Remote Learning and Examination based on Augmented Reality

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Conference Key Areas: *Virtual and Remote Labs*
Virtual and Augmented Reality in Education
Keywords: *Augmented Reality, Assisted reality, Remote learning, Remote coaching, Digital active learning*

doi:10.5821/conference-9788412322262.1301

ABSTRACT

Remote Learning and Examination based on Augmented Reality (RELAR) is a European Erasmus+ project (2020-1-NL01-KA226-VET-083043) that aims to create a crisis-proof resilient education environment, enabling remote coaching and digital skills training based on AR. RELAR integrates seven European partners –Vocational Training Institutions and Higher Education Institutions– all linked to the maritime industry. The industry itself is also represented.

With the help of a reference group, a set of learning outcomes has been defined to develop three demo scenarios to test and demonstrate the RELAR system, which is based on the RealWear HMT-1 assisted reality hands-free computer. All scenarios are scaffolded on the same framework that integrates active learning pedagogy, curriculum requirements and technological integration.

This digital active learning process pedagogy incorporates two processes for instruction: a remote instruction process called 'Expert Coaching' that gives the students the possibility of receiving instant feedback while taking actions and decisions; and a remote assessment process named 'Digital Workflow' that incorporates formative assessment to consolidate learning. The curricular aspect focuses on the professional competencies students will acquire, the expected learning outcomes, the required knowledge, and the transferable skills required by students to perform professionally. Finally, technological integration describes how and when the assisted reality system should be incorporated to add value to the learning process.

This paper describes the work in the learning spaces currently under development by the partnership based on the same methodological and pedagogical foundations.

1 INTRODUCTION

RELAR project aims to create a crisis-proof resilient maritime educational ecosystem by enabling remote learning and examination using Augmented Reality (AR). The project addresses the difficulties of the maritime and port education ecosystem caused by the situation unearthed by COVID-19 and any other crisis that may affect face-to-face education and training. In this context, new digital technologies such as AR can make it possible to transfer the expertise and knowledge of industrial organisations while improving security, safety, and efficiency by empowering frontline connected trainees and workers with remote technology. The RELAR consortium partners will identify and adopt a joint architecture and framework for future interoperability, scalability and sustainability of remote learning. The core concepts of the architecture will be inspired by the background and experience of functional design approaches for remote learning and assessment developed by STC Group for maritime education [1].

RELAR is formed by a consortium of seven European Vocational Education & Training (VET) Institutions and Higher Education Institutions (HEI), and industry organisations, all linked to the maritime industry.

The consortium –listed below– is coordinated by a lead partner, which is currently the STC Group.

- Shipping and Transport College Group, STC Group.
- Malta College of Arts, Science & Technology, MCAST.
- Šolski center Nova Gorica.
- Romanian maritime training centre, CERONAV.
- Satakunta University of Applied Sciences, SAMK.
- Universidad de La Laguna, ULL.
- University of the Aegean, Aegean.

This work is possible thanks to the consortium members and the following Industry associated partners:

- Knowledge Insight.
- KOTUG International.
- WeAR.
- WinNova.
- ONEX Syros Shipyards.
- MarineTraffic.
- Creative Solutions.
- Palumbo Shipyard Malta.
- Cassar Shipyard.
- Romanian Naval Authority.
- Tenerife Shipyards.
- Hidramar Shipyards.

RELAR project will deliver two Intellectual Outputs (IOs):

- *Architecture and framework* (IO1) contemplate technical development aspects.
- *Commons* (IO2) incorporates the pedagogical aspects of the project.

Given the focus of this conference on Engineering Education, this paper describes the development of IO2, which consists in the development of shared resources that will be integrated into three different demo scenarios that will incorporate pedagogical content. The idea behind these demos is to show how common resources developed by the consortium can be integrated with the RELAR ecosystem and how researchers, the educational community and even businesses and industry can use them and develop them further.

Three partners with experience in maritime education are building the above-mentioned demo scenarios for learning and examination purposes for the following use cases: *Marine Engineering* (developed by ULL), *Shipyard Technician* (developed by MCAST), and *Logistics/Fleet Technician* (developed by Šolski center Nova Gorica). All three demo scenarios will share the same pedagogical framework named in RELAR as Digital Active Learning process, which is described in detail in next section.

2 METHODOLOGY

The development of each demo scenario needed a shared structure to make them comparable, so it was necessary to define the common requirements, showed in Table 1:

Table 1. Common requirements for demo scenarios

Definition	Requirement
Level for qualification and learning outcomes, based on the European Qualification Framework (EQF)	4
Total learning hours, based on the European Credit Transfer and Accumulation System (ECTS)	1 ECTS (25 hours)
Assessment of the learning outcomes	Up to partner's decision
Providing of formal certification	Up to partner's decision
Cost of the contents	Free of charge
Delivering language	English

2.1 Designing Demo Scenarios

As much as possible, the development of the scenarios would follow a Scenario-Based Learning (SBL) methodology. This strategy uses an active learning approach, using real-life situations for exposing the learners to a relevant learning experience. This methodology will help learners in critical thinking skills training and communication skills training. Learners would also be able to understand the cause-effect in relation at the workplace [2].

Each scenario's methodology is based on three components that facilitate the adoption of active learning in Engineering Education: Curriculum, Pedagogy, and Technology (see Fig. 1) [3].

Curriculum. The curricular aspect is built-in base on the descriptors proposed by EQF level 4, *Knowledge, Skills,* and *Responsibility and autonomy* [4]. From these descriptors are extracted four aspects that feed each other and are used to determine the final outputs for the RELAR scenarios: *Professional competencies*, *Learning*

outcomes, *Subject knowledge*, and *Transferable skills*. Those are interrelated in such a way that the learning outcomes are dependent on the professional competencies, the required knowledge is set by the learning outcomes and transferable skills are determined by the professional work environment (see Fig. 2).

This loop in the curricular aspect guarantees to select all aspects related to the subject and how it connects to future application in learners occupation.

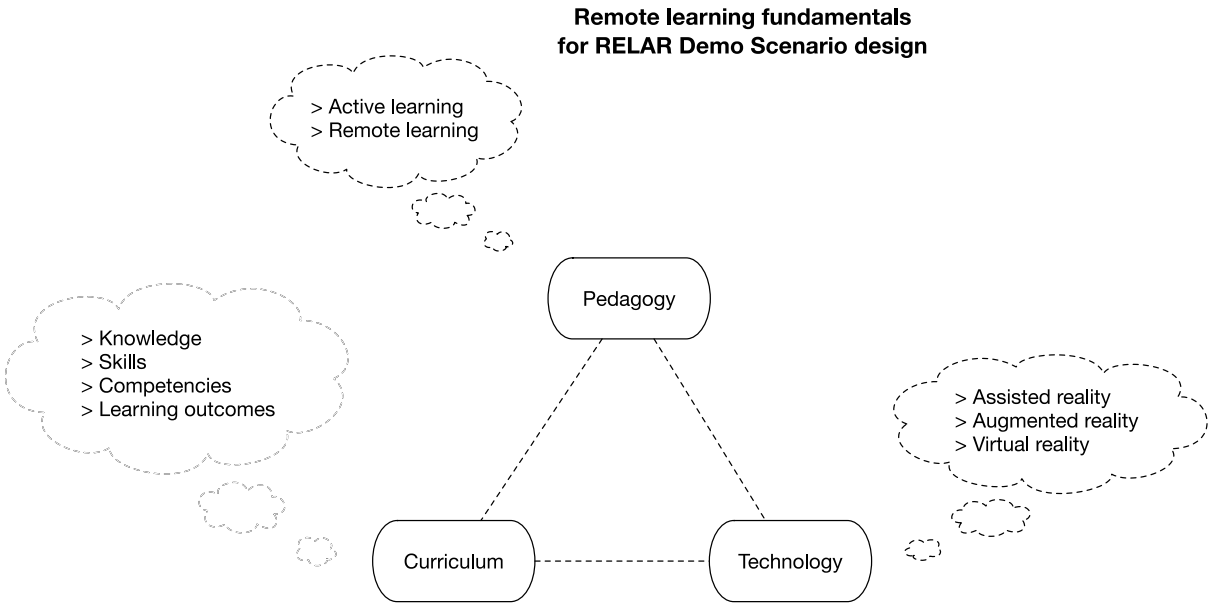

Fig. 1. Learning fundamentals for RELAR Demo Scenario design

Pedagogy. Pedagogical framework for Demo Scenario design is based on active learning and remote learning. The instructor's role during the process is to guide and facilitate the learners through their actions and to give feedback when it's needed. Considering it necessary for proper active learning, the activation of previous knowledge is fundamental, where wrong concepts and misconceptions are corrected and helps to relate previous experiences to a new situation. Creating new knowledge and competencies, and consolidating them are the next steps, always considering the learner's motivation for its optimal autonomous learning process (see Fig. 3).

The *Digital Active Learning process* incorporates two different actions for remote instruction called *Expert Coaching* and *Digital Workflow*.

During Expert Coaching, learners receive instant feedback through selected technology while they are taking their own actions and decisions. Digital Workflow contemplates asynchronous formative assessment to consolidate learning.

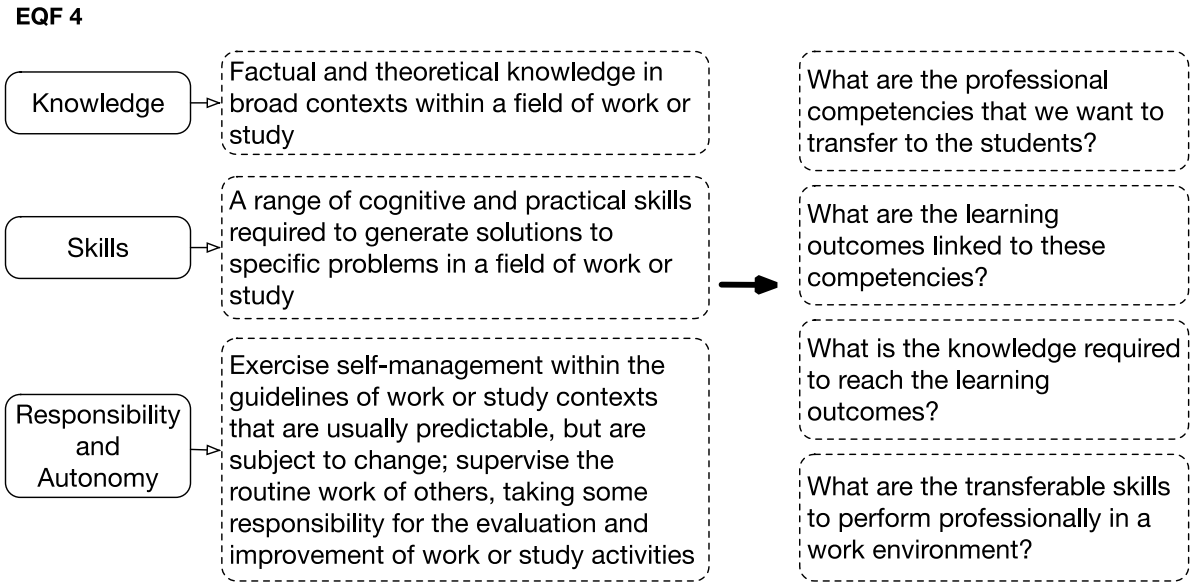

Fig. 2. RELAR curriculum aspects

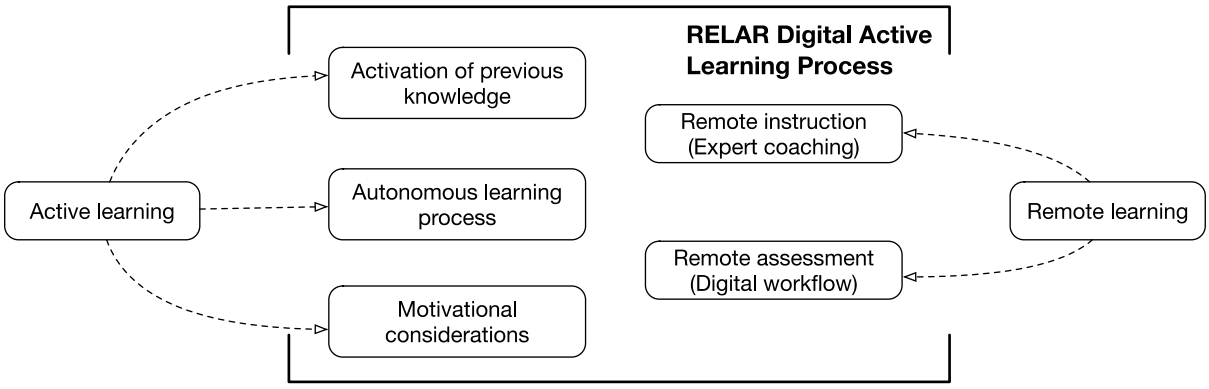

Fig. 3. RELAR pedagogical aspects

Technology. Technological integration describes how and when assisted reality system should be incorporated into the learning process. For this purpose, HMT-1 device is the chosen tool by the consortium, leaving other devices based on AR and VR as feasible options for similar scenarios (see Fig. 4).

HMT-1 device is a wearable computer that is designed to be used in industrial and commercial environments. It is a rugged device that can be worn on the head, and it includes a display, camera, microphone, and speakers. The device runs on the Android operating system, and it has been designed to be used with a variety of applications [5].

Its features allow the instructor to follow the user's view using a video call, capable to maintain a synchronous connection for immediate feedback or recording the action for asynchronous review, helping in Expert Coaching and Digital Workflow, respectively.

From the learner's point of view, the device can be used as a tool for viewing documentation related to their actions or as a guide to follow previously generated workflows.

Learning Management Systems (LMS) and videoconferences are useful tools to use in the digital active learning progress, to follow and share between learners and instructor in asynchronous or synchronous ways, respectively.

Technological integration into the digital active learning process is possible by the collaboration between lead and support partners, iterating with the possibilities and limits on software or hardware.

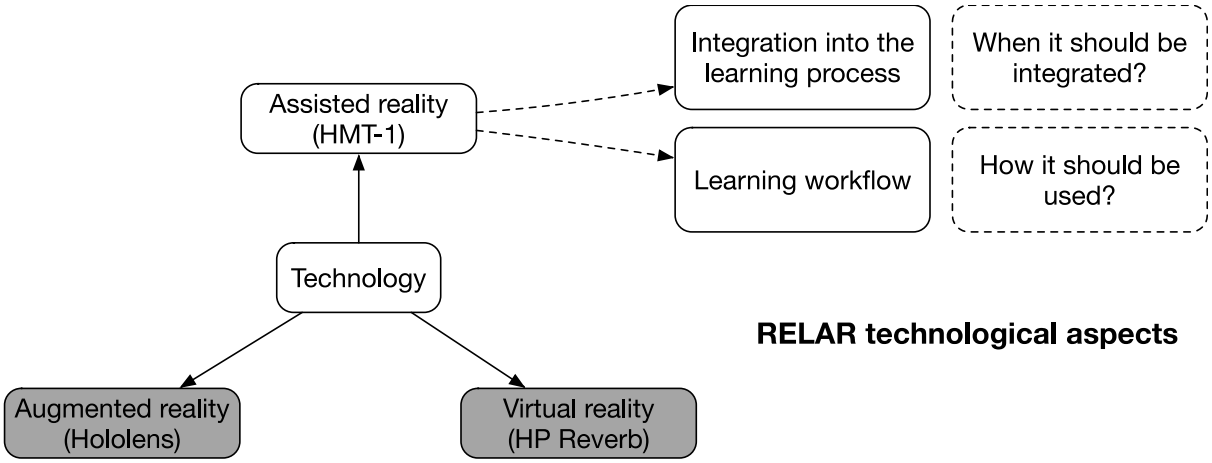

Fig. 4. RELAR technological aspects

2.2 Demo scenario workflow

In general words, RELAR demo scenarios are divided into 3 phases (see Fig. 5). 1st phase focuses on the activation of previous knowledge, where students can be exposed to the topic knowledge that they already should know. Using self-evaluation tests and having an open discussion between classmates and instructor is a proper way to know and understand lack of knowledge or misconceptions from the learners, facilitating flexible variations during the learning experience.

2nd stage's aim is to create new knowledge and competencies. Learners themselves must work as teams to investigate digital content about the topic and elaborate their own content to take action in training. During this stage can receive instant feedback from the instructor via HMT-1 (expert coaching).

On 3rd stage, the knowledge has to be consolidated, expecting that it can be transferred to new situations in learners' future professional environment. For this stage, learners may build their own workflow to follow in the expected problem. The learner action can be recorded by the HMT-1 device to receive asynchronous feedback from the instructor (digital workflow). This final stage could be used as an assessment of the topic.

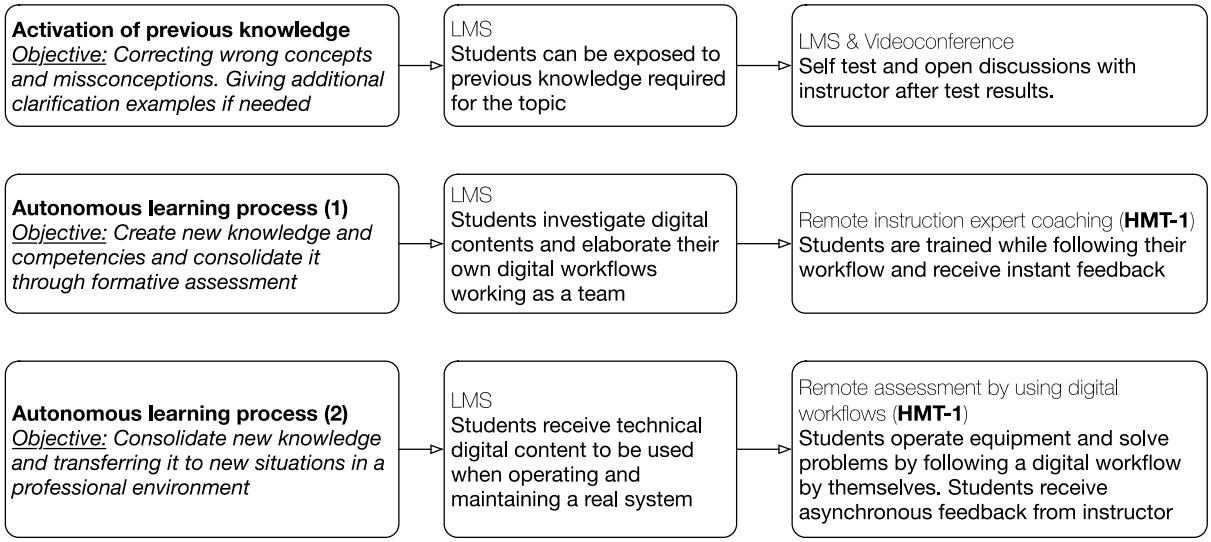

Fig. 5. RELAR digital active learning process

3 EXPECTED RESULTS

In future Intellectual Outputs scheduled in RELAR actions, the scenarios created by the consortium will be tested, ensuring that demo scenarios are correctly build in its three aspects, optimizing them if needed. The experience must be validated by the reference panel, through a series of meetings where product will be showcased.

As part of the dissemination activities, the partners will organise nine Transnational Meetings in total, of which four will be Training Events. During the Transnational Meetings teachers, students and experts from maritime industry and other sectors get familiar with RELAR and receive the necessary information on how to use it to educate and examine students and professionals on-the-job remotely.

During ‘train the expert’ sessions the partners ensure that the level of technical knowledge, the digital skills and understanding of concepts among teachers and trainers is sufficient for using RELAR in their daily work.

During ‘train the trainer’ sessions teachers and trainers get familiar with using RELAR scenarios for learning and examination using RELAR scenarios.

By the end of the project’s schedule, a RELAR Trainers’ pack must be developed by various partners. This trainer’s pack will include standard procedures with hardware and software and scenario specific info.

RELAR is a project under development with expectations of improving learning outcomes in engineering by using devices that are becoming common in the industry 4.0. With the backup of institutions and industry, future RELAR editions could have a vague expansion on the use of other devices and technologies and incorporating and testing over other environments.

4 ACKNOWLEDGMENTS

Remote learning and examination by using AR in maritime VET education, RELAR, is a European Erasmus+ project with agreement number 2020-1-NL01-KA226-VET-083043. This project is scheduled between May 2021 until April 2023.

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