



Modular Curriculum

Green Deal Awareness through Augmented Reality in Primary School Education

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TABLE OF CONTENTS

Foreword	4
MODULE 1: GREEN DEAL AWARENESS	5
Lesson 1.1: The European Green Deal and Definition of Green Deal Awareness	5
References.....	11
Lesson 1.2: The Aims of Green Deal Awareness	14
References.....	16
Lesson 1.3: Environmental Regulations Made So Far and What Is Planned to be Done with The Green Deal.....	17
References.....	23
MODULE 2: AUGMENTED REALITY.....	25
Lesson 2.1: Definition of Augmented Reality.....	25
References.....	29
Lesson 2.2: Historical Development of Augmented Reality.....	29
References.....	33
Lesson 2.3: Usage Areas of Augmented Reality.....	34
References.....	37
MODULE 3: ENVIRONMENT EDUCATION.....	39
Lesson 3.1: Environment Education in Primary Education Curriculum	39
Lesson 3.2: Contribution of Environment Education to Green Deal Awareness	42
Lesson 3.3: How Can We Increase Green Deal Awareness in Primary Education?	45
References.....	49
MODULE 4: THE USAGE AREAS OF AUGMENTED REALITY IN EDUCATION	50
Lesson 4.1: Software Used In Augmented Reality in Education	50
References.....	53
Lesson 4.2: Advantages and Limitations of Using Augmented Reality in Education	53
References.....	57
Lesson 4.3: Application Examples of The Use of Augmented Reality in Education	58
References.....	61
MODULE 5: THE USE OF AUGMENTED REALITY FOR INCREASING GREEN DEAL AWARENESS IN PRIMARY SCHOOL EDUCATION	62
Lesson 5.1: The Role of Augmented Reality in Primary School Education	62
References.....	66
Lesson 5.2: Examples of Augmented Reality in Primary Schools.....	67
References.....	71



Lesson 5.3: How Augmented Reality Help to Increase Green Deal Awareness in Primary Education?..... 72
References..... 76



FOREWORD

The primary objective of this specific work package has been the formulation of a comprehensive "Modular Curriculum Designed Using Augmented Reality (AR) in Environmental Education." The focal point of this project lies in bolstering the digital and ecological competencies within higher education, with particular emphasis on advancing the sectors of digital education and environmental stewardship. Additional key priorities include addressing issues related to "Environment and the fight against climate change" and fostering "Stimulating innovative learning and teaching practices."

The purpose of the modular curriculum is to empower pre-service teachers, educators, and practitioners in efficiently navigating the landscape of primary school environmental education through the strategic incorporation of Augmented Reality (AR) methodologies. By integrating AR approaches into the curriculum, these educators will gain proficiency in leveraging AR applications to enhance the educational experience. Moreover, the curriculum aims to cultivate a increased awareness of sustainable environmental practices, both within the educators themselves and among their students.

As articulated earlier, educators are expected to adeptly engage with students, demonstrating sensitivity to cultural, social, and global issues, harnessing new technologies, and adapting to the swiftly evolving educational environment (OECD, 2005). Recognizing that well-equipped teachers play a pivotal role in student success, the endeavor to enhance teaching skills becomes paramount. Consequently, the development of teaching skills is underscored as crucial, commencing with pre-service teachers who are poised to become the torchbearers of future education. The central outcome of this work package is the creation of the Modular Curriculum Using Augmented Reality (AR) in Environmental Education tailored for pre-service teachers and teachers. This curriculum aims to equip pre-service teachers, educators, and practitioners with the requisite skills demanded by 21st-century education, ensuring they are well-prepared for the evolving demands of the educational systems.

Partner institutions from five countries, Sofia University, Çanakkale Onsekiz Mart University, Lucian Blaga University of Sibiu, University of Latvia and GedonSOFT, have developed the following modular curriculum as a result of their cross-country literature studies, surveys and interviews. Each module includes at least three topics, learning outcomes, teaching methods and techniques, Learning-Teaching Activities, assessment tools and theoretical background.

MODULE 1: GREEN DEAL AWARENESS

Sofia University „St. Kliment Ohridski“

Content:

- 1.1. The European Green Deal and Definition of Green Deal Awareness
- 1.2. The Aims of Green Deal Awareness
- 1.3. Environmental Regulations Made So Far and What Is Planned to be Done with The Green Deal

Lesson 1.1: The European Green Deal and Definition of Green Deal Awareness

Duration: 2 hours

Learning Outcomes:

- Understanding of the European Green Deal as well as key processes and instruments of European environmental policy
- Understanding of the interdependence between EU's Green deal and the global Green transition
- Understanding of Green transition from a systemic perspective
- Discover ideas, pedagogical practices and tools that can help you to address the climate crisis and environmental sustainability in classroom
- Understand how to utilise and integrate student thinking about the climate crisis into classroom activities
- Investigate approaches to organise constructive debates on the topic of climate change and Green Deal

Teaching Methods / Techniques: Brainstorming, Self-Study, Question - Answer, Discussion, Teamwork

Learning-Teaching Activities:

- The teacher will introduce general Definition of Green Deal and historical background

- Presentations on the fundamentals of GD, including definitions, history, and etc. Use of visual aids and real-life examples to illustrate key concepts.
- Participants break into small groups. Each group shares their ideas with the larger group.
- The small groups will identify both the weaknesses of current Green deal paradigm and see engaging ways of moving forward and share their knowledge in the field they specialize. Each group will be discussed.
- The teacher will listen each group discussions, answer their questions, and provide feedback.
- Information obtained in the group discussion will be reported.

Assessment Tools: At the end of the lesson, the teacher asks different group members to ask each other questions about Green Deal and Green Deal Awareness. The teacher ensures that the deficiencies of the subject are corrected and reinforced with feedback-corrections and hints.

Themes:

1. Introduction to the European Green Deal
2. Funding the EU Green Deal
3. Elements of the EU Green Deal
4. The fundamentals of the European Green Deal
5. The global dimension of the Green Deal – practical examples

Theoretical Knowledge:

The European Green Deal is a package of policy initiatives, which aims to set the EU on the path to a green transition, with the ultimate goal of reaching climate neutrality by 2050. It supports the transformation of the EU into a fair and prosperous society with a modern and competitive economy. It underlines the need for a holistic and cross-sectoral approach in which all relevant policy areas contribute to the ultimate climate-related goal. The package includes initiatives covering the climate, the environment, energy, transport, industry, agriculture and sustainable finance – all of which are strongly interlinked. The European Green Deal was launched by the Commission in December 2019 and the European Council noted it

during its December meeting. In the recent past, proposals for “Green New Deals” (GND) have emerged as comprehensive policy packages involving states, civil society, and private actors in the fight against climate change and ecological breakdown. In many cases, these Deals involve considerable public investment and focus on green jobs and dignified living conditions (Aronoff et al., 2019; Mastini et al., 2021).

According to the European Commission, the EU Green Deal (henceforth EGD) aims to reduce EU net domestic production of greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels and attain *climate neutrality* by 2050 (European Commission-EC, 2019a). For the European Commission (EC), the EGD is “... Europe's structural response and new growth strategy that sets out ambitions to transform the EU into a modern, resource-efficient, and competitive economy” (EC, 2019).

The Green Deal represents an exceptional chance to promote a particular ideology of environmental protection and sustainability practices, and is supported by the very status of the EU. Ideologies are created by internalizing certain values, maintaining attitudes, responding to social settings, and aiming at social consent (cf. Fairclough 2001; Kress and Hodge 1979). The Green Deal aims to implement green strategies and goals in the circular economic model, and abandon the linear model. Kirchherr et al. (2017) define circular economy as “an economic system that replaces the “end-of-life” concept with reducing, reusing alternatively, recycling and recovering materials in production/distribution and consumption processes.”

Green growth is an alternative to the so-called “brown growth” that refers to economic development relying on intense fossil fuel consumption without dealing with the impact of this consumption on the environment (World Bank 2013, accessed on 27 December 2020). In contrast, green growth aims at “greening capitalism”, thereby shifting the focus on supporting business and industry practices with reduced environmental impact, developing and implementing environmental policy, and technological innovation that would reduce greenhouse gas emissions, all without slowing GDP growth (Ossewaarde and Ossewaarde-Lowtoot 2020, p. 1; see also specific features in which the Green Deal transcends the traditional discourse³).

Based on the above principles, the EC has defined its development strategies as “sustainable” and made it evident in its public communication. However, as (Braun 2013) pointed out, the

EU has been committed to sustainability rhetorically rather than in practice (p. 117; see also Siddi 2020). For one, the above-mentioned principles appear to be conceptual contradictions. For example, the ecological modernization theory, as interpreted by the EU, maintains that a simultaneous economic growth and environmental protection are possible but fails to address the “fundamental contradiction between an economic model fostering unlimited growth rates, and environmental and human resources which are by definition limited” (Lietaert 2008, p. 68).

The main objective of the European Green Deal strategy is connected with the reduction of net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels and achieving climate neutrality in 2050 (Communication..., 2019). The transition towards a climate-neutral economy is one of the most significant challenges faced by our generation and those that will follow (Amoroso et al., 2021; Montanarella & Panagos, 2021). The main goal of the European Green Deal strategy is to place sustainability and human well-being at the centre of economic policy and as a fundamental dimension of all policy decisions and the resulting actions. Achieving the goal of climate neutrality will only be possible with the participation of all stakeholders from different sectors, such as construction, biodiversity, energy, transport, agriculture and food. Fields of European Green Deal strategy interest.

A comprehensive analysis of the scope of the EGD strategy areas has shown that the implementation of the European Green Deal strategy will require: (i) dialogue, solidarity and involvement of all stakeholders; (ii) revision and reformulation of the legal framework for action relating to all identified areas; (iii) application of innovation and new technological solutions and, in particular, digital technologies; and (iv) widespread application of the circular economy and sustainable development principles. Successful implementation of the European Green Deal strategy, according to Pe’er et al. (2020), will also require political courage to overcome resistance to change and the introduction of many political, economic and social measures (Brodny & Tutak, 2020; Montanarella & Panagos, 2021).

The European Green Deal Increasing EU’s Climate ambition for 2030 and 2050 Supplying clean, affordable and secure energy Mobilising industry for a clean and circular economy Accelerating the shift to sustainable and smart mobility From Farm to Fork —a fair, healthy and environmentally friendly food system Preserving and restoring ecosystems and biodiversity Azero-pollution ambition for a toxic-free environment Building and renovating in

awaythat is energy- and resource-efficient The EU as a global leader A European Climate Pact
The European Green Deal Research Innovation.

Ambitious goals of the European Green Deal strategy will be possible to achieve by developing new technologies, sustainable solutions and break-through innovations. This requires a tremendous amount of intellectual effort and financial support to the research and innovation system. The Green Deal strategy is linked to Horizon Europe in supporting public and private investment through the financial support of research and innovation in transport technologies, including batteries, clean hydrogen, low-carbon steel making, circular bio-based sectors and the built environment (Communication..., 2019).

Accordingly, social and behavioral sciences have discussed associative processing methods and the nature, extent, significance, and influence of the personal experience of climate change over the past decade to understand how it affects adaptive capacity, that is, the ability to moderate impacts or to cope with the consequences of climate change (Myers et al. 2013; Reser et al. 2014; van der Linden 2014; Broomell et al. 2015; Marlon et al. 2018). Among others, Reser and Bradley (2020) highlighted four main themes conditioning psychological distance: (1) the extent and underpinnings of public acceptance or “belief” regarding anthropogenic climate change; (2) the effectiveness of communication regarding climate change and the level of public engagement; (3) the nature of environmental risk awareness, perception, and response in the context of climate change; and (4) the unfolding and increasingly dramatic local and global biophysical environmental changes, events, and conditions attributed to climate change.

Consequently, being aware requires recognizing that climate change is a problem and understanding the risks and impacts that need to be dealt with (Lieske et al. 2014). On the other hand, risk perception is how individuals receive information or stimuli from their environment, transform it into psychological awareness, and (re)act accordingly. In other words, it refers to a mental construct, an individual’s assessment of the probability of a particular event and its consequences, or a subjective estimation of the nature of a threat and its severity (Azadi et al. 2019a).

Although counterintuitive, some authors concluded that higher awareness of climate change might relate to lower risk perception due to risk normalization (Luis et al. 2018). Consequently, individuals could develop psychological risk minimization strategies to curtail perceived

threats and psychologically adapt to the situations. Therefore, timely and accurate risk perception is an essential determinant of intentions and for the choice of adaptation methods (Deressa et al. 2011).

In the respective strategy document, the Commission's Communication on the European Green Deal from December 2019, the President made clear, that this Green Deal "is an integral part of the Commission's strategy to implement the United Nation's 2030 Agenda and the sustainable development goals". (European Commission 2019, 3). To reach the ambitious goals, which were further refined in the "Fit for 55" legislative package of July 2021, the strategy calls for a sustainability mainstreaming of all EU policies. For education policy this means a new focus on competence development to ensure that citizens have the knowledge about climate change as well as the opportunities to gain skills and competences "to reap the benefits of the ecological transition" (European Commission 2019, 19). Furthermore, the Green Deal also advocates the greening of education infrastructure, making school buildings and operations more sustainable and climate-neutral.

The new framework for education policy and the respective cooperation between the EU level and the Member States, aims at ambitious goals, namely to reform education policy all over Europe along six dimensions – quality, inclusion, green and digital transition, teachers and trainers, higher education, geopolitical cooperation – and to reduce still existing barriers between the Member States as well as between the education sectors.

The Communication clearly refers to the Green Deal, stating that: "Education and training policies and investments geared towards inclusive green and digital transitions hold the key to Europe's future resilience and prosperity." (European Commission 2020, 8) To do so, education and training policies will contribute in a triple way: enhancing people's knowledge about sustainability and climate change, providing them with the necessary skills and competences for the green economy of the future and last but not least, facilitating a change of behavior which allows for a more sustainable way of life. The last point refers to UNESCO's understanding of a transformative dimension in education, which goes significantly beyond (but builds on) knowledge transfer.

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Lesson 1.2: The Aims of Green Deal Awareness

Duration: 2 hours

Learning Outcomes:

- Introduces the Green Deal awareness and students are asked to reflect on their own behaviour regarding energy consumption.
- Participants will discuss different priorities regarding the adoption of Green Deal policies and present their agreed (or not) policy in class. This approach will enable participants to grasp the sense of the importance of awareness and the complexity of changing behaviours regarding Green Deal and consumption when making decisions.

Teaching Methods / Techniques: The methods include a combination of self-paced activities and live interaction with the other participants. These activities and interaction include reading material, videos, forum discussions, office hours to ask questions to experts, and panel debates. The course ends with group work on a mastery challenge. Interactive Lectures, Demonstrations, Group Discussions, Case Studies

Learning-Teaching Activities:

- Teacher candidates are given a research task regarding the Green Deal Awareness. They are asked to examine in more detail which goals of the Green Deal they can contribute to, how they can contribute, and the impacts on education and sustainability.
- Teacher candidates are divided into small groups and asked to find appropriate awareness methods
- Feedback is received from teacher candidates about the content and practices of the course. Student opinions are evaluated to determine which topics need more emphasis or better explanation.

Assessment Tools:

- Class Discussions and Debates
- Students casus presentations
- Co-working-during the training will be evaluated.

Theoretical Knowledge:

The Green Deal Awareness aims to achieve several key objectives related to environmental sustainability, climate action, and the transition to a greener economy. Some of the primary aims of the Green Deal Awareness include:

- **Raising Environmental Awareness:** One of the fundamental goals is to increase awareness and understanding of the environmental challenges we face, such as climate change, greenhouse effect; pollution, and the loss of biodiversity. It seeks to inform and educate the public about the importance of addressing these issues.
- **Promoting Climate Action:** The Green Deal Awareness aims to encourage individuals, communities, businesses, and governments to take meaningful actions to combat climate change. This may involve reducing greenhouse gas emissions, transitioning to renewable energy sources, adopting sustainable practices and implementing carbon print.
- **Fostering Sustainability:** The promotion of sustainable living and sustainable business practices is a core objective. This includes sustainable agriculture, energy efficiency, waste reduction, and the conservation of natural resources.
- **Advancing Renewable Energy:** To accelerate the transition to a low-carbon economy, the Green Deal Awareness often promotes the development and adoption of renewable energy sources, such as solar, wind, and hydropower.
- **Supporting Policy Changes:** The awareness campaign may advocate for and support policy changes at local, national, and international levels that promote environmentally friendly regulations and incentives.
- **Economic Transformation:** It aims to facilitate the shift towards a green economy by supporting green jobs, sustainable industries, and the development of clean technologies.
- **Reducing Carbon Footprints:** The Green Deal Awareness encourages individuals and organizations to reduce their carbon footprints through measures like energy conservation, sustainable transportation, and eco-friendly choices.
- **Protecting Biodiversity:** Conservation and protection of biodiversity are integral components of the campaign. This involves preserving ecosystems and habitats and preventing species extinction.

- **Empowering Communities:** The awareness campaign may seek to empower communities to take local action and become actively involved in environmental initiatives.
- **Global Cooperation:** Given the global nature of environmental challenges, the Green Deal Awareness aims to promote international collaboration and cooperation to address issues like climate change and pollution.
- **Measuring Progress:** Monitoring and evaluating the progress in achieving environmental goals is essential. The campaign may encourage the tracking of key environmental indicators and the assessment of the impact of policies and actions.
- **Fostering Innovation:** Encouraging innovation and the development of new technologies and solutions that are environmentally friendly is a key aim. This may involve supporting research and development in green technologies.

Overall, the Green Deal Awareness seeks to engage and mobilize society as a whole to take meaningful actions toward a more sustainable and environmentally responsible future. It emphasizes the importance of individual and collective efforts in addressing environmental challenges.

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Lesson 1.3: Environmental Regulations Made So Far and What Is Planned to be Done with The Green Deal

Duration: 2 hours

Learning Outcomes:

- Participants will be expected to demonstrate mastery of core competencies through writing and speaking about environmental policies and laws.
- Identify core elements of best practice environmental regulation, and select the design principles necessary to achieve an optimal regulatory mix.
- Research, critically examine and communicate in writing about a problem or specific aspect of environmental regulation.
- Determine which regulations apply and why
- Understand environmental compliance requirements
- Develop smart strategies for ensuring on-going compliance

Teaching Methods / Techniques: Interactive Lectures, Demonstrations, Group Discussions, Case Studies

Learning-Teaching Activities:

- The teaching method promotes knowledge and understanding of environmental law and allows for the development of various skills, including analysis, synthesis, critical judgement, evaluation, and legal research skills
- Participants will be encouraged during seminars to offer and receive feedback on ideas shared with the group and to reflect upon the process of research, the concepts encountered, and evaluation of the sources they are using.
- Group-based research and presentations

Assessment Tools:

- Class Discussions and Debates
- At the end of the lesson, the teacher asks different group members to organize open discussion with questions and debates upon Environmental Regulations. The teacher ensures that the deficiencies of the subject are corrected and reinforced with feedback-corrections and hints.

Theoretical Knowledge:

In the 1980s, the EU assumed the position of an expert on environmental policies in the international context (Braun 2013, pp. 26–27). The number of policies and legislation regarding the protection of the environment that go hand-in-hand with rising living standards in the EU ideology has grown exponentially. European sustainability policies have documented environmental discourse of leading European institutions starting with The Single European Act (1987) (ibid.) and ending with the most recent The European Green Deal 2020. The EC has maintained this discourse in the Europe 2020: A European Strategy for Smart, Sustainable and Inclusive Growth (European Commission 2010) that presented a green-growth plan of self-sufficiency in energy resources, in EU Biodiversity Strategy to 2020 (European Commission 2011a) that proposed reconstructing ecology as a natural life-enabling asset that has caused economic losses when in crisis and in Roadmap to a Resource Efficient Europe (European Commission 2011b) that argued for green growth strategy as a way to overcome the crisis. The discourse and terminology of environmental care and sustainability have been developed extensively by the EC in economic and developmental policies over the last decade. The Juncker Commission of 2014–2019 prioritized geopolitical issues, and security in particular, due to the Ukrainian crisis in 2014 and political tensions with Russia (Siddi 2020). In An EU Action Plan for the Circular Economy (2015), the Commission proposed to transition to a different, “sustainable” economy. In A European Strategy for Plastics in a Circular Economy 2018, the EC put forward its global leadership in “transitioning to the plastics of the future” and its focus on transforming the EU economy into a “modern, low-carbon, resource and energy-efficient” one. Finally, in the Green Deal, the newly elected Von der Leyen Commission pledged to reaffirm its leadership in global environmental challenges.

In line with the commitments made under the Paris Agreement, in 2019 the EC reported that by 2018 the EU had reduced total greenhouse emissions by 23% compared to 1990 levels and in December 2019 presented the European Green Deal (EGD) - a package of measures called "a road map for achieving the sustainability of the EU economy" through an inclusive and just transition.

The objective of the European Green Deal is to provide an overall direction for the EU legislation and regional development strategies where climate policy and emissions reduction have become the top priority (Siddi 2020). When praising the Green Deal, the EC’s President

Ursula von der Leyen pointed out its emphasis on making Europe the world's first climate neutral continent by planning for net zero carbon emissions by 2050. In her words, the Green Deal is Europe's "new growth strategy" and "man on the moon moment" (Harvey and Rankin 2020). It presents the EU as the incontestable leader with a prominent and well-recognized status in the domain of environmental protection that has made the topic its priority (see EC, Europe 2020). In September 2023, in her Annual State of the Union Address, European Commission (EC) President Ursula von der Leyen stated, "We have seen chaos and chaos from extreme weather events — from Slovenia to Bulgaria and across the Union. This is the reality of a boiling planet." It reaffirmed the role of the European Green Pact in protecting our planet Europe's seas, oceans, and environment are a source of natural and economic wealth for Europe. We must preserve and protect them to ensure that they continue sustaining us in the future. European Green Deal priorities include:

- protecting our biodiversity and ecosystems
- reducing air, water and soil pollution
- moving towards a circular economy
- improving waste management
- ensuring the sustainability of our blue economy and fisheries sectors

Global challenges, like environmental pollution, climate change, etc., are compelling nations to use technologies and approaches to economic activity that are less harmful to the environment (IISD, 2022). With this level of environmental degradation, sustainable development is impossible, and there is an urgent need for comprehensive global strategies and policies to ensure it (García-Feijoo et al., 2020).

Environmental regulation can potentially influence all of the sources of environmental pollution in a manner that reduces the negative impact of those sources (automobiles, industrial operations, household combustion appliances, etc.) and ensures sustainable development (Lin and Zhang, 2023). It can revolutionize new technology or innovation development by ensuring the "green" factor. i.e., key environmental pollution sources can be efficiently reduced by policies and investments supporting cleaner household energy and transportation, power housing, electricity production, industry, and improved municipal

waste management (Zhou et al., 2023). It can also be a source of industrial upgrading or transformation in a sustainable manner (He and Zheng, 2023).

Environmental regulations are laws and policies the government passes to preserve and protect the environment (Ramanathan et al., 2017). These laws and regulations are equally important and necessary for business organizations and the environment. They effectively prevent businesses from being destroyed by the environment and have been crucial in preserving the environment (Zefeng et al., 2018). Environmental regulations are an important policy tool for achieving governmental targets and guiding enterprise production and operational activities (Zhang and Song, 2021). In general, there are three types of environmental regulatory tools: command-and-control regulations, market-incentive regulations, and public participation-based regulations. These tools have different characteristics. First, as a traditional method for implementing environmental controls, command-and-control regulations are mandatory measures formulated by the government to directly affect the emission-reduction activities of polluters, while market-incentive environmental regulations mainly rely on price or cost mechanisms; such regulations include environmental pollution taxes, subsidies, and tradable license, which guide producers and consumers toward more energy-saving and environment-friendly options (Xie et al., 2017; Chen et al., 2020b). For example, Xie et al. (2017) confirmed that the productivity effect driven by market-based regulations is much stronger than that of the command-and-control. Regulations. i.e., market incentive regulation, command.

In contrast with the aforementioned two environmental regulatory tools designed by the government, public participation-based environmental regulations mainly rely on practices driven by public awareness of environmental protection, such as the reporting of environmental violations to superiors to exert pressure on polluting enterprises (Ge et al., 2021; Johnson, 2020). Of the three tools, command-and-control environmental regulations are the most popular tool in many developing countries for their simplicity and high efficiency, although such regulations have been criticized for their extremely large economic efficiency losses (Tang et al., 2020).

The European Climate Law writes into law the goal set out in the European Green Deal for Europe's economy and society to become climate-neutral by 2050. The law also sets the intermediate target of reducing net greenhouse gas emissions by at least 55% by 2030,

compared to 1990 levels. Climate neutrality by 2050 means achieving net zero greenhouse gas emissions for EU countries as a whole, mainly by cutting emissions, investing in green technologies and protecting the natural environment. The law aims to ensure that all EU policies contribute to this goal and that all sectors of the economy and society play their part.

Objectives

- Set the long-term direction of travel for meeting the 2050 climate neutrality objective through all policies, in a socially fair and cost-efficient manner
- Set a more ambitious EU 2030 target, to set Europe on a responsible path to becoming climate-neutral by 2050
- Create a system for monitoring progress and take further action if needed
- Provide predictability for investors and other economic actors
- Ensure that the transition to climate neutrality is irreversible

The Climate Law also addresses the necessary steps to get to the 2050 target:

Based on a comprehensive impact assessment, the EU has set a new target for 2030 of reducing net greenhouse gas emissions by at least 55% compared to levels in 1990. The new EU 2030 target is included in the Law. In July 2021, the Commission adopted a series of proposals to revise all relevant policy instruments to deliver the additional emissions reductions for 2030. The Law also includes a process for setting a 2040 climate target.

Environmental regulations and policies vary widely from one country to another, and it's not possible to provide a comprehensive list of all global regulations in a single response. However, I can offer an overview of some notable international agreements and initiatives and the key objectives of the European Green Deal. Please note that this information is accurate as of my last knowledge update in January 2022, and specific regulations may have evolved since then.

International Environmental Agreements and Initiatives:

- **Paris Agreement:** The Paris Agreement, adopted in 2015, is a landmark international treaty within the United Nations Framework Convention on Climate Change (UNFCCC). Its goal is to limit global warming to well below 2 degrees Celsius above pre-industrial levels, with efforts to limit it to 1.5 degrees. Each signatory country has set its own emissions reduction targets, known as Nationally Determined Contributions (NDCs).

- **Montreal Protocol:** The Montreal Protocol on Substances that Deplete the Ozone Layer is an international treaty aimed at protecting the ozone layer by phasing out the production and consumption of ozone-depleting substances, such as chlorofluorocarbons (CFCs).
- **Convention on Biological Diversity (CBD):** The CBD is a multilateral treaty focused on the conservation of biodiversity, sustainable use of its components, and the fair and equitable sharing of benefits arising from the utilization of genetic resources.
- **United Nations Sustainable Development Goals (SDGs):** Goal 13 of the SDGs specifically addresses climate action, with targets related to reducing greenhouse gas emissions and building resilience to climate change.
- **Basel Convention:** The Basel Convention is an international treaty that controls the transboundary movements of hazardous wastes and their disposal.

European Green Deal policy framework:

The European Green Deal is a comprehensive policy framework of the European Union (EU) aimed at making the EU climate-neutral by 2050. Some key objectives and planned actions of the European Green Deal include:

- **Climate Neutrality:** Achieving climate neutrality (net-zero greenhouse gas emissions) by 2050, with an intermediate target to reduce emissions by at least 55% by 2030.
- **Renewable Energy:** Increasing the share of renewable energy sources in the energy mix and supporting the growth of wind and solar power.
- **Energy Efficiency:** Promoting energy efficiency measures in buildings, transportation, and industry.
- **Circular Economy:** Advancing a circular economy to reduce waste and promote recycling and sustainable consumption.
- **Biodiversity:** Initiatives to protect and restore biodiversity, including a new EU Biodiversity Strategy.
- **Farm to Fork Strategy:** Promoting sustainable and environmentally friendly agricultural practices, including reducing the use of chemical pesticides.
- **Sustainable Transportation:** Encouraging the use of electric vehicles, improving public transportation, and making transport more sustainable.

- Just Transition Fund: Supporting regions and communities affected by the transition to a green economy.
- Zero Pollution: Reducing pollution and improving air and water quality.

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MODULE 2: AUGMENTED REALITY

University "Lucian Blaga" of Sibiu

Content:

- 2.1. Definition of Augmented Reality
- 2.2. Historical Development of Augmented Reality
- 2.3. Usage Areas of Augmented Reality

Lesson 2.1: Definition of Augmented Reality

Duration: 2 hours

Learning Outcomes:

- To define and explain augmented reality in different contexts
- To arouse students' curiosity and motivate them to explore, to acquire new knowledge through multisensory learning
- To become aware of the importance of using augmented reality by applying knowledge in real-world contexts, by acquiring practical skills through various simulations of real-world tasks, by personalizing learning for effective learning
- To make learning interactive

Teaching Methods / Techniques: Lecture, discussion, brainstorming, the "I know-I want to know-I've learned" model

Learning-Teaching Activities:

- At the beginning of the lesson, the teacher will introduce the students to the topic of discussion, then will present the model of the course, the structuring model of the course "I know-I want to know-I have learned"
- The teacher asks the students to draw on a sheet a table with two lines and 4 columns, to think and write down in it everything they know about Augmented Reality, what they want to know about this topic. Following that, during the course, students will complete the following 2 columns. This approach has the role of stimulating the spontaneity of learners and obtaining a large number of opinions/ideas on the proposed topic.

- The teacher will generate a virtual panel using the Padlet application <https://padlet.com/> will divide it into 4 sections and share it with the students. By the end of the course, the table will be filled in by students with correct and relevant information.

What do I know?	What do I want to know?	What have we learned?	What else would I like to know?
Evocation of knowledge	Making a list of questions through which the topic is included in the sphere of interest	Awareness of newly acquired knowledge, comparison with old knowledge and learners' expectations expressed in the section I want to know	It involves expanding learning centred on questions that have not been answered in the text or on new questions

- Through the brainstorming method, one student at a time will mention a single aspect he / she knows/wants to know about the topic. Before moving it to the Padlet panel, there will be frontal discussions/analyses to avoid irrelevant, ambiguous or erroneous information.
- All ideas generated by learners will be displayed on the digital panel and seen in real time by all learners.
- After brainstorming, the teacher will present students with pictures, websites ([https://www.interaction-design.org/literature/article/beyond-ar-vs-vr-what-is-the-difference-between-ar-vs-mr-vs-vr-vs-xr#what_is_extended_reality_\(xr\)?-2](https://www.interaction-design.org/literature/article/beyond-ar-vs-vr-what-is-the-difference-between-ar-vs-mr-vs-vr-vs-xr#what_is_extended_reality_(xr)?-2)), a video tutorial <https://youtu.be/vz0UUVDt2ps> in order to explain the differences between VR, AR, MR, XR.
- Students get in touch with the new contents: text, graphic materials, tutorial video, graphic schemes, etc.; seek answers to written questions, understand new information through previous knowledge and build new meanings.
- After watching the presentation of the video, there are group discussions, additional explanations on distinguishing AR from other interrelated technologies, such as virtual reality (VR), mixed reality (MR) and extended reality (XR), the need and advantages of

introducing Augmented Reality in the classroom as well as defining Augmented Reality from several perspectives.

- During teaching, students fill in column 4 on their papers, then return to the Padlet panel and brainstorm one student at a time will say a single aspect they have learned about the topic. Before passing it on the Padlet panel, there will be frontal discussions/analyzes to avoid irrelevant, ambiguous or erroneous information.
- In order to extend the learning and have a basis for discussion for the next course, at the end of the course students are asked to write down on the board what else they would like to know about the topic.

Assessment Tools:

- Formative assessment throughout the course
- At the end of the lesson, the teacher asks students to split and present their own definition and ask each other questions, ensuring that the subject's deficiencies are corrected and reinforced with feedback corrections and suggestions.

Theoretical Knowledge:

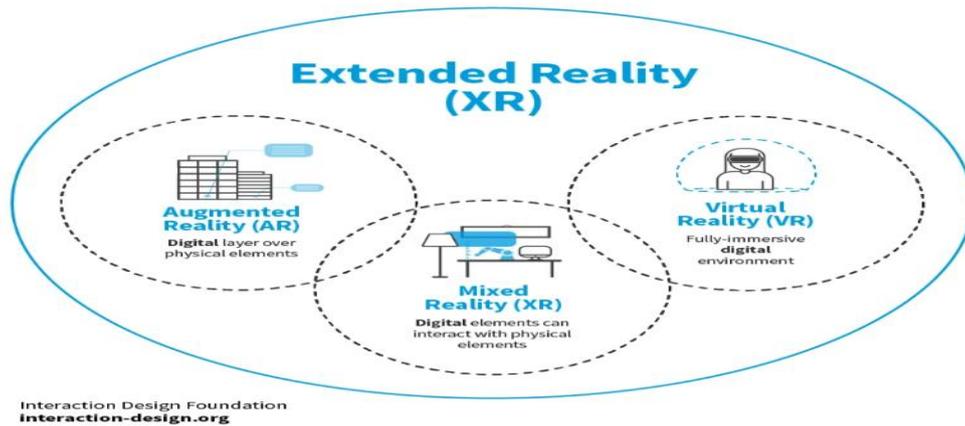
Augmented reality (AR) is a technology that allows the superposition of digital elements into the real-world environment.

Mixed reality (MR) is a technology that allows not only the superposition of digital elements into the real-world environment but also their interaction.

Virtual reality (VR) is a technology that allows the creation of a fully-immersive digital environment.

Extended reality (XR) is an umbrella term that encompasses any sort of technology that alters reality by adding digital elements to the physical or real-world environment by any extent, blurring the line between the physical and the digital world. XR includes AR, MR, VR, and any technology (Tremosa, 2023).

Augmented reality is an innovative way to improve learning, transforming the way students access and assimilate knowledge. This technology has the potential to make education more accessible, attractive and effective.



The definition of Augmented Reality (AR) can vary depending on the perspective and context from which it is approached.

- The classic definition that emphasizes that AR adds information or virtual elements to what we see around us. This concept is often used to describe how digital data can be integrated into the real environment.
- Technical definition focusing on the technical aspects of AR and the equipment needed to create AR experiences. The numerous applications of AR require specific software and hardware.
 - Input devices: these devices allow users to interact with AR systems. The AR interface acts as a mediator between these devices and the AR system.
 - Sensors: these devices, useful in the tracking mechanisms, allow determining of the generic user's position or the generic object. This operation is essential for the visual recording of the physical environment and its digital information; in this way, it will allow a fusion of images of the physical world and the digital world.
 - Display: these devices allow users to interact with the AR system. Examples are HMDs, monitors, and wearable devices (such as glasses, gloves, and clothing). (Arena, Collotta, Pau, & Francesco Gaetano Termine, 2022)
- The definition from a user experience perspective, where the focus is on the impact of AR on the user experience and how it can improve interaction with the environment.
- Defining from the perspective of application diversities that highlight the diversity of AR applications and how it can be used in different fields: education, tourism, industrial design, medicine, architecture, interactive entertainment, etc. An augmented reality

application complements the real images viewed with a certain device with certain graphic materials in two-dimensional or three-dimensional format that are meant to detail certain topics without accessing other materials equipped only with a smartphone or tablet with internet connection (Carmigniani & Furht, 2011).

- The definition of augmented reality (AR) in education which refers to the use of AR technology to provide students with an interactive, interdisciplinary, multisensory, collaborative, personalized and accessible learning experience by applying knowledge in real-world contexts.

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Lesson 2.2: Historical Development of Augmented Reality

Duration: 2 hours

Learning Outcomes:

- to define augmented reality and distinguish it from virtual reality.
- to describe the historical evolution of augmented reality.
- to recognize key milestones and innovations in the development of augmented reality technology.

- to understand the significance and applications of augmented reality in various fields.

Teaching Methods / Techniques:

- Lecture and discussion.
- Multimedia presentations (videos, images, and historical footage).
- Group activities.
- Hands-on demonstration of AR apps (if possible)

Learning-Teaching Activities:

- The lesson starts with an engaging question: "Have you ever used Snapchat filters or played Pokémon Go? These are examples of augmented reality. Today, we'll delve into the history of this fascinating technology."
- Teachers present the theoretical part of the lesson. Students can ask questions.
- Teachers define augmented reality and differentiate it from virtual reality.
- Teachers explain the fundamental concept of overlaying digital information onto the real world.
- Then, the teachers discuss the historical roots of AR, beginning with Ivan Sutherland's "Sword of Damocles" in the 1960s, and highlights significant milestones, such as the development of the first head-mounted display.
- Teachers present key technological advancements that contributed to the evolution of AR.
- Some images and films will be presented that will show a set of events related to AR development, such as the first AR head-mounted display, the introduction of AR applications in healthcare, or the release of landmark AR software.
- We will give the students some time to analyse what they have seen.
- The class will be organised in groups.
- Then students research each event and collaboratively create a visual timeline to showcase the evolution of AR technology over time. Each group will have to create a timeline that shows the progression of AR technology.
- Each group presents their timeline to the class.
- If there are questions for the teacher presenting the lesson, he/she will answer with the necessary arguments.

- Furthermore, the teachers explore the current applications of augmented reality in fields like gaming, education, healthcare, and industry and discuss how AR has impacted these domains and its potential for the future.
- Teachers present case studies of notable AR applications (e.g., AR in surgery, architectural visualization).
- The students will engage in a discussion about the impact and potential of these cases.
- At the end of the lesson, teachers summarize the key takeaways from the lesson, emphasize the significance of understanding the history of AR for future developments; and encourage students to share their thoughts on the lesson.

Assessment Tools:

- Teachers conduct a short quiz or open-ended questions to evaluate students' understanding of the historical development of AR.
- Teachers encourage discussion and questions for clarification.

Theoretical Knowledge:

Historical Development of Augmented Reality

Augmented reality (AR) is a technology that superimposes digital information onto the real world, creating an interactive and immersive experience. AR has a rich history that dates back to the late 1960s when Ivan Sutherland created the first head-mounted display, called The Sword of Damocles. Since then, AR has evolved significantly, and it has become a widespread phenomenon, encompassing various sectors ranging from gaming to education, healthcare to marketing. In this essay, we will explore the historical development of augmented reality, including its milestones, notable applications, and future trends.

Milestones of Augmented Reality

The development of contemporary AR was largely propelled by the arrival of Microsoft Kinect (in 2010) and Google Glass (2013), but Pokémon Go (2016) brought AR to the attention of the public. Here are some other notable milestones in the history of AR:

- 1957: Cinematographer Morton Heilig invented the Sensorama, which delivered visuals, sounds, vibration, and smell to the viewer, providing the first example of an attempt at adding additional data to an experience.

- 1968: The first head-mounted display system was developed at Harvard by computer scientist Ivan Sutherland, who is named the “father of computer graphics”.
- 1990: Former Boeing researcher Thomas P Caudell coined the term “augmented reality”.
- 2017: Apple introduced the ARKit SDK for iOS devices, and Facebook launched the Camera Effects platform, later renamed Spark AR.
- 2019: Microsoft introduced the HoloLens 2 headset.
- 2022: Apple launched its own AR headsets, followed by smart glasses.
- 2025: AR cloud-based experiences will gain prominence, supported by 5G networks.

Notable Applications of Augmented Reality

AR has been used in various industries, including manufacturing, healthcare, education, and more. Here are some notable applications of AR:

- AR for Field Navigation by NASA: AR was used for field navigation by NASA.
- AR for Holocaust Education: AR can be used to create immersive experiences that help students understand the horrors of the Holocaust. For example, the app "Witness: Auschwitz" uses AR to allow users to explore the Auschwitz concentration camp and learn about the experiences of survivors.
- AR for Museums: AR can be used to enhance museum exhibits by providing additional information and interactive experiences. For example, the Smithsonian American Art Museum has used AR to create an exhibit that allows visitors to see how a painting was created.
- AR for Historical Objects: Scholars are using virtual and augmented reality tools to aid history research. The tools also enable laypeople to visit places and examine objects normally only available to scholars. For example, using VR, people can turn the pages of a 15th-century book or stand before Renaissance-era artwork in the Vatican.

Future Trends of Augmented Reality

AR is a rapidly evolving field, and many factors could influence its development and adoption. However, with the expansion of technological advances and adoption, AR will likely continue to be used in various industries. Some potential ways in which AR could impact the enterprise industry in 2023 include increased efficiency and productivity, improved customer service, and new business models. Additionally, AR can create memorable interactive stories to

narrate historical events, which can increase student engagement and enthusiasm for learning.

In conclusion, augmented reality has come a long way from a science-fiction concept to a science-based reality. AR has a rich history that dates to the late 1960s, and it has evolved significantly since then. AR has been used in various industries, including manufacturing, healthcare, education, and more. AR is a rapidly evolving field, and many factors could influence its development and adoption. However, with the expansion of technological advances and adoption, AR will likely continue to be used in various industries, including history education.

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Lesson 2.3: Usage Areas of Augmented Reality

Duration: 2 hours

Learning Outcomes:

- To explain the usage areas of AR.
- To give examples of the usage areas of AR.
- To examine and present AR examples developed in different usage areas.

Teaching Methods / Techniques: Lecture, discussion, brainstorming, collaborative learning.

Learning-Teaching Activities:

- At the beginning of the lesson, the teacher explains the usage areas of AR.
- Then the teacher shows examples from different usage areas of AR. Watch the following videos about these examples.

https://www.youtube.com/watch?v=e7Calb4EsDg&ab_channel=Zappar

https://www.youtube.com/watch?v=w3qTQiXd4UI&ab_channel=Zappar

https://www.youtube.com/watch?v=2-Cof7GxWcE&ab_channel=Zappar

- The benefits of the use of AR in different fields are discussed in the class by brainstorming method.
- After the brainstorming, the teacher divides the students into groups to apply the "Let's ask together, let's learn together" technique, one of the cooperative learning techniques.
- Each group is given a material related to a different usage area of AR.
- Each group works on its own learning material and prepares questions about other usage areas.
- The students who are determined as postman from the groups take the questions of the group to the group of the related field of use. the groups answer the questions they receive.
- Afterwards, each group shares a question and answer with the class and briefly explains its own AR usage area.
- Thus, the subject is reinforced through active participation.

Assessment Tools:

- A short multiple-choice test is distributed to make the measurement and evaluation of the lesson and students are asked to answer.
- The groups are made to fill in the group evaluation form to make group evaluation.

Theoretical Knowledge:

The application range of AR is very wide from education to engineering, health and entertainment. New areas of application for AR may emerge every day.

Augmented reality in education

The need for continuous development in education is driven by current technologies. Augmented reality is becoming an important part of this. Taking into account the psychological development of children by age stages they need more models and examples to understand their environment and how it works. Augmented reality can enhance learning by applying it to different contexts (Uluyol & Şahin, 2016). This kind of education appeals to students and develops their curiosity to learn (Sünger & Çankaya, 2019).

Studies have been done on the impact of using AR in courses that showed students' interest in what they studied and much better results after using Augmented Reality (Hsin Kai Wu et al 2013). Also studies and opinions of students from the Vocational Department of Health Services on an anatomy app for anatomy lessons with Unity 3B platform, Blender and After Effect. The results obtained in the research show that students respond positively to the use of technology and believe that the use of technology in the learning-teaching process will increase their performance (Djibril & Çakır, 2023).

The experiences students have using augmented reality lead to involuntary and directly understood learning. Several studies are being done in various periods of augmented reality use and especially on smartphones. Or searched the latest studies and new research in the period 2015-2020 at what level augmented reality is applied in education, what are the application requirements and other related to augmented reality in Education. Augmented reality is becoming to be a big interest in academia. New educational opportunities are becoming to be related to the virtual world and technologies. Research results indicate that augmented reality has various potentials and advantages and can be added to the field of education (Yusuf et al., 2023).

Starting game-based learning, leads to the study of concepts in various disciplines (Marija et al., 2022). Learning in the virtual environment with augmented reality takes the learner into the main role and problem solving, which also develops responsibility but also independence in the face of a situation that requires solutions.

Examples of application of augmented reality in education: in biology, achieving photosynthesis in plants; in mathematics, 3D representations of bodies and their sections; - in geography, the eruption of volcanoes; in astronomy, the formation of a star.

Augmented reality in health

Research shows that the most important motivations for applying augmented reality were for health. Both for media training and for studying various problems in the field.

In one study, researchers developed an augmented reality navigation system using a precise three-dimensional sensory accurate navigation system that can be used in endoscopic surgery. They used augmented reality visualization, which superimposed 3D-US visualized images and CT-based segmented and rendered images onto live captured laparoscopic images. The system provided real-time anatomical information that cannot be viewed without system navigation. And they applied their system in various clinical cases (Sünger & Çankaya, 2019). With such possibilities, human errors can be reduced.

Many devices and apart are very expensive, but with the help of augmented reality, some investigations could also be performed at a lower cost. Virtual reality can help with surgery and psychological health problems.

An example of virtual reality used in dentistry. In this direction, the application of augmented reality will help patients in a virtual way how to properly take care of their oral hygiene but also what problems can occur and what dental procedures are needed, which is much clearer being visualized in a 3D virtual form (Bhatnagar & Bhatnagar, 2023).

Augmented reality in engineering

A wide application of augmented reality is also in engineering and specifically in construction AR applications related to construction and simulation summaries will improve the construction management process by reducing the risk of injuries and with more safety in the work process, which will boost productivity and employee confidence in this field. Starting

from the handler to the workers Augmented Reality can be applied so that they can understand the construction process and implementation (Trivedi & Tiwari, 2023).

Augmented reality in architecture and decoration

Designing a home and furnishing it with furniture and other decorations is another interesting and used trend of applying virtual reality. There are furniture companies applying augmented reality to the choice of desired furniture such as Ikea (Sünger & Çankaya, 2019). Another example can be the arrangement of computers, servers and other devices needed for studies in a computer science or mechanics lab.

Augmented reality in beauty

As technology has dominated various fields, it has also had an influence in the beauty sector. As health concerns have grown in recent times, and as the pandemic is linked to it, people are looking for solutions to test beauty products through technology, namely augmented reality. With augmented reality, customers can test products on their skin and what suits them with minimal risk of returns and fewer complaints (Wang et al., 2022).

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MODULE 3: ENVIRONMENT EDUCATION

Çanakkale Onsekiz Mart University

Content:

- 3.1. Environment Education in Primary Education Curriculum
- 3.2. Contribution of Environment Education to Green Deal Awareness
- 3.3. How Can We Increase Green Deal Awareness in Primary Education?

Lesson 3.1: Environment Education in Primary Education Curriculum

Duration: 2 hours

Learning Outcomes:

- To define environmental education
- To express environmental education gains in primary education curriculum
- To get knowledge what students will acquire environmental education
- To evaluate about the issues to be addressed in environmental education
- To classify environmental education gains in the primary education curriculum according to the courses

Teaching Methods / Techniques: Lecture, discussion, cooperative learning.

Learning-Teaching Activities:

- Before starting the lesson, pre-service teachers are divided into groups of three in order to use the jigsaw technique, one of the cooperative learning techniques.
- The teacher will introduce general idea of environmental education in primary education.
- They will discuss about environmental education in primary education. Information obtained in the group discussion will be reported.
- After the group discussion, each pre-service teacher in the group will choose the task of examining environmental education gains in the mathematics, life sciences or social studies program.

- The teacher will listen each group discussions, answer to their questions, and provide feedback.
- Pre-service teachers in the groups will join their new groups on the subject in which they will be experts. Thus, 3 groups will be formed in the classroom that will work on environmental education achievements in mathematics, life sciences and social studies lessons.
- Environmental education achievements of the course studied in expert groups will be examined. A group discussion will be held and thus knowledge and experiences will be shared.
- The pre-service teachers will return to their small groups. Pre-service teachers returning to their small groups will share their knowledge in the field they specialize with their group friends. Thus, environmental education achievements of 3 lessons in each group will be discussed.
- The teacher will listen each group discussions, answer their questions, and provide feedback.
- Information obtained in the group discussion will be reported.
- At the end of the lesson, a spokesperson from each group will share the group's report. Thus, the reports of all groups will be discussed by the class. The teacher will keep an eye on their development and offer criticism as needed.

Assessment Tools: At the end of the lesson, the teacher asks different group members to ask each other questions about environmental education gains in primary education curriculum in front of the class. The teacher ensures that the deficiencies of the subject are corrected and reinforced with feedback-corrections and hints.

Theoretical Knowledge:

The Turkish Ministry of Environment and Forestry emphasized the importance of environmental education in the “Turkish Environmental Atlas” published in 2004 and determined what to do in this regard. The aim to be achieved in the subjects related to social and natural sciences, human and environmental relations, natural resources and their use included in the curriculum; is to train individuals have attained environmental awareness and

gained environmental awareness and positive behaviors rather than being burdened with knowledge (ÇBS, 2004).

Due to the rapid increase in the importance of the environment today, the Ministry of Environment and the Ministry of National Education, Cooperation Protocol on Studies” was signed and put into effect with the thought that starting from the kindergartens and continuing the environmental education in a systematic and regular way in primary and secondary education institutions, will bring important results. The following items are included in the protocol (ÇBS, 2004):

- Giving importance to applied activities in environmental education of preschool and primary school children,
- Providing training to teachers to improve environmental awareness,
- Allocating one hour a week to environmental education within the scope of Environment Lesson within the framework of the program deemed appropriate in secondary education institutions,
- Giving importance to environmental issues in apprenticeship training programs,
- It is in the form of in-service training courses on environmental education so that teachers and students all over the country can have environmental awareness.

Primary and secondary school is the basic education level for children aged 6-14. In this period, environmental gains are given in various courses (Life Science, Science, Turkish, Social Studies, etc.). In the Life Science curriculum updated in 2018, the subject related to environmental education is included in the "Life in Nature" unit in the 1st, 2nd and 3rd grades. In the unit in this curriculum;

- Getting to know nature and living things,
- Keeping the environment clean and being aware of recycling,
- Knowing natural events and taking precautions,
- There are basic gains such as being aware of the world and those who travel.

In the social studies curriculum taken in the 4th grade of primary school, environmental issues were included in the unit of People, Places and Environments. In the unit; Gains such as making

inferences about the location of any place around it, drawing a sketch of the spaces used in his daily life, distinguishing the natural and human elements in his environment, observing the weather events occurring around him, and making the necessary preparations for natural disasters are included (MEB, 2018). In the primary school 3rd grade science curriculum, the subjects related to environmental education; It is included in the unit named “Journey to the world of living things”. If we look at the achievements of this unit, gains such as recognizing the assets in our environment, understanding and knowing the natural and artificial environment, and protecting the natural environment come to the fore. When we look at the 4th grade level of the same curriculum; In the “lighting and sound technologies” unit: while sound, light and noise pollution are at the forefront; In the “human and environment” unit: resource use, being economical, being a conscious consumer, the importance of resources and recycling are emphasized (MEB, 2018).

Lesson 3.2: Contribution of Environment Education to Green Deal Awareness

Duration: 2 hours

Learning Outcomes:

- To get knowledge about what the green deal awareness is, its purposes and the activities carried out by the member countries.
- To explain the interaction between green deal awareness and environmental education.
- To express environmental education role for increasing green deal awareness
- To discuss the interaction environment education to green deal awareness.

Teaching Methods / Techniques: Lecture, discussion, brainstorming.

Learning-Teaching Activities:

- At the beginning of the lesson, the teacher tells the pre-service teachers that they will discuss what they know about green deal with the brainstorming technic. The pre-service teachers say the first thing that comes to their mind about green deal. This information is written on the board by the teacher. Then, a group discussion is held

and similar ideas are grouped and ideas that are not considered relevant to the topic are crossed out.

- After brainstorming, the teacher will show the pre-service teachers a short video about Green Deal. The link to the video is given below:

<https://www.youtube.com/watch?v=zf74KGV0hm4>

- After watching the video, the teacher asks the pre-service teachers to create a chart. On one side of the chart, the objectives related to the green deal will be located, and on the other side, the environmental education gains will be located. The similarities and differences between these two parts will be explained.
- Volunteer pre-service teachers will share the chart they have prepared with the class. Through this sharing, a large group discussion will be held and information about the green deal and environmental education will be deepened. At this stage, the teacher will assume the role of a guide and make corrections where deemed necessary.
- At the end of the course, a link to a video about the Green consensus will be shared with students and they will be asked to watch it outside of class. The link to the video is given below:

https://www.youtube.com/watch?v=xVU_ihJgW5A

Assessment Tools:

- A self-evaluation form will be used by pre-service teachers to evaluate their knowledge about the green deal.
- Information about the video given at the end of the course will be reported by pre-service teachers.

Theoretical Knowledge:

The European Union (EU), with the European Green Agreement announced on 11 December 2019, while setting out the goal of being the first climate-neutral continent in 2018; at the same time transforming the industry that it will adopt a new growth strategy that requires announced that it would reshape. Relevant actions under the European Green Deal are energy, will reshape the EU economy, including transport, industry, finance, construction, agriculture, and forms the basis of a transformation that will gain momentum.

The three main tenets of the European Green Deal, which will help cut greenhouse gas emissions and improve the quality of life for our population, are (commission.europa.eu, 2023):

- putting greater emphasis on energy efficiency, enhancing the energy efficiency of our buildings,
- and creating a power sector that mostly uses renewable energy sources
- establishing a fully integrated, networked, and digitalized EU energy market; ensuring a secure and affordable EU energy supply.

First, the Commission suggests introducing a Net-Zero Industry Act to support industrial manufacturing of essential technologies in the EU as part of the Green Deal Industrial Plan. In order to achieve our climate neutrality goals, the act would create a streamlined regulatory framework for the manufacturing capacity of items including batteries, wind turbines, heat pumps, solar panels, electrolysers, and carbon capture and storage technologies.

The Commission will also suggest a Critical Raw Materials Act, which comes second. The production of EU net-zero technologies is only feasible if access to necessary raw materials is ensured, including through sourcing diversification and recycling of raw materials to lessen the EU's reliance on highly concentrated supplies from third countries and to foster the growth of the circular economy and high-quality jobs. This law will work to ensure high environmental standards and ongoing research and innovation, such as reducing material use and creating bio-based substitutes, while also improving international engagement, facilitating extraction (where appropriate), processing, and recycling. There have already been observable successes: some EU companies are replacing graphite in batteries with lignin derived from wood today.

Lastly, energy. The weaponization of energy by Russia served as a stark reminder of the need for supply security and dependency reduction. Due to rising energy prices and supply chain disruptions, many companies' ability to compete has been significantly hampered. This has been especially true for the industries that use a lot of energy. In accordance with the REPowerEU plan, significant initiatives have been done to alleviate the high cost of energy and replace expensive fossil fuels with less expensive renewables. For instance, the EU's capacity to produce renewable energy from wind and solar sources surpassed 400 GW in 2022, an

increase of over 25% from 2020. To pool gas demand, coordinate infrastructure use, negotiate with foreign partners, and make savings while filling storages and putting a ceiling on short-term markets, we established the EU energy platform. Both for gas and electricity, a number of infrastructure initiatives and interconnections have been finished.

The Net-Zero Industry Act would in particular:

- Determine 2030 industrial capacity objectives after conducting sector-specific analyses to make sure that strategic dependencies won't jeopardize the transition to a greener economy. It will take into account the entire supply and value chain across borders to ensure that supplies do not become a bottleneck;
- Reduce the length and improve predictability of permitting processes by defining specific time limits for different stages of permitting; and Significantly strengthen Member States' administrative capacity, for example by introducing a 'one-stop-shop' - a single point of contact for investors and industrial stakeholders throughout the entire administrative process.

Lesson 3.3: How Can We Increase Green Deal Awareness in Primary Education?

Duration: 2 hours

Learning Outcomes:

- To learn how green deal awareness can be increase in primary education.
- To design a project-based learning activity that will increase green deal awareness in primary school courses.
- To evaluate project-based learning activities done by one's own group
- To evaluate project-based learning activities done by other groups.

Teaching Methods / Techniques: Lecture, discussion, collaborative learning.

Learning-Teaching Activities:

- At the beginning of the lesson, pre-service teachers are divided into groups of five. Each group chooses one of the green deal goals written on the board.

- The teacher provides brief information about the project-based learning method and enables pre-service teachers to activate their prior knowledge. Asks each group to prepare a project-based learning draft suitable for students' interests and abilities that will increase green deal awareness.
- Each group designs a project-based learning application aimed at gaining the outcome that will increase awareness of the green deal they choose from the board.
- A spokesperson is selected from each group to discuss the prepared project-based learning draft with the whole class.
- The course is completed by completing the project evaluation forms distributed by the teacher by the pre-service teachers.

Assessment Tools:

- A self-evaluation form will be used by pre-service teachers to evaluate their knowledge about the green deal.
- Projects are evaluated by the teacher using the project evaluation form.

Theoretical Knowledge:

The European Green Deal has stated objectives. However, it is believed that a key component in achieving the project's objectives is the dissemination of knowledge and any popularization of the subject, particularly among the younger generation, whose influencers include non-scientific conferences and publications, the Internet, social networks, and trends, as well as politicians, sociologists, economists, and professionals in fields directly related to the European Green Deal. Because "being trendy" is more frequently emphasized than "being environmentally conscious," consumers frequently purchase new technology even if it is not totally sustainable in terms of consumption (Menshykova&Burchenko, 2022).

By offering the following, the European Green Deal will enhance the well and health of its citizens and future generations (commission.europa.eu, 2023):

- fresh air, clean water, healthy soil and biodiversity
- renovated, energy efficient buildings
- healthy and affordable food

- more public transport
- cleaner energy and cutting-edge clean technological innovation
- longer lasting products that can be repaired, recycled and re-used
- future-proof jobs and skills training for the transition
- globally competitive and resilient industry

The DECC hired GfK NOP in 2012 to conduct tracking research to examine five crucial areas, including knowledge and comprehension of the Green Deal. Respondents were asked if they were familiar with a list of projects, including the Green Deal. The quantitative tracking study's Wave 1 and Wave 2 results, as well as small dips, revealed that, before the program's official launch, Wave 1 awareness was at 10%. In Wave 2, this climbed by 9%, but only by 3% in May's dip (DECC, 2013d). The Figure 1 illustrates this. Despite the fact that the report's use of the word "significantly" created the appearance that knowledge had improved, considering the UK government's aggressive CO2 emissions target, the degree of awareness of the program at the time was a severe cause for concern.



Base: All respondents (W1 = 3,562; W2 = 3,409, May Dip = 1,648)

Significant wave on wave increases are indicated by a green arrow (↑) on the chart.

Figure 1. Green Deal

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scientific conferences and publications, the Internet, social networks, and trends, as well as politicians, sociologists, economists, and professionals in fields directly related to the European Green Deal. Because "being trendy" is more frequently emphasized than "being environmentally conscious," consumers frequently purchase new technology even if it is not totally sustainable in terms of consumption (Menshykova&Burchenko, 2022).

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- cleaner energy and cutting-edge clean technological innovation
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- globally competitive and resilient industry

There is no doubt that human activity has warmed our climate. Recent changes are quick, getting worse, and unlike anything in thousands or even centuries. These changes will intensify with each incremental degree of heat, having long-lasting, irreversible effects, especially on sea level rise. The evidence is undeniable, according to United Nations Secretary-General António Guterres, and "we see the warning signs in every continent and region.

Using coal and oil, which are non-renewable energy sources, both causes environmental pollution and drags the world into an energy crisis. The carbon emission resulting from the use of such energy sources leads to climate change. In place of coal and oil, which were utilized as energy sources throughout the so-called "old world" era, there are renewable energy sources like natural gas, which emits less carbon, and green energy, which emits no carbon at all. The EU has even invited the world's leaders to the EGD, which has been established to address concerns of mitigating global warming and climate change, in this context, placing itself at the center of the world. Therefore, it is reasonable to argue that the EGD has become

one of the most important agreements that the EU has enacted. The various components of the EGD are clearly shown in Figure 2 (European Commission, 2023):

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MODULE 4: THE USAGE AREAS OF AUGMENTED REALITY IN EDUCATION

University of Latvia

Content:

- 4.1. Software Used In Augmented Reality in Education
- 4.2. Advantages And Limitations of Using Augmented Reality in Education
- 4.3. Application Examples of The Use of Augmented Reality in Education

Lesson 4.1: Software Used In Augmented Reality in Education

Duration: 2 hours

Learning Outcomes:

1. Understand various software applications utilised in augmented reality (AR) for educational purposes
2. Evaluate and analyse different AR software tools suitable for primary school education
3. Gain confidence in utilising AR tools to enhance teaching practices, preferably when integrating AR content related to environmental issues into their future lessons.

Teaching Methods / Techniques: lecture, hands-on activity, group activity, discussion, brainstorming

Learning-Teaching Activities:

1. Engaging lecture about AR in primary education – examples of how AR apps could enhance learning and how they can be integrated in primary education.
2. Hands-on demonstration/activity, where students can explore and try out educational AR apps (2-3 apps). During the activity, it is not so important to look at applications specifically for the topic of environmental protection, because the goal is to introduce students to the AR environment, the available applications and the possibilities of their use in primary school. The goal is to get acquainted with the 3D environment, application design, and technical use. More experienced students can try to create their own version of an AR application in a 3D environment. When trying the activity, invite students to think about the possible results that the application can help to achieve and about the relevance of the application to the age stage.

3. Group activity – students make small groups of 4-5 students. Each group explores a different AR app that can be used in education and reports back on its features and applications, brainstorms and discusses how they could integrate specific AR software into different topics. Students can find their own AR applications or use some from the list - <https://www.educatorstechnology.com/2018/04/12-good-augmented-reality-apps-to-use.html>. Students can be encouraged to find and explore apps for teaching about environmental issues.
4. Group work presentation - students present their findings about AR apps.
5. Discussion – what are important things to know about usage of AR, before using AR apps in classroom

Assessment Tools:

Peer evaluation – discussion about AR app use in classroom, when presenting group findings about AR apps

Theoretical Knowledge:

The use of AR applications in the learning process can effectively guide the student to the desired result, increase motivation, create interest in the subject to be learned and promote the development of cooperation skills (Zhang et al, 2014; Lu & Liu, 2015). The use of AR applications in the learning process is especially beneficial when it is necessary to learn complex and abstract topics that the student cannot see in real life, but with the help of AR technology it can be visualised (Akçayır & Akçayır, 2017). However, the effective use of AR technologies has its limitations – lack of teacher training, difficult access to AR technology, insufficient quantity or insufficient quality of teaching materials (Gómez-García et al., 2021).

In order to use educational content enriched with AR technology, the content itself must also have a certain design. The essential elements of an AR application are listed below to make the technology-enriched learning process more effective:

1. **AR application design.** When evaluating an AR application and its possibilities of use, the design of the AR application itself and whether it will be intuitive for the user are also important (Hidayat et al., 2021; Lu & Liu, 2015). This means that all the elements where you can get additional information, buttons, instructions and other design elements of the application are designed in the way that we encounter on a daily basis.

For example, a sound button is represented by a musical note or a speaker symbol, text by a letter symbol, the most important things are highlighted by a bold text or an exclamation mark.

2. **Linking to real life.** In order for the student to be able to learn abstract topics, it is necessary to base the student's new knowledge on previous knowledge (Hidayat et al., 2021). For example, it may happen that a student who has lived in the city all his life does not know how products get to the store, that milk is obtained by milking cows, or that chickens lay eggs. But it is more likely that he knows what an egg or a chicken looks like. Therefore, when learning the topic, the entire chain of events should be shown and situations that the student may be familiar with and face on a daily basis should be foreseen. When evaluating specific AR applications, it is necessary to understand what the achievable result is and whether the student in the relevant age group will have previous knowledge of the subject in order to be able to learn new situations from the AR application.
3. **Expected duration** of use of the AR application and subject to be learned. In order to successfully use the AR application in the learning process and its use does not disrupt the scheduled lesson, it is necessary to evaluate whether the AR application can be used during one lesson (Hidayat et al., 2021). The use of the AR application should be included as a small part of the lesson, assuming that the lesson will also include other activities or discussions for learning the topic. It is important for the expected application to be "flexible" in terms of time use - the AR activity can be stopped at any moment without losing progress, the activity does not have a specific order in which it should be performed and it can be used to gain insight into the topic both with a shorter and longer time interval.
4. **The result to be achieved.** AR activities should be used within the lesson in such a way that they complement the topic and lead to the expected result of the learning process (Zydney & Warner, 2016). In order not to create too much cognitive load for the student, the application cannot contain too much information that is not related to the topic to be learned (Hidayat et al., 2021).

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Lesson 4.2: Advantages and Limitations of Using Augmented Reality in Education

Duration: 2 hours

Learning Outcomes:

1. Understand the advantages and limitations of integrating AR in educational settings.
2. Evaluate the potential benefits and challenges of using AR in classroom for primary education
3. Identify strategies to maximise the advantages and mitigate limitations of AR in environmental education.

Teaching Methods / Techniques:

Lecture, discussion and brainstorming, group activity, case study

Learning-Teaching Activities:

1. Introduction and Discussion – brief overview of AR in education from previous lessons. Discussion on what the pre-service teachers already know about AR and its potential in teaching environmental issues.
2. Advantages of AR in education through examples, case studies, and research findings. Highlights on how AR can enhance understanding and engagement in environmental topics.
3. Limitations and challenges of AR in education, such as access to technology, cost, and potential distractions. Critical thinking and discussion are encouraged on how these limitations might affect teaching environmental issues. Discussion of the ethical considerations related to using AR with young learners – safety measures and guidelines for responsible usage.
4. Case Study – showcase real-life examples of successful implementation of AR in primary education, preferably environmental protection topics. Discussing advantages of AR in education and the strategies used to overcome limitations.
5. Group Activity - advantages vs. limitations – divide students into groups. Each group identifies specific advantages and limitations of using AR for teaching environmental issues. Students can analyse their own lesson plans that they did in previous lessons or use new lesson plans and think about advantages and limitations. Important - not always AR would be the best solution, so students should find the best topic to implement AR in the lesson plan. Groups present their findings to the class.
6. Strategies to maximise advantages – a brainstorming session where pre-service teachers suggest ways to maximise the benefits of AR while teaching environmental issues. Finding the best topics for environmental education where AR can be used. Topics should be summarised for further use for example in *Padlet* or *Miro*

Assessment Tools:

Group presentation assessment – evaluation of the depth of understanding and presentation skills of each group regarding advantages and limitations.

Scenario-based evaluation – give students a lesson plan that does not include the use of AR, individually supplement the lesson plan with AR activities, evaluating the benefits that the use of AR activities will bring in the specific lesson plan, as well as evaluating limitations.

Theoretical Knowledge:

The use of technology in education has created a new way of learning content. The use of technology in the learning process makes learning more active, moving from passive learning in which the student listens to new information to an active hands-on learning process in which the student has the opportunity to see and do (Saidin et al., 2015). However, like any technology, the use of AR in the learning process also has its own appropriate moment and limitations and precautions that must be evaluated when introducing technology-enriched learning content.

Advantages of using AR in classroom

1. Authentic explorations in the real world – one of the most important possibilities of AR is to show complex processes in real life. This means that the student has the opportunity to see the same environment that he sees every day, only with "changes" that represent processes that cannot be seen with the eye, simulations that present the idea of "what if..." allow us to look at the environment changes and other things that cannot be shown otherwise (Akçayır & Akçayır, 2017). This allows combining the student's usual environment with the new material to be learned, creating a connection between the already known and the new.
2. Helps achieve learning goals - Using AR applications with the ability to represent complex processes in real life helps to effectively achieve learning goals (Lu & Liu, 2015). Achieving complex learning goals is not an easy task when subjects are fragmented and not presented as a single concept, but the use of AR can help to see the subject as a whole, guiding the student towards the complex outcome (Kamarainen et al., 2013).
3. Increasing motivation and interest in learning the subject. The use of AR applications increases students' interest in the subject, as there is an opportunity to be active, to "experience" what is being learned in a way that other methods could not provide. This is especially important when learning complex and abstract topics that cannot be seen in real life – learning it theoretically and not being able to imagine the narrative, students can quickly lose interest and motivation in learning the topic (Zhang et al, 2014; Lu & Liu, 2015).

4. Increasing cooperation skills. AR applications provide an opportunity to improve collaboration skills. When solving complex problems together, students have the opportunity to discuss the possible solutions to the problem, learn to accept the opinions of group members, and work together towards a common goal. Cooperation skills can also be looked at from another point of view - creating an element of competition, which in turn will increase the motivation to learn the subject and participate in the lesson, after which they discuss the results obtained and what should have been done differently (López-Faican, & Jaen, 2020).

Limitations and challenges of using AR in classroom

1. Availability of technology. Using AR technology remains an expensive option (Hidayat et al., 2021). Even if some AR applications can be viewed with modern smartphones, there is a price to pay for good and educational content. It is still necessary to anticipate that primary school students may be limited in their parents' ability to use their smartphones (screen time settings, installation of applications), and the Internet connection of educational institutions themselves should be taken into account if students need to download or use an application online. It should also be noted that smartphone models are different and may not support the use of certain applications.
2. Can cause excessive cognitive load. AR applications often contain a large amount and complex information, as a result of which the student may experience an excessive cognitive load. In addition, the student should not only focus on learning a complex topic, but also learn to handle the AR application, get to know how to handle it, especially if it is done for the first time. There is a possibility that primary school students have not often used AR applications in the learning process, as a result of which it is essential to divide the instructions into small fragments in order to learn how to use the technology itself. As for the large amount of information, it is important to observe the principle that the use of the AR application does not have to take place throughout the lesson, but rather as a small activity within the topic that deepens understanding (Hidayat et al., 2021).
3. Technical difficulties. The use of any technology may have technical problems – Low sensitivity in triggering recognition, causes of technical problems (camera, Internet, indoor use), large file size limits the sharing of content, GPS errors, etc. (Akçayır &

Akçayır, 2017). In this case, it is necessary to investigate the possible technical problems of each AR application before giving it to students to try. A unified approach, such as the use of school tablets, would essentially solve this problem.

4. AR may take longer to use. In this case, the problem is relevant during the adaptation period, when it is necessary to learn a new technology. Using AR in the learning process may take longer due to the lack of experience of both the students and the teacher himself. In order to obtain an optimal time consumption in the use of AR applications during the lesson, it is necessary several times for both the students and the teacher to get used to using them (Munoz-Cristobal et al., 2014).

Summary

Each technology has its advantages and disadvantages, however, comparing them in this case shows that limitations and challenges of AR use in the classroom can be overcome. It is essential to train both teachers and students in the use of AR applications, thus reducing the possibility that the lesson plan could fail, because the use of AR in the learning process can increase both motivation and interest in the subject, leading the student to a complex achievable result, which is a valuable benefit for a full-fledged learning for the process.

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Lesson 4.3: Application Examples of The Use of Augmented Reality in Education

Duration: 2 hours

Learning Outcomes:

1. Identify and evaluate relevant AR apps for teaching environmental issues to primary school students.
2. Develop lesson plans integrating AR technology for environmental education aligning it with primary school curriculum

Teaching Methods / Techniques: lecture, demonstration, brainstorming, designing and discussion in groups.

Learning-Teaching Activities:

1. Lesson starts with an engaging discussion about the importance of environmental education. After discussion follows lecture with introduction of the concept of AR and its potential in education.

2. Discussion about what is a successful lesson, highlighting that a good lesson has a specific result to be achieved, tasks that lead to it and reflection that reflects whether the student has achieved the learning goals.
3. Group activity - lesson planning. Students develop their own lesson plans integrating AR technology and make sure there is alignment with primary school curriculum standards. Advantages and limitations of AR use are included.
4. Discussion – sharing and discussing activity designs, getting feedback and peer evaluation.

Assessment Tools:

1. Peer evaluation on group work - lesson plan with AR for primary school design
2. Short reflection paper on students understanding of AR in education and its potential in teaching environmental issues

Theoretical Knowledge:

In the Latvian education standard, environmental education is a relevant topic at all age stages, starting from pre-school education and ending with higher education. Already in the first stages of pre-school education (before compulsory pre-school education), environmental education topics are provided, which include the basics of how to act carefully towards the environment and reduce the impact of human activity on it. In the educational standard, the topic of environmental protection for preschoolers is broadly defined and included in the block of natural science education "understands that nature and its resources must be preserved, engages in cleaning up the immediate surroundings" (Latvijas vēstnesis, 2018; MK 716).

In primary school, when basic education begins, environmental education is organised as an interdisciplinary subject, which is studied in both natural sciences and social and civic fields. While natural resources and natural threats are learned in the thematic block of natural sciences, the social and civic field supports the student's critical thinking, teaching them to evaluate their own and society's actions regarding the meaningful and reasonable use of resources (Latvijas Vēstnesis 2018, MK 747). By interacting in several subjects and looking at environmental problems from the perspective of different subjects, a complex achievable

result is achieved, in which the student is able to act responsibly towards the environment and engage in activities related to environmental protection.

However, when learning the topic of environmental education in different subjects, it may be more difficult for the student to connect it all as a complex process. Students often view individual subjects as separate subjects to be learned, without connecting them together, especially if there is no immediate cross-subject connection in different subjects, where similar subjects are learned in different subjects in the same period of time. Therefore, augmented reality (AR) can act as a cross-curricular link builder that helps to look at complex topics from the perspective of different subjects (Kerawalla et al., 2006).

Some examples of AR applications that can be used in education for environmental issues:

- **Planet Stories AR** – shows an important topic of environmental degradation, including the issue of extinction of animals, for example – sea turtles. The game takes the player deep into the ocean. All the waste that he has to collect during the game floats around him – you can see it exactly on the smartphone screen. They are dangerous food for animals. The player's task is to prevent the turtle from eating waste: cans, straws, and other extremely harmful garbage (GiantLaser, n.d.).
- **'Inside the Amazon: The Dying Forest' AR Experience** – This immersive journey follows a team of journalists TIME sent deep into the Amazon. There, they met the indigenous people fighting illegal logging, the loggers cutting paths into the jungle, and the frontiersmen and women making an illicit living from the land (AM EDT, 2019)
- **See How the World's Most Polluted Air Compares With Your City's** – visualisation that uses an accompanying AR mobile experience to help you visualise the nearly-invisible pollution floating all throughout our air (Carlton, 2019)

When creating a lesson plan that includes the use of AR applications, it is important to take into account that there is not much time for one lesson. When creating a lesson, it is still necessary to observe the essential parts of the lesson -actualization of the topic, activities and learning of the new topic, reflection. This means that the use of the AR application itself is only a small part of the entire lesson for the students. Considering that the use of the AR application in the learning process can achieve complex results (Hanid et al, 2020), when learning topics from different subjects, it is worth considering the possibility of combining teachers of different subjects, gaining more time for learning a deeper topic. A lesson plan can

be created for the implementation of the achievable results of natural sciences, socio-civic, and other thematic blocks, thus solving the fragmentation of subjects and creating a common understanding of the achievable results for students.

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MODULE 5: THE USE OF AUGMENTED REALITY FOR INCREASING GREEN DEAL AWARENESS IN PRIMARY SCHOOL EDUCATION

GEDONSOFT

Content:

5.1. The Role of Augmented Reality in Primary School Education

5.2. Examples of Augmented Reality in Primary Schools

5.3. How Augmented Reality Help to Increase Green Deal Awareness in Primary Education?

Lesson 5.1: The Role of Augmented Reality in Primary School Education

Duration: 2 hours

Learning Outcomes:

- Develop a clear understanding of what augmented reality is, its components, and how it differs from virtual reality.
- Identify and describe various augmented reality applications and tools that are suitable for primary school education.
- Learn how to integrate augmented reality technology into lesson plans to enhance learning and engagement among primary school students.
- Understand how augmented reality can be used as an assessment and evaluation tool in primary school education, including the benefits and potential challenges.
- Aware of the ethical considerations, potential risks, and best practices associated with using augmented reality in primary school settings.

Teaching Methods / Techniques: Interactive Lectures, Demonstrations, Group Discussions, Case Studies

Learning-Teaching Activities:

- **Welcome and Introduction:** Brief welcome and introduction to the topic. Ice-breaker activity to engage participants and set a positive tone for the session.
- **Interactive Lecture on Augmented Reality (AR) Basics:** Presentation on the fundamentals of AR, including definitions, history, and its evolution in education. Use of visual aids and real-life examples to illustrate key concepts.

- **Group Brainstorming: Potential Uses of AR in Primary School:** Participants break into small groups and brainstorm potential applications of AR in primary school education. Each group shares their ideas with the larger group.
- **Video Showcase: Examples of AR in Classroom Settings:** Showing curated videos that depict real-life examples of AR being used in primary school classrooms. Brief discussion and reflection on the showcased examples.
- **Hands-On Activity: Exploring AR Apps:** Participants use tablets or smartphones to explore and interact with pre-selected educational AR apps. Facilitator circulates to assist and answer questions.
- **Discussion: Benefits and Challenges of AR in Education:** Open discussion on the advantages and potential challenges of integrating AR into primary school education. Facilitator guides the conversation to cover various perspectives and considerations.
- **Collaborative Activity: Designing an AR-Enhanced Lesson Plan:** Participants work in small groups to design a lesson plan that incorporates AR technology. Groups share their lesson plans and receive feedback from peers and facilitator.
- **Ethical Considerations and Best Practices:** Brief lecture and discussion on ethical considerations, privacy concerns, and best practices when using AR in education.
- **Q&A and Recap:** Open floor for any questions, clarifications, or additional discussions. Recap of key takeaways and resources for further learning.
- **Feedback and Closing:** Participants complete a short feedback form on the training. Facilitator provides closing remarks and thanks participants for their engagement.

Assessment Tools:

- **Pre-Training and Post-Training Surveys:** With the help of a survey, participants' initial understanding of augmented reality in education will be evaluated and changes in their knowledge and attitudes after the training will be measured.
- **Participation and Participation:** How actively the participants participate in discussions, activities and group work during the training will be evaluated through the observation form.
- **Group Activity Evaluation:** Lesson plans or other collaborative work produced during the training will be evaluated.

- **Exam or Knowledge Check:** A short quiz will be given at the end of the course to assess participants' understanding of the basic concepts of using augmented reality in primary education.

Theoretical Knowledge:

Introduction to Augmented Reality

Augmented reality (AR) is a technology that superimposes digital information onto the physical world, enhancing the user's real-world experience. It differs from virtual reality (VR) as VR creates a completely virtual environment, while AR integrates digital components into the existing environment (Milgram & Kishino, 1994). Understanding these fundamental concepts is essential for educators aiming to effectively implement AR in primary school settings. In the field of primary education, AR has demonstrated significant potential in increasing learning outcomes. Research has shown that AR experiences can improve memory retention, engagement, and motivation among elementary school students (Ibanez and Delgado-Kloos, 2018). AR fits well with young children's natural curiosity and instinct to explore, making learning interactive and engaging.

Components of Augmented Reality

AR systems generally consist of three primary components: a display device, tracking system, and software application. The display device, such as smart glasses or a tablet, presents digital information to the user. The tracking system senses the user's movements and orientation, adjusting the digital content accordingly. The software application generates and manages the digital content (Azuma et al., 2001).

AR Applications and Tools for Primary Education

Various AR applications and tools have been developed specifically for educational purposes. For example, "Aurasma" allows teachers to create interactive, multimedia content that students can access through their devices. Applications like "Google Expeditions AR" enable immersive learning experiences, taking students on virtual field trips to enhance their understanding of the world (Billinghurst & Dünser, 2012).

Integrating AR into Lesson Plans

Integrating AR into lesson plans requires thoughtful planning and alignment with educational objectives. Educators can use AR to create engaging learning activities that enhance understanding of complex concepts, promote critical thinking, and foster collaboration among students (Wu et al., 2013). For instance, an AR-based activity could allow students to explore the solar system, visualizing the planets in 3D and interacting with them to learn about their characteristics.

AR for Assessment and Evaluation

AR can also serve as a tool for assessment and evaluation, providing immediate feedback and enabling personalized learning experiences. However, it is important to consider the validity and reliability of AR-based assessments, ensuring that they accurately measure students' knowledge and skills (Di Serio et al., 2013). Educators must also be mindful of potential technical challenges and ensure that all students have equal access to the necessary technology.

Benefits of AR in Assessment

The use of AR in assessment offers numerous benefits, including increased engagement, the ability to provide instant feedback, and the capacity to assess higher-order thinking skills through interactive and immersive activities. These advantages can contribute to a more comprehensive and holistic evaluation of student learning (Ibáñez & Delgado-Kloos, 2018).

Challenges and Considerations

While AR has significant potential to enhance learning and assessment in primary education, it also presents challenges. Technical issues, the cost of equipment, and the learning curve associated with new technologies can pose barriers to implementation (Bujak et al., 2013). Additionally, educators must be trained to effectively integrate AR into their teaching practices.

Ethical Considerations and Best Practices

The integration of AR in education necessitates consideration of ethical issues, including student privacy, data security, and equitable access to technology. Educators should adhere

to best practices, such as obtaining parental consent for the use of AR applications and ensuring that all content is age-appropriate and culturally sensitive (Luckin et al., 2006).

Conclusion

Understanding the fundamentals of AR, identifying suitable applications, integrating AR into lesson plans, and recognizing its potential for assessment are crucial for educators looking to leverage this technology in primary school settings. Equally important is an awareness of the ethical considerations, potential risks, and best practices associated with AR to ensure a safe and equitable learning environment.

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Lesson 5.2: Examples of Augmented Reality in Primary Schools

Duration: 2 hours

Learning Outcomes:

- Understand of Augmented Reality (AR) in Primary Schools
- Know of AR Applications in Various Subjects
- Recognise of the Benefits and Challenges of AR in Primary Schools
- Aware of Special Education Applications
- Encourage to think critically about the current state and future implications of AR in Primary Schools.
- Think critically about the current state and future implications of AR in Primary Schools.

Teaching Methods / Techniques: Interactive Lectures, Demonstrations, Group Discussions, Case Studies

Learning-Teaching Activities:

Introduction to Augmented Reality in Education

- **Activity:** AR Scavenger Hunt: Set up various AR markers around the classroom. Teacher candidates use AR devices/apps to identify and learn about each marker.
- **Discussion:** How did AR enhance your learning experience?

Interactive Books and Storytelling:

- **Activity:** AR Storybook Session. Provide students with AR storybooks. As they read, students can interact with characters and settings using an AR app.
- **Discussion:** How did the AR features improve your comprehension of the story?

Educational Games and Puzzles

- **Activity:** AR Puzzle Challenge: Students use an AR app to solve educational puzzles.
- **Discussion:** How did the AR game challenge and improve your problem-solving skills?

Cultural and Historical Exploration

- **Activity:** Virtual Field Trip. Using “Google Expeditions”, take students on a virtual trip to Ancient Egypt.

- **Discussion:** How did the AR expedition compare to learning from a textbook?

Art and Creativity:

- **Activity:** AR 3D Art Creation. Teacher candidates use “AR Doodle” to create their unique 3D artwork.
- **Discussion:** How does creating art in 3D space differ from traditional methods?

Special Needs Education

- **Activity:** AR Visual Storytelling. For dyslexic students, create a visual-based AR story where words are supplemented with interactive images.
- **Discussion:** How did AR visuals assist in understanding the story?

Conclusion and Future Implications

- **Activity:** AR Idea Pitch. Teacher candidates brainstorm potential future applications of AR in education. They pitch their ideas to the class.
- **Discussion:** How do you envision the future of AR in education?

Assessment Tools:

Quiz: A series of multiple-choice, true/false, and short-answer questions designed to assess students’ basic understanding of AR, its functionality, and its application in educational settings. Example Question: What is Augmented Reality, and how is it used in educational settings?

Portfolio: Teacher candidates create a portfolio showcasing different AR applications in various subjects, describing how each application enhances learning in that particular subject. Example Task: Compile a list of AR applications used in mathematics and describe how they aid in understanding geometric concepts.

Group Discussion and Peer Evaluation: Teacher candidates participate in a structured group discussion about the current state of AR in education and its potential future developments. Peers evaluate each other based on their contributions, insights, and ability to think critically. Example Criteria for Evaluation: Quality of arguments, evidence provided, engagement with peers, and consideration of future implications.

Presentation: Teacher candidates create a presentation on the use of AR in special education, showcasing specific applications and discussing how they cater to the needs of students with learning differences. Example Task: Prepare a presentation on how AR tools can be utilized to assist students with dyslexia in their learning process.

Theoretical Knowledge:

Introduction to Augmented Reality in Education

Augmented Reality (AR) has emerged as a significant tool in education, offering interactive and immersive learning experiences. In primary schools, AR is particularly effective as it aligns well with the playful and exploratory nature of young learners. AR enhances the learning environment by overlaying digital information in the real world, making abstract concepts more tangible and engaging (Billingham, 2012).

Interactive Books and Storytelling

One of the prevalent uses of AR in primary schools is in interactive books and storytelling. Books with AR capabilities can bring stories to life, with characters and objects popping out of the pages when viewed through a smartphone or tablet. This not only makes reading more engaging but also aids in comprehension and retention (Yilmaz, 2017).

Educational Games and Puzzles

AR educational games and puzzles are designed to be both fun and educational, providing hands-on learning experiences that cater to various learning styles. These games often include elements of problem-solving, critical thinking, and creativity, enhancing cognitive skills in young learners (Ibáñez & Delgado-Kloos, 2018).

Learning Natural Sciences

In the natural sciences, AR can bring concepts to life, allowing students to explore the human body, plant life, or the solar system in a 3D space. For example, apps like “Quiver” allow students to color a printed page and then view it in 3D through a device, adding a layer of interaction and exploration to the learning process (Chen et al., 2017).

Mathematics and Geometry

In mathematics, AR can help visualize complex geometric shapes and algebraic expressions. Tools like “Geometry AR” provide an interactive platform for students to explore and

manipulate 3D shapes, enhancing their spatial awareness and understanding of geometric concepts (Kaufmann & Schmalstieg, 2003).

Language Learning

AR also shows promise in language learning, providing immersive environments where students can practice vocabulary and grammar in context. Applications like “Google Translate” use AR to translate text in real-time when viewed through a device, providing an instant and interactive language learning tool (Godwin-Jones, 2016).

Cultural and Historical Exploration

For subjects like history and cultural studies, AR can transport students back in time or to different parts of the world. Apps like “Google Expeditions” allow students to embark on virtual field trips, exploring historical sites and cultural landmarks through AR (Dunleavy et al., 2009).

Art and Creativity

In art education, AR can provide a platform for students to create and interact with digital artwork. Apps like “AR Doodle” allow students to draw in 3D space, encouraging creativity and artistic expression while integrating technology into the curriculum (Rosenbaum et al., 2007).

Special Needs Education

AR also holds potential in special needs education, providing tailored learning experiences for students with different learning requirements. For example, AR can be used to create visual aids for students with dyslexia or to develop social skills in students with autism (Lorenzo et al., 2019).

Conclusion and Future Implications

The integration of Augmented Reality in primary schools represents a significant step towards interactive and immersive learning. As technology continues to advance, the potential applications of AR in education are vast, with the capability to transform traditional teaching methods and provide enriching learning experiences for students of all ages.

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Lesson 5.3: How Augmented Reality Help to Increase Green Deal Awareness in Primary Education?

Duration: 2 hours

Learning Outcomes:

- Defines the European Green Deal and explains its main objectives.
- Explains how augmented reality (AR) can be used as an educational tool to support learning about the Green Deal
- Shows how AR enables interactive and experiential learning, especially in the context of environmental education.
- Provides examples of how AR can be used to visualize and interact with complex environmental concepts, such as the effects of climate change on different ecosystems.
- Evaluates how AR can increase student engagement and motivation in learning about sustainability and the Green Deal
- Explores and interacts with AR applications for Green Deal awareness.

Teaching Methods / Techniques: Interactive Lectures, Demonstrations, Group Discussions, Case Studies

Learning-Teaching Activities:

- Teacher candidates were asked: "What is the Green Deal? What is it used for?" By asking questions such as these, the subject of the course is introduced and students are encouraged to share their ideas.
- Explain how the Green Deal relates to environmental protection and sustainability. How AR can be used in this context is explained with examples.
- AR applications compatible with the Green Deal are shown. For example, the use of AR to introduce natural habitats or visualize recycling processes is discussed.
- Pre-service teachers are offered AR experiences related to the Green Deal. For example, an AR application is used that allows them to virtually visit natural habitats via smartphones or tablets.

- Teacher candidates are divided into small groups and asked to find AR applications related to the Green Deal. They are asked to consider how these practices can increase sustainability and support Green Deal goals.
- Each group presents the AR applications they designed to the class. Other teacher candidates are allowed to give feedback and discuss the impact of the practices in terms of sustainability.
- A class-wide discussion is held on the importance of the Green Deal and how AR can be combined with sustainability. Students are asked to share their ideas on how AR can be used to further contribute to the Green Deal
- Feedback is received from teacher candidates about the content and practices of the course. Student opinions are evaluated to determine which topics need more emphasis or better explanation.
- Teacher candidates are given a research task regarding the Green Deal and AR. They are asked to examine in more detail which goals of the Green Deal they can contribute to, how they can contribute, and the impacts of AR on sustainability.

Assessment Tools:

- Class Discussions and Debates
- Pre and Post Assessments
- Feedback Surveys

Theoretical Knowledge:

Introduction

The European Green Deal is a critical initiative aimed at making the EU's economy sustainable by turning climate and environmental challenges into opportunities. Enhancing awareness and understanding of this initiative is crucial, particularly among younger generations. Augmented reality (AR) offers an innovative tool to accomplish this within primary education, transforming traditional learning methods and fostering a deep understanding of sustainability.

Green Deal Awareness

The European Green Deal aims to make the EU's economy sustainable, ensuring that climate and environmental challenges are transformed into opportunities across all policy areas.

Education plays a crucial role in promoting awareness and understanding of these objectives, and AR has the potential to bring these abstract concepts to life for young learners (European Commission, 2019).

Interactive Learning through AR

AR allows for interactive and experiential learning, enabling students to visualize and engage with complex environmental concepts in a tangible way. For example, an AR application could enable students to see the effects of climate change on different ecosystems, helping to concretize these abstract concepts in their minds (Chen et al., 2017).

Enhancing Engagement and Motivation

By creating a dynamic and interactive learning environment, AR has the potential to significantly enhance student engagement and motivation. Studies have shown that when students are engaged and motivated, they are more likely to absorb and retain information (Clark & Mayer, 2016). This is particularly crucial when it comes to fostering an understanding and awareness of the Green Deal and its implications.

Collaborative Learning

AR also promotes collaborative learning, enabling students to work together to explore and solve environmental challenges. This not only enhances their understanding of the subject matter but also helps to develop crucial social and teamwork skills (Dunleavy et al., 2009).

Certainly, here's a comprehensive information note on how augmented reality (AR) can help increase Green Deal awareness in primary education, along with examples of AR applications:

Some AR applications that can be used to Increase Green Deal Awareness in Primary Education

- **Interactive Learning with "Green Quest":** "Green Quest" is an example of an AR application designed to teach students about renewable energy sources. Using a tablet, students can scan images in their textbooks, triggering an AR experience where they can interact with 3D models of wind turbines, solar panels, and hydroelectric dams, learning about how these technologies work and their benefits for the environment.

- Virtual Field Trips with "EcoExplorer": "EcoExplorer" offers virtual field trips to various ecosystems, allowing students to explore and learn about different environments and the impact of climate change. Through AR, students can witness the effects of deforestation in the Amazon or the melting ice in the Arctic, providing a visual and interactive way to understand these complex issues.
- Gamified Learning with "Recycle Hero": "Recycle Hero" is an AR game that teaches students about recycling and waste management. As students scan different objects with their device, the app provides information on how to properly recycle or dispose of the item. This gamified approach makes learning about waste management fun and interactive.
- Collaborative Projects with "AR Sustainable City": "AR Sustainable City" allows students to work together to build a virtual sustainable city. Using AR, students can place digital buildings and infrastructure onto a physical surface, learning about sustainable urban planning and the importance of green spaces in the process.
- Enhancing Creativity with "EcoArt": "EcoArt" is an AR application that lets students create digital art with an environmental theme. Students can draw trees, animals, and other nature-related elements, which then come to life through AR. This not only enhances creativity but also fosters a connection with nature and an understanding of biodiversity.
- Real-World Application with "Green Energy AR": "Green Energy AR" provides students with the opportunity to see how renewable energy is implemented in real-world settings. By scanning QR codes at various locations, students can view AR models of solar panels on buildings or wind turbines in a field, bridging the gap between theoretical knowledge and practical application.
- Assessment and Feedback with "EcoQuiz": "EcoQuiz" is an AR application that offers interactive quizzes on sustainability topics related to the Green Deal. Students receive immediate feedback on their answers, allowing for a fun and educational way to assess their understanding of the material.

Conclusion

Augmented Reality represents a powerful tool for enhancing Green Deal awareness among primary school students. By creating an interactive, engaging, and collaborative learning

environment, AR has the potential to bring complex environmental concepts to life, fostering a generation of students who are conscious of and engaged with the challenges and opportunities presented by the European Green Deal.

Augmented reality presents a transformative tool in primary education, making learning about the Green Deal and sustainability both engaging and interactive. Through applications like "Green Quest," "EcoExplorer," and "Recycle Hero," students can explore, learn, and understand the importance of environmental protection and sustainable practices. By integrating AR into the curriculum, educators can inspire a generation of environmentally conscious individuals, equipped with the knowledge and motivation to contribute to a sustainable future.

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