-Demonstrations show students how to apply theoretical knowledge in practical situations.
- Increased confidence-Demonstrations can increase students' confidence in their ability to perform tasks or procedures.
- Efficient use of time-Demonstrations can be an efficient way to teach complex procedures or concepts.
- Improved retention-Demonstrations can improve knowledge retention by providing students with a memorable visual experience (Okoro & Haruna, 2006; Durdanovic, 2015;Vargas, 2015).

Overall, the demonstration method can be an effective teaching approach, especially for skills-based or technical subjects, where students need to learn specific procedures or techniques.

Qualities of a Good Teacher

A good teacher possesses certain qualities that enable them to effectively teach, inspire, and support their students. Some of these qualities include:

- Knowledge and expertise- A good teacher has a strong understanding of the subject matter and stays up-to-date with new developments.
- Communication skills-Effective teachers can communicate complex ideas in a clear and concise manner.
- Patience and empathy-Good teachers are patient and understanding, recognizing that students learn at different rates and may face challenges.
- Passion and enthusiasm-Teachers who are passionate about their subject can inspire and motivate their students.
- Flexibility and adaptability-Good teachers can adapt their teaching methods to meet the needs of different students and learning styles.
- Creativity and resourcefulness-Effective teachers can think creatively and find innovative ways to engage students and promote learning.
- Classroom management-Good teachers can manage their classrooms effectively, creating a positive and productive learning environment.
- Feedback and assessment-Teachers who provide constructive feedback and fair assessment can help students improve and grow.
- Support and encouragement-Good teachers provide support and encouragement, helping students to build confidence and develop a growth mindset.
- Continuous learning-Effective teachers recognize the importance of ongoing learning and professional development, staying current with best practices and new technologies Okoro & Haruna, 2006; Durdanovic, 2015;Vargas, 2015).

By possessing these qualities, teachers can create a positive and supportive learning environment that fosters student growth and achievement.

Requirements for Teaching Environmental Science

To effectively teach environmental science, teachers should possess certain knowledge, skills, and qualities. Some of the key requirements include:

- Strong knowledge of environmental science- Teachers should have a solid understanding of environmental science concepts, including ecology, conservation, sustainability, and environmental policy.
- Interdisciplinary approach- Environmental science is an interdisciplinary field that draws on concepts from biology, chemistry, physics, and social sciences. Teachers should be able to integrate these disciplines to provide a comprehensive understanding of environmental issues.
- Real-world examples and case studies-Teachers should use real-world examples and case studies to illustrate environmental concepts and make them relevant to students' lives.
- Hands-on and experiential learning-Environmental science is a hands-on field that lends itself to experiential learning. Teachers should incorporate hands-on activities, field trips, and projects to engage students and promote learning.
- Critical thinking and problem-solving skills-Teachers should encourage students to think critically and develop problem-solving skills to address environmental issues.

- Current and relevant content-Teachers should stay up-to-date with current environmental issues and research, incorporating relevant and timely content into their teaching.
- Ability to promote sustainability-Teachers should promote sustainability and environmental stewardship, encouraging students to adopt environmentally responsible behaviors.
- Effective communication skills-Teachers should be able to communicate complex environmental concepts in a clear and concise manner, using a variety of teaching strategies to engage students.
- Ability to facilitate discussions and debates-Environmental science often involves complex and controversial issues. Teachers should be able to facilitate discussions and debates, encouraging students to think critically and consider multiple perspectives.
- Commitment to ongoing learning-Teachers should be committed to ongoing learning and professional development, staying current with best practices and new technologies in environmental science education (Okoro & Haruna, 2006; Durdanovic, 2015;Vargas, 2015).

By possessing these requirements, teachers can effectively teach environmental science and inspire students to become environmentally responsible citizens.

Instructional Materials for Teaching Environmental Science

A variety of instructional materials can be used to teach environmental science, including:

- Textbooks and online resources-These provide foundational knowledge and information on environmental science concepts and issues.
- Videos and documentaries-These can be used to illustrate complex concepts, showcase real-world examples, and promote critical thinking.
- Interactive simulations and models-These can help students visualize and understand complex environmental systems and processes.
- Field equipment and sampling tools-These can be used to collect data and conduct hands-on investigations in the field.
- Case studies and real-world examples-These can be used to illustrate environmental concepts and issues in a real-world context.
- Games and role-playing activities-These can be used to engage students and promote learning through interactive and immersive experiences.
- Online resources and databases-These can provide students with access to current research, data, and information on environmental science topics.
- Environmental monitoring equipment-This can be used to collect data on environmental parameters such as air quality, water quality, and weather patterns.
- Multimedia presentations-These can be used to present information in an engaging and interactive way, using a combination of text, images, and audio.
- Hands-on materials and kits-These can be used to support hands-on learning and experimentation, such as water testing kits or composting materials (Okoro & Haruna, 2006; Ordu, 2021).

By using a variety of instructional materials, teachers can create a rich and engaging learning environment that promotes student understanding and appreciation of environmental science.

Audio-Visual Materials

Audio-visual materials are educational resources that use a combination of sound and visual elements to convey information and promote learning. Examples include:

- Videos-Educational videos, documentaries, and tutorials.
- Films-Feature films, short films, and educational films.
- Slideshows-Presentations that use images, diagrams, and text to convey information.
- Podcasts-Audio recordings that provide information on a specific topic or theme.
- Interactive multimedia-Computer-based learning materials that incorporate text, images, audio, and video.
- Animations-Animated videos and graphics that illustrate complex concepts and processes.
- Audio recordings-Lectures, interviews, and audio dramas that provide information and promote learning (Okoro & Haruna, 2006; Ordu, 2021).

Benefits of Audio-Visual Materials are as follows:

- Engage learner-Audio-visual materials can engage learners and promote active learning.
- Illustrate complex concepts-Audio-visual materials can help to illustrate complex concepts and processes.
- Provide real-world examples-Audio-visual materials can provide real-world examples and case studies.
- Cater to different learning styles-Audio-visual materials can cater to different learning styles, such as visual and auditory learners.
- Enhance retention-Audio-visual materials can enhance retention and recall of information (Okoro & Haruna, 2006; Ordu, 2021).

Uses of Audio-Visual Materials of audiovisual includes:

- Classroom instruction- Audio-visual materials can be used to support classroom instruction and promote learning.
- Distance learning- Audio-visual materials can be used to support distance learning and online education.
- Training and development-Audio-visual materials can be used to support training and development programs.
- Presentations- Audio-visual materials can be used to support presentations and public speaking (Okoro & Haruna, 2006; Durdanovic, 2015).

By incorporating audio-visual materials into teaching and learning, educators can create engaging and effective learning experiences.

Visual Materials

Visual materials are educational resources that use images, diagrams, charts, and other visual elements to convey information and promote learning. Examples include:

- Pictures-Photographs, illustrations, and diagrams that illustrate concepts and ideas.
- Charts and graphs-Visual representations of data and information that help to illustrate trends and patterns.
- Diagrams-Visual representations of objects, systems, and processes that help to illustrate complex concepts.
- Maps-Visual representations of geographic areas that help to illustrate spatial relationships and patterns.

- Posters-Visual displays that use images, text, and graphics to convey information and promote learning.
- Graphs and infographics-Visual representations of data and information that use a combination of images, charts, and text to convey information (Okoro & Haruna, 2006; Durdanovic, 2015).

Uses of Visual Materials

- Classroom instruction-Visual materials can be used to support classroom instruction and promote learning.
- Presentations-Visual materials can be used to support presentations and public speaking.
- Educational resources-Visual materials can be used to create educational resources, such as textbooks and online materials (Okoro & Haruna, 2006; Durdanovic, 2015).

Audio Materials

Audio materials are educational resources that use sound to convey information and promote learning. Examples include:

- Podcasts-Audio recordings that provide information on a specific topic or theme.
- Audio lectures- Recordings of lectures or presentations that provide instruction and guidance.
- Audiobooks- Audio recordings of books and other written materials.
- Sound effects- Audio recordings that use sound to illustrate concepts or create a specific atmosphere.
- Music: Audio recordings that use music to convey information, create a mood, or promote learning (Okoro & Haruna, 2006; Durdanovic, 2015).

Uses of Audio Materials

- Language learning-Audio materials can be used to support language learning and improve pronunciation.
- Classroom instruction-Audio materials can be used to support classroom instruction and promote learning.
- Self-directed learning-Audio materials can be used for self-directed learning and professional development.
- Relaxation and stress relief-Audio materials, such as music and nature sounds, can be used for relaxation and stress relief (Okoro & Haruna, 2006; Durdanovic, 2015; Hamane & Khalki, 2024).

Conclusion

In conclusion, environmental science is a vital field that requires a comprehensive understanding of the natural world and human impact on the environment. The use of instructional materials, such as visual and audio materials, can enhance student learning outcomes and promote environmental awareness. Additionally, the integration of Artificial Intelligence (AI) in teaching and learning environmental science can provide numerous benefits, including personalized learning, intelligent tutoring systems, and real-time feedback. By leveraging these tools and approaches, educators can create engaging and effective learning experiences that inspire students to become environmentally responsible citizens. Ultimately, the effective teaching and learning of environmental science can help mitigate environmental challenges and promote a more sustainable future.

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