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HEALTH INFORMATION SYSTEMS COURSE AND PRACTICE-BASED LEARNING: METHODOLOGICAL EXPERIENCES

CORSO DI SISTEMI INFORMATIVI SANITARI E PRACTICE BASED LEARNING: ESPERIENZE METODOLOGICHE

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Abstract

The paper describes the structure of the Health Information Systems course aimed at students in the 1st year of the Master of Science in Biomedical Engineering at the University of Naples Federico II. Through the extensive use of simulation tools, an attempt was made to implement a project-based learning model for the acquisition of a set of "key" skills for the training of biomedical engineers that are particularly valuable in the relevant professional area. In the case of digital simulation "didactics," the relationship between realized experience and conceptual structuring becomes central to the learning processes activated. In this sense, the mediation between the simulation process with artifacts-didactic mediation-cognitive growth of the subject achieves a long series of transformations both in the learner and in the technological objects and software used, which are in turn "adjusted" based on the specific needs of those subjects and that context. The same is true for docimological choices adopted such as the use of remote - computer-mediated - examination modes chosen during the violent irruption of the pandemic during A.A. 2020/2021.

Il lavoro descrive la strutturazione del corso di Sistemi Informativi Sanitari rivolto agli studenti del 1 anno del Corso di Studi Magistrale in Ingegneria Biomedica dell'Università di Napoli Federico II. Grazie all'utilizzo esteso di strumenti di simulazione si è provato a realizzare un modello di apprendimento per progetti (Project Based Learning) per l'acquisizione

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di una serie di competenze “chiave” per la formazione di ingegneri biomedici particolarmente preziose nell’area professionale di pertinenza. Nel caso della didattica digitale “di” simulazione, il rapporto tra esperienza realizzata e strutturazione concettuale diventa centrale circa i processi di apprendimento attivati. In tal senso, la mediazione tra processo di simulazione con artefatti–mediazione didattica–crescita cognitiva del soggetto, realizza una lunga serie di trasformazioni sia in chi apprende che negli oggetti tecnologici e i software utilizzati, che vengono a loro volta “aggiustati” sulla base delle esigenze specifiche di quei soggetti e di quel contesto. Lo stesso vale per le scelte docimologiche adottate come l’utilizzo di modalità d’esame a distanza – *computer-mediated* – scelte in occasione dell’irruzione violenta della pandemia durante l’A.A. 2020/2021.

Keywords

Project Based Learning; digital learning; digital assessment.
Project Based Learning; apprendimento digitale; valutazione digitale a distanza.

1. Introduction

In the course of structuring various theoretical and practical approaches to university teaching, the description of new models is particularly relevant, these, taking up pragmatism (Biesta & Burbules, 2003), American and European activism (Travaglini, 2020), try to bring the praxis, the action, the operational structuring of the training processes back to the center of the teaching-learning categories.

The idea of an adaptive matrix solicitation, as an implicit basic phylogenetic and ontogenetic mechanism of human development, has laid the foundations for a series of educational models that develop precisely starting from the active and adaptive solicitation of the species-specific peculiarities of human development (Frauenfleder, Santoianni, Ciasullo, 2018; Santoianni, 2019; Ciasullo, 2019).

In the process of exchanging subject/environment, individual/context, problem/solution, and basic adaptive mechanisms are stimulated which can act on a multiplicity of levels, from biological to cultural, in a series of learning processes that contribute continuously and are complementary to realizing multilevel knowledge.

In the dense galaxy of methodological acronyms, models that use the bodily-organismic approach for learning activities are spreading with greater force; these stimulate challenges in learning communities about solving a given problem; who aspire to build and solve activities based on projects and/or involve active problem-solving strategies presented as an opportunity to test their skills.

These are respectively: Practice-Based Learning (Strati, 2007; Wenger-Trayner et al., 2014); Challenge Based Learning (Gallagher & Savage, 2020; Johnson et al., 2009); Project Based Learning (Krajcik, Blumenfeld, 2006; Kokotsaki et al., 2016); Problem-Based Learning (Hung et al., 2007; Wood, 2003).

2. Theoretical framework

Practice-based learning (PBL), brings with it the big theme of knowledge never detached from the sensitive act and therefore from the bodily, kinesthetic, organismic dimension of subjectivity in a process of mental acquisition no longer anchored only to brain functioning. In this sense, it is the active pressure that the senses exert on the subjectivity that is formed that forcefully determines its openness to the world and with it to all the learning processes that take place. It is in the "aesthetic-sensitive" exchange (Strati, 2007, p.62), anchored to the bodily dimension in its total capacity to become part of the world, that elements of active and cognitive construction of the world itself are realized. In this "carnality" made up of active coexistence with the world, as extensively argued by Maurice Merleau-Ponty (Merleau-Ponty, 1964; Mortari, 2003; Strati, 2007), the subject "takes" and determines coexistence of reciprocal exchange with the experiences that happen around him.

In this sensitive exchange process, the following factors come into play:

- The "situated" dimension, in a specific learning community or a place;
- The ability to structure functional organizational actions in which people and non-human artifacts (consider the revolutionary effect of AI applied to educational contexts) are continuously interrelated;
- The approach to cultural materials, spaces and their design, artifacts, and the need to codify them in a practical sense;
- The ability to attract one's dimension made up of skills and inventiveness to training systems to be shared within communities of practice;
- The ability to adequately communicate cognitive achievements from the individual to the group and vice versa (Strati, 2007).

The so-called "Challenge Based Learning" model stands as an evolution and refinement of "Problem-Based Learning" - which we will discuss later - and has some interesting peculiarities capable of promoting an engaging organizational approach to the challenges that are intended to be faced.

The process is based on the organization of a series of tests which, starting from questions of a global/general nature, attempt to promote a series of activities addressed to real local issues.

The teacher provides information around an initially not well-defined problem, the students clarify and refine the substantial issues of the problem, define research hypotheses, deepen the topic using various materials on the topic, and develop a series of possible solutions to then identify the most reasonable one.

Access to technology is an integral part of the CBL which is divided as follows according to the scheme of Johnson (2009):

- general question/idea;
- essential questions;

- content challenge;
- guiding questions, guidance activities, and guidance resources;
- action/solution;
- assessment;
- publication of student-constructed examples/essays, publication of reflections/documentation of activities (Johnson et al., 2009, p. 8).

Project Based Learning has as its central elements some socio-constructivist principles: knowledge has strong situated and contextual foundations, students are actively involved in the learning process and can achieve their cognitive goals by sharing and actively disseminating their learnings. Also, this model, like the previous ones, has direct links with the Problem-Based Learning model, in fact, in both cases, the main objective is to reach operational conclusions through a collaborative process. The main difference between the two models is that while in problem-based learning students focus primarily on the learning process, PBL places particular emphasis on the end product (Kokotsaki et al., 2016). Five substantial characteristics appear as the main points on which Project Based Learning moves: 1. Centrality, 2. Guiding question, 3. Constructive investigations, 4. Autonomy and 5. Realism (Thomas, 2000).

As we have seen from the analysis of the previous models, the organized resolution of situations, problems, and structured questions to push towards evolved forms of resolution the subjective adaptive matrix plays an essential role.

This is the model called Problem-Based Learning (PBL), learning based on some questions, actions, needs, and emerging "trigger" problems of the case or scenario capable of defining one's learning objectives. Subsequently, space is left for individual study before returning to the student group to discuss and refine the knowledge gained (Wood, 2003).

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PBL tutorial process

Step 1—Identify and clarify unfamiliar terms presented in the scenario; scribe lists those that remain unexplained after discussion
Step 2—Define the problem or problems to be discussed; students may have different views on the issues, but all should be considered; scribe records a list of agreed problems
Step 3—"Brainstorming" session to discuss the problem(s), suggesting possible explanations on basis of prior knowledge; students draw on each other's knowledge and identify areas of incomplete knowledge; scribe records all discussion
Step 4—Review steps 2 and 3 and arrange explanations into tentative solutions; scribe organises the explanations and restructures if necessary
Step 5—Formulate learning objectives; group reaches consensus on the learning objectives; tutor ensures learning objectives are focused, achievable, comprehensive, and appropriate
Step 6—Private study (all students gather information related to each learning objective)
Step 7—Group shares results of private study (students identify their learning resources and share their results); tutor checks learning and may assess the group

Figure 1 Problem-Based Learning (Wood, 2003, p. 329)

Problems are based on real problems that have been selected and modified to meet educational goals and criteria. The structure of the Problem-Based Learning model makes use of elements that coincide with actual thematic blocks from which the processes of deconstruction and restructuring are initiated which contribute to the cognitive growth of individuals and groups.

One of the seven-level methods used at the University of Maastricht (De Graaf & Kolmos, 2003) structures the various phases as follows:

1. clarify concepts;
2. define the problem
3. analyze the problem
4. find the explanation;
5. formulate the learning objective
6. search for more information;
7. report and verify new information (De Graaf & Kolmos, 2003, p. 659).

The role of the so-called "Project Work", defined as a central organizational element around the discipline/subject, whose objectives must be satisfied within a defined educational program, appears to be central in the description of Problem-Based Learning.

The Project work, according to the level of focus, can be divided into "Task project", "Discipline project" and the "Problem project".

The Task Project is highly planned and is characterized by elements of support and guidance from the teacher with complex tasks to solve.

The Discipline Project is determined starting from the choice in advance, but not necessarily due, of disciplines and methods by the teacher (requirements of the study program). It is a question of defining the areas and disciplinary rules within which to direct and carry out the training action, without defining its operational characteristics in detail.

In the Problem Project, the action is not planned in detail by the teachers. It is the problem itself and its intrinsic difficulties that guide the choice of disciplines and methods. In other words, the group can work with very different disciplines and methods depending on the individual needs that may arise and above all on the solutions that emerge during the work itself (De Graaf & Kolmos, 2003).

PBL presents some unique challenges for all docimological aspects aimed at ensuring and capturing the quality of the educational process (Major et.al 2001).

The verification and evaluation processes are oriented towards the development of competencies and not only knowledge and skills (van Luijk & van der Vleuten, 2001; Yakhlef, 2010). However, this involves the use of a variety of docimological tools given the complexity of the domain of medical expertise to which it is addressed.

The difficulties identified in the PBL assessment phase in the university medical field are mainly related to the lack of homogeneity of the groups evaluated not all students follow the course at the same pace and with the expectation of taking the exam at the same time.

Some solutions, however, seem to meet the typical needs of a Problem-Based university teaching centered on the relationship presence/distance, although each particular PBL teaching environment is unique and therefore deserves its evaluation strategy.

Among these possibilities emerge some operational suggestions suggested by Major and Palmer (2001) and which we report here:

- External evaluation by experts;
- Project content analysis. In PBL each group of students may have slightly different goals and may research subject areas, so teachers may evaluate different tasks to see the variety of resources students are gathering. In this way, further skills such as research ability, critical analysis, or writing can be assessed;
- Discussion groups are aimed at reflecting and collecting data about their problem-solving experience within the group;
- Peer assessments;
- Diaries or activity logs. Since activities are often carried out outside formal groups, it can be difficult to record or monitor the processes that develop. This is why they are advised to methodically use a register of activities carried out along the way, to compare them with the final results;
- Personal reflections. such as developing critical thinking or research skills.

3. Methodological experiences

This work presents some methodological choices adopted for the realization of the course of "health information systems" by prof. Alessandro Pepino aimed at students of the master's degree course in biomedical engineering at the University of Naples Federico II.

The course, scheduled in the first year of the master's degree course, is part of a series of professionalizing courses for future biomedical engineers, the curricular structure combines the methodologies and technologies of Engineering applied to the problems of the life sciences.

The course was organized giving space to the extensive use of simulation tools which methodologically follows a consolidated trend of numerous technical courses (Breckwoldt et al., 2014).

Simulated learning environments are often used in the medical field to integrate and complete traditional teaching (Murray, 2008); this methodology makes it possible to create high-level training processes both by activating the simulation of "problem" situations to be solved mediated by software and by determining processes of systematic collaboration within the so-called communities of practice and learning (Wenger, 2006).

The innovative nature of the course prompted two main types of reflection:

1. the first related to digital teaching and simulation;
2. the second on the type of evaluation to be adopted.

In the case of digital "simulation" teaching, the relationship between realized experience and conceptual structuring becomes central to the learning processes activated. In this sense, the mediation between the simulation process with artifacts/didactic mediation/cognitive growth of the subject brings about a long series of transformations both in the learner and in the tools used, which are, in turn, "adjusted" based on the specific needs of those subjects and of that context (Rossi, 2016).

The same principle applies to the docimological choices made, such as the use of computer-mediated remote exam methods chosen on the occasion of the violent outbreak of the pandemic during the Academic Year. 2020/2021.

Two fundamental issues were considered: On the one hand, guaranteeing meaningful learning processes, on the other, the need for an assessment of objective learning objectives and not altered by consulting materials, notes, and online references during the exams themselves (Tamborra, 2021).

In this great reconstruction of the teaching-learning-evaluation processes, some solutions have been experimented with that are suitable for reducing the space between the growth process and the formative evaluation of the same.

The Moodle platform was used to structure the course which allowed both the creation of an "enriched" learning environment and valid and reliable assessment tools (Marchisio et al., 2021). Starting from May 2020, following the pandemic emergency, some exam methods were adopted and maintained even when the exams were returned to face-to-face. During the transition to face-to-face/remote modality, even when it was possible to take the exam remotely, students preferred to participate mainly face-to-face.

The “Healthcare Information Systems “ course consists of five sections:

1. Discrete event simulation for the analysis of healthcare organizational models
2. Network infrastructure services
3. Analysis and modeling of healthcare databases
4. Security and privacy
5. Accessibility and assistive technologies

Chapter 1, guides students to explore and analyze healthcare organizations through a discrete event simulation software system developed by Simul8. Students have at their disposal an educational license that allows them to create simulation models of healthcare organizational structures (ward management, outpatient clinics, analysis laboratory, etc.). This type of competence is essential for developing in a biomedical engineer the skills of analysis and synthesis of healthcare flows which are the basis of the implementation of information systems.

In chapter 2, the student, through the use of another simulation tool called Cisco Packet Tracer, acquires the knowledge and skills necessary for the sizing and configuration of the infrastructural services of both a local and a geographic network. based on the specifications obtained following the analysis.

In chapter 3 the student learns to analyze and create the conceptual model of a generic database, with practical exercises related to healthcare models. In this chapter, the student must also acquire the necessary skills to develop simple applications for data management.

In chapters 4 and 5, of a theoretical nature, the student addresses the fundamental issues for a biomedical engineer related to computer security, privacy, and accessibility of information systems.

The first three chapters, after a theoretical introduction, take place through a series of classroom exercises where the students, using their laptops, are guided in the creation of application objects that respond to the corresponding training needs: a model of simulation with Simul8, an IT configuration with Cisco Packet Tracer and a data entry application for a healthcare database. The next two chapters are developed through several hours of theoretical lessons, accompanied by videos and explanatory demonstrations.

All lessons, both theoretical and practical, are regularly recorded using desktop recording software that transforms everything that appears on the teacher's PC screen into video and audio with relative explanations.

This material is uploaded daily to the Moodle platform which supports the entire course; a virtual place used for the teaching-learning process, for evaluation, as a repository of teaching materials, and as a space for relationships and collaboration between course colleagues.

The platform is not an alternative to the traditional lesson, but a support and implementation tool for blended teaching.

In the Moodle course the digital objects and sections are classified as follows:

- "Link Url" object that allows the student to view the power points of the individual lessons uploaded to the Google Drive cloud platform, the supporting documents or the video recordings of the lessons, and the exercises uploaded to youtube;
- "Announcements" object that allows the teacher to send messages with any attachments to all students
- "Forum" object that allows each student to send messages with any attachments to the teacher. The messages of the students and the relative answers of the teacher are visible to all the students which allows them to quickly share and socialize on problems that have emerged and proposed solutions;
- "Task" object that allows the teacher to assign tasks to the students who in turn can reply with text messages with any attachments. Furthermore, the task object allows the teacher to formulate an opinion on each student based on the text and attachments received, however, it does not perform the function of final summative evaluation.

Once the lessons have been completed, based on the scheduled exam schedule, a specific task object is created for each exam session. Students who intend to take the exam will have to prepare three different exercises as homework:

1. a simulation model with Simul8;
2. a computer network diagram with Cisco Packet Tracer;
3. a model of management application through Caspio.

These three exercises will then have to be discussed during the exam, in the presence of the teacher, using their PC.

The three exercises will have to be carried out starting from an analysis document of a real organizational situation linked to a healthcare-type operating model. This document, which certifies and accurately describes the three exercises, must be proposed by the student using the task object related to the exam.

Two days before the exam session, the teacher examines the students' proposals and if he deems them correctly set, he assigns an assessment of sufficiency, otherwise, he gives the candidate the possibility to make adjustments based on the indications provided by the teacher again through the task object.

The candidate then has at least 24 hours to carry out the three exercises with complete autonomy based on a track that will be different from that of the other candidates.

During the exam, the candidate, using his PC, presents the three project documents to the teacher; the presentation of the three projects must only demonstrate consistency with the analysis presented through the platform. Subsequently, he holds an oral interview with the teacher on the two other parts of which the course is composed. For each of the individual parts (which have different weights about the relevance of the topic and the lesson hours of which they are composed) he receives a score out of thirty. The final result will be given by the sum of the five scores.

The exam method used allows the student to concentrate his/her study on the active structuring of skills rather than on the memorization of abstract concepts, with a completely personalized learning process. Furthermore, the entire design of the course, although delivered traditionally, also allows it to be easily managed in e-learning mode.

4. Conclusions and research hypotheses

From May 2020 to today, around 300 exams have been carried out, to verify the training outcomes of the structuring method of the entire course through qualitative and quantitative evidence, a feedback questionnaire has been prepared, the analysis of which we reserve the right to publish in a further work.

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