Innovative Approach for Serious Educational Games with Creative Visualization in Selected Eco-context

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Abstract. This paper presents a new research approach for technological solutions in the ProNature project to create an innovative software platform for serious educational games with creative visualization to build competence on natural ecosystems, responsible management of natural resources and environmental protection. With the built software platform and based on created educational game scenarios, demonstration serious educational games with creative visualization will be developed in a selected eco-context.

Keywords: Serious Educational Games, Gamification, Creative Visualization, Natural Resources, Green and Digital Technologies.

1 Introduction

Currently, gamification and computer games are an indispensable part of the information age. The unprecedented proliferation of digital games is becoming a key component of culture and society. It has had an extraordinary impact on social trends by legitimizing the overcoming of gaps in scientific knowledge regarding the impact of games on society on the one hand, and on the other hand, *imposing the need to offer digital game solutions with high added value*.

Modern serious educational games are similar to games of the type of interactive systems or simulators, developed using game technologies and design principles. They are usually intended for learning purposes and rely on the added pedagogical value of fun and competition. Thanks to their advanced interactivity and multimedia interfaces, today's serious educational games convey complex concepts and facts in a widely accessible and engaging way. The rapid development of virtual and mixed reality games provides additional opportunities for collaboration and teamwork, critical thinking,

problem solving, flexibility and adaptability, global and social awareness, information and technology literacy, leadership, communication, initiative, social responsibility and ethics.

Non-commercial serious educational games occupy a certain place in the gaming space. Very good examples of non-commercial serious educational games, developed by the team from the current project and created in Bulgaria, are the games " Thracians" and "Aquae Calidae". In these games, by immersing in the virtual 3D reality of ancient archaeological complexes, learners can play intuitive mini-games and improve their historical knowledge and understanding of ancient inhabitants and Balkan civilizations (Zlatkov et al., 2019; Luchev et al., 2020, Paneva-Marinova et al., 2022). In the field of ecology, we will note the European project Nature, which relies on digital game solutions to build the capacity of students from higher education institutions and their teachers to adopt responsible behavior in relation to the management of natural resources (Nature Project, 2024; Caeiro- Rodríguez et al., 2022; Tsalapatas et al., 2023). In addition, it is important to note the European project B-Green-ED (Boosting the Green Future via University Micro-Credentials) with participants from the team of the current project, which aims to stimulate the European green economy and neutrality in relation to of the climate by developing innovative teaching practices (B-Green-ED project, 2022; Zhelev et al., 2023).

In the project ProNature - Innovative Software Platform for Serious Educational Games with Creative Visualization to Build Competence and Responsible Management of Natural Resources (https://pronature-project.math.bas.bg), *new technological solutions will be developed to create* ***innovative software tour platform for serious educational games with creative visualization*** (https://pronature.math.bas.bg) for *building competence for* ***natural ecosystems, responsible management of natural resources and environmental protection***. With the built software platform and on the basis of created game educational scenarios, ***demonstration serious educational games with creative visualization in a selected eco-context will be developed***.

Through the proposed software platform and the built serious educational games, significant progress will be achieved in building awareness of natural resources and ecosystems, practical skills for designing environmentally sustainable solutions and innovative thinking in solving the problems of the future in direction of sustainable management practices in industry and social life.

The natural basis of the current project is the Burgas lake eco-system (Lake Burgas, Lake Mandrensko, Lake Atanasovsko and Lake Pomorie). Its total area is 9,500 hectares, of which 3,300 hectares is a protected area. It is distinguished by exceptional biodiversity and among the three most significant protected natural complexes with a concentration of waterfowl on the Bulgarian Black Sea coast. More than 300 species of birds have been identified, of which 12 are globally protected and 105 are protected in Europe. It is an important part of the Via Pontica, one of the main routes of bird migration from Europe to Africa, where migratory birds traditionally stop to rest, and some stay to winter and nest. At the same time, the Burgas lake complex is in close proximity to industrial and urbanized areas and serious environmental protection is needed in case of pollution, waste water and human negligence.

2 Objectives of the ProNature Project

The overall goal of the ProNature project *is to carry out scientific research and develop new technological solutions for the creative industries (serious educational games with creative visualization) with innovative socially significant applications*.

The specific goal of the ProNature project within its continuum ***is the development of an innovative software platform for serious educational games with creative visualization with technological readiness level 7*** *for building competence for natural ecosystems, responsible management of natural resources and conservation of the environment.* The software platform will contain:

- Module for creative visualization and management of game objects simulating a natural environment;
- Repository of game objects created for multiple use;
- Module for defining and developing game educational scenarios;
- Module for formalization and development of game rules in a selected context.

It is planned to create game educational scenarios in the context of:

- awareness and knowledge of functioning of protected ecosystems;
- sustainable use, protection and management of natural resources;
- pollution prevention and control;
- protection and reactions in critical situations of biodiversity and natural ecosystems, *etc*.

With the built software platform and based on the created educational game scenarios, ***the specific goal*** of ***developing demonstration serious educational games with creative visualization*** *in a selected eco-conte*xt will be achieved.

An additional specific goal is the creation of new knowledge and scientific results about the innovation potential of serious educational games and their role as a tool for the transmission of eco-culture at different levels and for different target groups.

A specific goal in the long term is to lay a foundation for promoting innovative thinking, the ability for responsible and engaging actions in the target group in solving eco-problems of the future in the direction of *a sustainable impact on the creative industries, economy, environment and society*.

The target group of the current project is mainly formed by junior and high school students and other interested parties such as representatives of the scientific community, educational institutions, thematic-oriented non-governmental organizations, policy makers, industry and the general public.

3 Methodology

The methodology adopted in the ProNature project takes into account the exceptional dynamics of development of the target subject area (serious educational games in virtual reality for building competence for natural ecosystems and responsible management of natural resources), of applied research in it and of its interdisciplinarity, and requires developing models, methods and tools to be reusable, flexible and extensible.

The development of software for serious games and the corresponding analyzes (including analysis of use in training) is considered a dominant innovation element in the project, for which the best and relevant practices of the Agile methodology will be applied. Agile is a set of agile software development practices aimed at improving the performance of software development professionals, teams and organizations.

For the development of the software in the ProNature project to the target level of technological readiness TRL7, as well as for solving the research and technological tasks in the project, a number of methodological principles will be followed:

- Core group user needs and motivations. Characteristics of the selected context;
- Identification of project objectives and their clear definition;
- Following an iterative design process;
- In-depth knowledge in relevant multi- and interdisciplinary fields;
- Defining and using indicators for evaluating and monitoring success, as well as psychological and behavioral effects, *etc.*

In the ProNature project, through the proposed methodology, scientific research will be carried out and new technological solutions will be developed to create an innovative platform for serious educational games with creative visualization for *building competence for natural ecosystems, responsible management of natural resources and environmental protection*.

4 Expected Results and Their Impact

The main result of the ProNature project is focused on the creation of **a new digital technology** (innovative software platform) **for the development of serious educational games** relevant to the economy and eco-society. On this basis, ***demonstration serious educational games with creative visualization*** *in a selected eco-context* are developed. The aim is to create new knowledge about the innovation potential of serious educational games and their role as a tool for the transmission of eco-culture at different levels and for different target groups. Flexible skills are developed in the target group to promote innovative thinking, the ability to take responsible and engaging actions in solving eco-problems of the future in the direction of *sustainable long-term impact on creative industries, economy, environment and society*.

It is expected that the impact of the project results will be maximized by integrating and synergizing the dissemination, utilization and communication stages during the project phases with post-project activities towards achieving long-lasting impact. It is envisaged that collective research and technological products such as services, software, demonstration serious educational games, learning scenarios, guidelines for good practices, and other results resulting from the implementation of the work plan of the project will be widely distributed ***under an open-source license*** or ***under the CC 4.0 Open Science license***.

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