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Interdisciplinary Simulation-Based Learning for Improving Practical Skills Acquisition in Vocational Education

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Abstract

Simulation represents a real revolution in the process of vocational teaching and learning. Learning and assessing knowledge through practical experience, safely and with the possibility of acquiring skills from mistakes and preparing for the unexpected by developing problem-solving and decision-making capabilities, are just some of the advantages offered by simulation.
Simulation is used in many contexts, such as simulation of technology for performance optimisation, engineering, testing, training, education, and video games.
Over time, the universities have set up in-house real simulation laboratories, locations for teaching and research activities mostly dedicated to the engineering and medical areas.
The University of Genoa has invested human and financial resources in creating a new and broader learning context in simulation, and has designed a Centre for the entire university staff able to offer new opportunities for research and simulation training developed in an interdisciplinary and inter-professional perspective.
The focus of this paper is how students perceive that simulations help them learn and suggests that simulation may play a part in how students perceive learning that is meaningful to them. A literature review on the use of simulation is presented together with literature related to the learning theory that underpins simulation. This work aims to share the experience at the SimAv simulation centre of the University of Genoa that represents a unicum in the Italian panorama.

Keywords**:** *Simulation; interdisciplinary; interprofessional education*

1. Introduction

Simulation is a well-established technique in some strategic fields (military and industrial, first of all) and represents an important tool of knowledge and work in the scientific field, widely used in hard sciences (e. g. chemistry, physics, mathematics, etc.), but also in applied sciences (e. g. aeronautics, engineering, medicine). In the educational field, its use is now consolidated [1]. Cognitive sciences, such as neuroscience, also have significant points of contact: studies on mental simulation, cognitive skills and learning processes are an example of this.
Landriscina describes the simulation as "an interactive representation of reality based on the construction of a model of a system whose functioning is to be understood". At the base, it is, therefore, the concept of imitation of an environment or system, real or imaginary. This is not static playback, but active, better, interactive. More than a generic "learning by doing" one should speak of "active elaboration", or even better of "focused elaboration" [2], that is to say, explicitly connected to the concepts and central principles for learning a discipline.

2. Training experiences with simulation in medicine

Training in medicine is currently the field in which simulation has become more widespread as an educational tool [3] and now represents a methodological standard inserted in university curricula and lifelong learning [4; 5]. In literature, there are many examples of simulations for building interprofessional skills. The complexity of the paths and the increasing availability of simulators, is diversifying the simulation activities according to the logic of progressive specialisation [6].
One of the success factors is that simulation meets the need to train health professionals "safely" [7]. More safety not only for the patient but also for the learner, who is put in a position to make mistakes without these causing any effect on the real patient. Kallberg [8] shows that the cause of errors committed in emergency departments is often multifactorial, with a significant role of human error, followed by defects in a local organisation and mediocre teamwork.
Another strong push for the introduction of simulation in medicine comes from changes in care organisations, where the hospitalised patient has lost much of his teaching potential. In fact, in the

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face of the reduced time spent in a hospital and for intensive hospitalisation, it is increasingly difficult to carry out professional training activities. To this is added the fact that the simulation offers the learner a wide range of situations (pathologies, procedures to perform, therapies), optimizing learning times and completeness of cases that could hardly be subject to training on the real patient.
It is also very flexible with regard to a constant and fast evolution of diagnostic techniques and technologies: today, simulators with high technological content (high fidelity) are available, capable of promoting rapid and continuous learning, as well as being able to evolve and adapt to new needs.
It is a complicated scenario in which only teamwork in teams of experts in different fields can provide adequate responses. The most critical challenge in the educational field is to offer validated simulation training through accreditation processes that are increasingly integrated into curricula, that can combine the need for specialisation with the introduction of new technologies, and that is increasingly interprofessional.
Introducing the simulation requires rethinking the didactics and carefully structuring the students' training path and in particular devoting attention to the training of tutors who must assist the student in teaching using simulators.
According to Bridges [9], an interprofessional curriculum requires a significant and synergistic commitment from all those who revolve around the training of health professionals: the university, the faculty, hospital companies, experts of the professionals involved. To this end, the role of simulation training experts as facilitators in disseminating the methodology is essential.
Another crucial aspect for an increasingly widespread and beneficial dissemination of the simulation methodology is the necessity to encourage research activities aimed at introducing and experimenting with new technologies, as well as evaluating the effectiveness of the training carried out in this way.

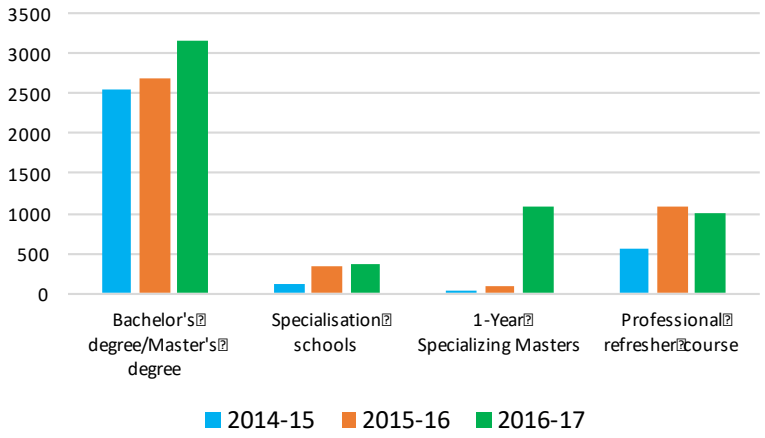
3. Simulation as a multidisciplinary training tool

Simulation in the social sciences has become increasingly widespread and for years has been studying complex social phenomena through the use of computational models that allow discovering how individuals, interacting with each other, generate macro effects that are difficult to study with traditional investigation tools. It is an innovative research tradition in the social sciences, offering solid explanations of complex phenomena and strengthening collaboration between scientists from different disciplines.
Today, moreover, the use of simulation has expanded in the social sciences also in training, no longer being limited to only military and medical fields. In fact, there are many sectors in which modelling and simulation programs are developed, which often allow developing transversal methodologies of didactic design to be developed according to the specific training needs of different professions.
It can be said that the learning paradigm based on "focused elaboration" has now found application in its various declinations in all areas, in addition to the scientific ones, in particular, simulation as a learning method is used in the economic sciences, social and also cultural sciences [10; 11].
The use of simulations in the training of social service providers is not new. The literature reveals the use of classroom simulation through role-playing with classmates, the reproduction of scenarios depicted by students, the use of specialized actors as standardized clients.
These new scenarios introduce the need to favour the design of increasingly multidisciplinary paths, in which the tool-simulation needs to be redesigned, adapted and enriched with functionality, and this can only happen by making use of the contribution of scientific expertise coming from many different disciplines.

4. The experience of the first university centre for interdisciplinary simulation in Italy

Around the world, many universities and healthcare institutions have equipped themselves with simulation centres for university training and continuous training of already specialised healthcare personnel. The University of Genoa is the first university in Italy to have designed and built a centre for simulation and advanced training that makes available to university teachers and students, as well as schools and other training and research institutions methods, devices and good practices [12].
Simulation training for future doctors and health professionals enrolled at the University of Genoa has been developed since 2012 and has seen a constant growth in activities that are now fully integrated into the programs of degree and speciality courses. At the same time, there has also been an increase in activities aimed at outsiders, especially specialists attending masters or professional refresh courses, as shown in Fig. 1.

Fig 1. Activities at SIMAV (number of learners in the last 3 years)



5. Conclusion

Every educational process always begins along the lines of simulation, imitation and play, which are robust learning mechanisms able to facilitate the acquisition of the skills necessary to carry out the tasks assigned in real life. In fact, it is often not enough the theory and not even a careful observation of how the expert professional behaves to understand how one does something, but it is necessary to be accompanied step by step, to try to do, first, together with an expert, and then work again on one's own, until gaining a real autonomy. But even when you have become autonomous, you can always improve your performance.

However, simulation is not able to faithfully reproduce reality, and therefore it must be accepted with a critical sense, representing a stimulus to develop reflective and analytical capacities. The most effective didactically useful simulations are not those that claim to be a copy of reality, but those that facilitate in students the construction of new mental schemes or the modification and replacement of the existing ones, thus favouring learning.

In conclusion, it can be said that simulation is the most suitable didactic method when the learning objective requires a restructuring of students' mental and relational models and at the same time the acquisition of complex operational skills; when you want to explore environments and situations that would otherwise be unreachable, because they are far away in time or space, or not manipulable; when it is not allowed to make mistakes. Error in a simulation does not have human, material and economic costs, but only, at most, emotional and cognitive costs. The simulation approach expands time by favouring the processes of reflection and deepening. If, for example, in a real dialogue we are almost obliged to respond immediately, in the simulated dialogue we can stop to weigh up all the possibilities, evaluating their consequences and hypothesising all the possible reactions of the interlocutor. The reflective approach determines the growth of the individual and society and, precisely for this reason, must constitute one of the aims of education. Just these aspects make simulation a fundamental tool for modern curricula oriented to adult learning theory.

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