Promoting Interactive Learning Using 5G Networks and Synchronous Immersive Contents: the DI5CIS Project

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***Abstract*— The DI5CIS project seeks to address the challenges faced by multimedia learning designers in providing advanced interactive mobile content that requires massive data streams and low latency. To achieve this, the project aims to explore the potential of 5G networks in enabling mobile enjoyment of highly sophisticated audiovisual content created through a gamified interactivity production methodology applied to live-action film material. The project will enact this experiential format in two use cases, related to the teaching of STEM disciplines. The impacts of 5G infrastructure on the technical mobile enjoyment of content, such as fluidity and audiovisual quality, will be investigated, as well as the effects on specific indicators such as engagement, motivation and learning outcomes in the educational context. By improving the quality of experience and learning, the DI5CIS project is highly relevant for e-learning and mobile learning challenging innovative educational and technical aspects.**

Keywords-Digital Game-Based Learning; Gamification; Digital Storytelling; Interactive Narrative Learning; 5G.

I. INTRODUCTION

The project "Interactive Learning in 5G: Synchronous Immersive Contents" (Didattica Interattiva in 5G: Contenuti Immersivi Sincroni, DI5CIS) aims to explore innovative ways of using interactive visual content centered on narrative and video-ludic mechanics and created through an innovative methodology and technology. The 5G architecture is a decisive enabling factor for the realization of highly immersive educational content for mobile devices, opening up interesting possibilities for the use of Digital Game Based Learning (DGBL) [1] and Digital Storytelling (DST) [2]. The DI5CIS project, funded by the Ministry of Enterprises and Made in Italy (MIMIT) under the "Progetto 5G audiovisivo (2022)" grant, involves five partners: PRODEA Group, HYPEX, Capgemini engineering, Vodafone Italia, and the Institute for Educational Technology of the Italian National Research Council (CNR-ITD).

This poster first presents the two main objectives of the project (Section II). Then the four main pillars on which the project is based on are detailed (Section III). Furthermore, the process to realize the educational digital artefacts (Section IV) and to test them in real educational settings (Section V) is presented briefly. Finally, Sections VI highlights some relevant preliminary considerations for the implementation of the project.

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II. PROJECT OBJECTIVES

The DI5CIS project exploits the 5G architecture [3] to produce edutainment content based on pioneering interaction patterns covered by an industrial patent, capable of enabling real-time interactive cooperation within the experience between multiple users. In this perspective, DI5CIS aims at pursuing the following two objectives: a) research and identify use cases that utilize real-time interaction and co-operation between multiple users, merging technological advancement with the impacts of cooperative learning; b) measure the related impact on the Quality of Experience within the use cases thus investigated. In this direction, the project makes use of high-level assets: structural, such as Multi-Access Edge Computing provided by Vodafone Italia and Capgemini Engineering; patenting, both process and method, for the creation of interactive and branched live-action video content, provided by HYPEX (with the support of PRODEA Group for video production); and methodological-scientific as well of educational technology research, provided by CNR-ITD.

III. THE FOUR PILLARS OF THE PROJECT

At the macro level (Pillar 1), the DI5CIS project shows an interpenetration between the game and the narrative dimension, aimed at motivating and engaging students [4]. Then, the disciplinary dimension (Pillar 2) is translated into the development of interactive multimedia content for learning physics and chemistry, based on the fundamental elements of the STEM approach [5]. Furthermore, it is possible to find development choices (Pillar 3), defined by the grammars of the multimedia products, and the user's possibility of interacting by elements coherent with the content of the scene they are viewing. This element leads to the technological layer (Pillar 4), that is the integration of different elements to provide a true immersive experience: from devices integrated sensors to the 5G network infrastructure. More in depth the uninterrupted flow of the story and a user-narrative interaction reinforce its sense of presence in the plot [6].

IV. ARTEFACT DEVELOPMENT PROCESS

The development of the artefacts tends to harmonize the learning approach with the technical development choices, supported by the technological infrastructure described. The combination of the disciplinary, the playful, the narrative and the interactive elements supports the student's learning activities based on the multimedia artefact exploration. The realization of this 'common thread' is possible thanks to the involvement of teachers (in a perspective of Stakeholder Engagement) in the design and development phases of the products and the creation of an action-research group in which all the actors are involved. Two artefacts will be implemented in the educational case study: PhysiGame, dealing with Physics' topics (i.e., state functions, equations of state, first and second laws of thermodynamics, etc…), and ChemiGame, about Chemistry's topics (i.e., phase transition, latent heat, thermal expansion, etc…).

Figure 1. Moke-up of a user-story interaction within DI5CIS artifact.

V. EXPERIMENTATION

The artefacts will be initially tested within three classrooms, 4th grade of high school, in co-located situated learning activities [7], in which students will use the artefacts as a learning activity. The experimentation goal will be to understand how the interactive and playful artifacts are used and what are their effects on learning. engagement, behaviour and motivation. These elements will also be read in the light of the students' profiles, to understand to what extent personal characteristics can have a moderating effect on the previously mentioned dimensions. To detect the elements useful for the research, tools such as standardized tests and observation grids, as well as a user behavior tracker integrated within the interactive stories, will be used.

VI. PRELIMINARY CONSIDERATIONS

The process of developing interactive and engaging stories is complex and requires coordination between teachers and the development team. Modern technologies such as 5G and mobile devices offer new opportunities to create immersive experiences with learner-narration and peer interaction, which can advance learning of STEM disciplines through DGBL and DST.

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