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Designing Cities for Coexistence: Wildlife and Urban Spaces

BIOS4YOU
AR 2.0

BIO-INSPIRED STEM TOPICS FOR ENGAGING YOUNG GENERATIONS
THANKS TO THE USE OF AUGMENTED REALITY

Project Number: 2023-1-DE03-KA220-SCH-000126516

KIT Karlsruher Institut für Technologie · ktu kaunas university of technology · Università degli Studi di Palermo · CEIPES · Eduact

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Specific name of the learning unit	Designing Cities for Coexistence: Wildlife and Urban Spaces
General topic of the learning path	Urban Ecosystem Integration
Age of the target users	14-18 years
Requirements for the learner	1. Basic understanding of environmental science concepts (e.g.,water recycling). Basic literacy and numeracy skills. Basic ICT skills. 2. Access to a computer or tablet with internet connectivity. 3. Willingness to engage with digital tools (AR apps, Delightx). 4. No prior coding or AR development experience required
Description of the learning unit	This unit explores urban ecosystems, bio-inspiration for sustainable design, and the integration of augmented reality to visualize and create urban spaces that support both human and wildlife flourishing. It is divided into three sections: "Explore" introduces foundational concepts of climate change, ecosystems, and restoration. "Execute" delves into bio-inspiration, showcasing how natural processes inspire solutions and how Augmented Reality (AR) can visualize these processes and impacts, supported by real-world examples and practical activities. "Enhance" justifies the pedagogical benefits of AR, offering examples of useful AR applications and practical integration strategies. The unit culminates in a hands-on exercise where students use a gamified AR experience in Delightex to strengthen their understanding and engagement with the topic.
Subject: Parties involved	Environmental Science, Biology, Geography, Urban Planning, Design Technology, Art.

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Keywords	Urban ecology, biodiversity, ecosystem services, biomimicry, green infrastructure, augmented reality (AR), sustainable cities, wildlife, coexistence, urban planning.
Key qualifications, skills and knowledge that can be acquired	Qualifications (Mindset/Attitude): ● Environmental awareness. ● Proactive and innovative thinking towards environmental challenges. ● Appreciation for nature's role in sustainable solutions. ● Motivation to participate in climate action. Skills: ● **Critical Thinking:** Analyzing environmental problems and proposing solutions. ● **Problem-Solving:** Applying bio-inspired concepts to environmental challenges. ● **Digital Literacy:** Navigating and utilizing AR applications. ● **Scientific Inquiry:** Interpreting data and observing natural processes (virtual or real). ● **Communication:** Explaining complex environmental concepts and presenting restoration ideas. Knowledge: ● Understanding of urban ecological principlesIdentifying environmental problems in urban settings ● Recognising bio-inspired solutions derived from nature. ● Understanding the potential and applications of Augmented Reality in environmental education.
Resources and didactic aids used	Resources: ● Textbooks/Scientific articles ● Case studies ● Internet resources ● Free AR platforms (Delightex) ● AR-compatible devices (smartphones/tablets)

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Assessment criteria and evaluation	• **Participation:** Engagement in discussions and activities throughout the unit. • **Activity Completion:** Execution of practical AR exercise • **Concept Map/Mind Map:** Creation of a visual representation linking ecosystems, urban spaces, coexistence and bio-inspired solutions.

Introduction

As our world becomes increasingly urbanized, the spaces where humans and nature intersect are shrinking. This unit will empower you to understand the challenges and opportunities of urban living for wildlife and to explore innovative solutions inspired by nature itself. We'll delve into how we can design cities that are not just functional for people, but also thriving habitats for a diverse range of species, fostering a harmonious coexistence.

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1. Explore – Foundations of Wildlife and Urban Spaces

In this section, we lay the groundwork for understanding the intricate relationship between urban environments and natural ecosystems. While cities are often perceived as separate from nature, they are, in fact, complex ecosystems where human activities profoundly impact local biodiversity.

1.1 What is an Urban Ecosystem?

Urban ecosystems refer to areas where human settlements, infrastructure, and modified natural environments interact, supporting a unique array of plant and animal life (Grimm et al., 2008). Urban areas, once considered devoid of significant wildlife, are increasingly recognized as complex ecosystems where human activities profoundly influence natural processes.

1.2 What are the key concepts of Urban Ecology?

The field of **urban ecology** studies these interactions, focusing on how plants, animals, and microorganisms adapt to, thrive in, or are displaced by cities (Wu, 2014).

- **Biodiversity**: Refers to the variety of plant and animal life in the world or in a particular habitat. The variety of life in an ecosystem – is not limited to pristine natural areas; it also exists within cities, in parks, gardens, riversides, and even on buildings.
- **Habitat Loss & Fragmentation:** The destruction and division of natural habitats, often due to urban expansion. The rapid **urbanization** leads to significant **habitat loss and fragmentation**, posing major threats to species survival (Marzluff, 2008).
- **Human-Wildlife Conflict:** Negative interactions between people and wildlife, often arising from shared or overlapping spaces. The destruction and division of natural habitats, often due to urban expansion can result in **human-wildlife conflict**, where interactions between humans and urban animals lead to negative consequences for one or both parties, such as property damage or injury (Frank et al., 2017).
- **Green Infrastructure:** A network of green spaces and natural elements designed to provide environmental benefits. To mitigate these challenges, the concept of **green infrastructure** is vital. This refers to a strategically planned network of natural and semi-natural areas, designed to deliver a wide range of **ecosystem services** – the benefits that humans receive from ecosystems (e.g., clean air and water, pollination, climate regulation).
- **Ecosystem Services:** The benefits people obtain from ecosystems. Examples include green roofs, permeable pavements, urban forests, and wildlife corridors

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(Tzoulas et al., 2007). These elements are not just aesthetic; they are functional components that support urban biodiversity and improve the quality of life for human residents.

2. Execute – The role of Augmented Reality in designing cities for coexistence

Augmented Reality (AR) applications can significantly support the "Designing Cities for Coexistence: Wildlife and Urban Spaces" initiative by making complex ecological concepts tangible and by fostering empathy and a sense of stewardship in students. By overlaying digital information onto the real world, AR transforms the built environment into an interactive classroom, bridging the gap between abstract biological principles and their practical application in urban planning (Wang & Li, 2020).

2.1 Specific features and types of AR Tools

An AR application for this purpose would be more than just a visualization tool; it would be a dynamic platform for discovery, design, and problem-solving. Key features and tools would include:

- **3D Model Visualization:** Project 3D models of proposed urban developments onto a real-world map (e.g., their school grounds or local park) and then overlay simulations of how these developments might impact local wildlife habitats, water flow, or light pollution.
- **Data Visualization Overlays:** Overlay virtual representations of biomimetic architectural elements (e.g., a building façade inspired by a desert beetle's water collection) onto existing structures, allowing students to "see" how these designs could function in real time.
- **Identification and Information:** Use AR to "discover" virtual wildlife species in designated urban areas, learning about their habitats, behaviors, and how urban design decisions affect them.

2.2 Real studies and practical exercises

Meaningful integration of AR in hands-on learning is already happening globally, particularly in fields like environmental and urban education. These examples demonstrate how AR can move students beyond passive observation and into active, creative problem-solving inspired by nature.

A case study in Oslo, Norway, involved youth in the "Oslo Trees" plan to plant 100,000 new trees. Using AR, the students could generate their own planning proposals on-site and at scale. This hands-on, AR-supported activity not only increased their

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understanding of urban planning and design but also gave them a sense of control and confidence in presenting their ideas. This model is directly applicable to coexistence design, where students could propose and visualize wildlife-friendly infrastructure (Reaver, 2023).

By integrating these features and activities, an AR application becomes a powerful educational engine, enabling students to "see" the invisible connections in their urban environment, practice designing with nature, and become active participants in creating more harmonious cities for all species.

3. Enhance – Augmented Reality for deeper learning and engagement

Augmented Reality (AR) tools and applications are a powerful medium for environmental and urban education because they transform abstract concepts into tangible, interactive, and memorable experiences. For a topic as complex as "Designing Cities for Coexistence," where the goal is to integrate natural systems into the built environment, AR provides a unique ability to bridge the gap between theory and practice. It does this by:

- **Deepening Understanding of Complex Concepts:**
  - **Visualization of the Unseen:** AR allows students to visualize abstract ecological processes (like water infiltration or air purification by plants) in real-time within their physical environment. Seeing a virtual overlay of roots absorbing water or pollutants being filtered makes the concept far more concrete and understandable than a diagram in a textbook.
- **Making Complex Concepts Accessible:**
  - **Bridging Theory and Reality:** Concepts such as "habitat fragmentation" or "ecological corridors" can be abstract. AR can project virtual representations of these concepts onto a real landscape, allowing students to virtually "walk through" a fragmented habitat or "see" how a green bridge connects two previously isolated areas.
- **Increasing Engagement and Motivation:**
  - **Immersion:** The immersive and interactive nature of AR captivates students' attention, making learning more exciting and memorable. It feels like "playing" while learning.
  - **Gamification:** Integrating game-like elements (challenges, points, progress tracking) within AR experiences boosts motivation and encourages persistence.

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3.1 Examples of Useful AR Apps and Tools

Various AR tools can significantly enhance the learning experience for ecosystem restoration by providing immersive and interactive ways to explore complex environmental concepts. Here is an example:

Delightex (CoSpaces Edu):

Delightex allows users to create interactive 3D virtual worlds and then experience them in augmented reality or virtual reality. It features a drag-and-drop interface and a visual block-based coding language (CoBlocks), making it highly accessible for students and teachers with no prior coding experience. It offers a free version with core functionalities. Students can design and build their own virtual ecosystems, simulate environmental changes, and visualize restoration efforts. Its creative freedom empowers students to become content creators, not just consumers.

3.2 Practical Suggestions for Integration into the Learning Experience

Gamified learning environments or interactive 3D virtual worlds can challenge students to explore green infrastructure like trees and green roofs in a city to mitigate the effects of climate change like flooding and heatwaves. This makes learning about urban design both fun and informative.

Exercise: "Eco-Visionary" AR App

"Eco-Visionary" AR app allows students to explore a real-world location, e.g. a city park, and then interact with virtual 3D models, like green infrastructure, wildlife habitats and info panels, directly onto that space. Each virtual object comes with an informational panel explaining its ecological purpose and how it contributes to a more biodiverse city. By physically walking through their augmented design, students gain a deeper, more intuitive understanding of how individual ecological elements can connect to create a cohesive and vibrant urban ecosystem.

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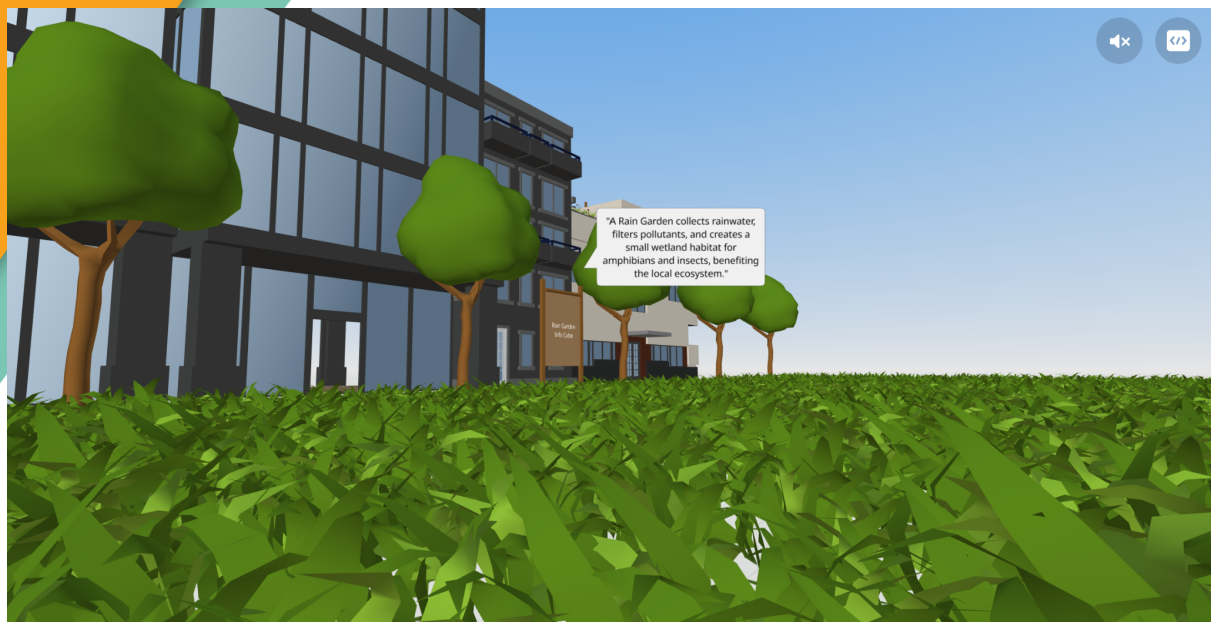

Image 2. "Eco-Visionary" AR App

By making learning more immersive, interactive, and directly relevant to the students' immediate environment, AR technology significantly strengthens their connection to urban ecosystems and promotes more effective knowledge building for future sustainable urban development.

Conclusion

This learning unit provides a holistic framework for understanding and actively participating in the design of cities for coexistence. By exploring fundamental ecological principles, executing practical bio-inspired solutions, and leveraging the immersive capabilities of augmented reality, learners are empowered to become proactive agents of change. The unit emphasizes that cities are not just human habitats but also vital components of larger ecosystems, where thoughtful design can lead to mutual prosperity for both people and wildlife. Through critical thinking, creative problem-solving, and a deeper connection to their environment, students will be equipped to contribute to the development of greener, more resilient, and truly coexistent urban spaces for generations to come.

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Phase	Description
Explore	- Research and Discovery: Study how cities affect wildlife and ways to support coexistence through green spaces and corridors.
	- Content Development: Present key ideas (biodiversity, green infrastructure, ecosystem services) with simple visuals and examples.
	- Needs Analysis: Identify learners' prior knowledge and misconceptions about urban ecology.
Execute	- Curriculum Implementation: Apply nature-inspired solutions in city design using AR features like virtual representations.
	- Interactive Exercises: Analyze real case studies. Walk through spaces with AR overlays (e.g., green roofs, wildlife passages).
	- Feedback Collection: Share AR designs, reflect on outcomes, and get feedback from peers/teachers.
Enhance	- AR Integration: Use AR app Eco-Visionary to visualize habitats and designs.
	- Interactive Learning: Explore parks or streets through AR, making ecological concepts tangible.
	Gamified Content: - **Rewards for Exploration**: New AR models and design tools are unlocked as students explore different locations or successfully complete challenges, encouraging them to apply their knowledge in diverse settings.
	AR-Based Assessments: Replace traditional tests with AR-based evaluations, such as students exploring their AR urban ecosystem models or completing biodiversity "quests" in real environments.

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