

AN E-COMPETENCE EVALUATION PORTAL FOR SOFTWARE ENGINEERING MASTER COURSE

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Abstract: Competence evaluation is essential for any educational institution who wants to establish and adopt a generally accepted common standard for identifying and quantifying their offered courses and the qualifications that their students acquire. Most of higher educational institutes (HES) have applied such evaluations for many years based on traditional approaches such as printed questionnaires. But the widely spread of internet; the trend to compare educational institutes at worldwide level and the competition among HES require novel approaches and tools for competence evaluation. This paper describes the functionalities and main characteristics of an Engineering Competence Evaluation Internet Portal (SECEIP). The portal provides to the students and professors an innovative research-based online tool, which facilitates the exchange of information on learning outcomes, referring to a graduate's knowledge, skills and e-CF competence upon completion their Master of Science in Software Engineering Program. It also includes unified metadata and service IT system for promoting the educational materials

Key words: E-competence evaluation, learning outcomes, educational portal.

1. INTRODUCTION

Over the last years the widespread usage of Internet and accessibility at educational resources; the new technologies and various accessing means have led to the creation of vast amount of open online educational environments. Such approaches require many resources along with setting-up the validation of the learning outcomes. There have been examined and proposed new concepts and methodologies towards the realization of e-participation of students and at the same time aiming to the integral combination of academic and industrial sector ([1, 2, 7, 8]). Nowadays, the classical academic practices are strongly challenged and students are in the centre

of attention, who have to actively and directly participate in evaluating their education. But, one of the main obstacles for the wide adoption of competence evaluation tools, is the reluctance of students to participate. This reluctance can be, partially, attributed to the, relatively, low penetration of technology among academic community and labor market. In addition to this reluctance, another drawback is the lack of common evaluating standards for higher education qualifications, which is needed for establishing a widely accepted method for measuring educational outcomes in generally and particularly to actual ICT jobs requirements.

Competence evaluations process aims to establish a common standard for higher education qualifications. Learning and teaching evaluation is essential in the competitive world of higher education, initially there were used quite simple approaches such as printed questionnaires. Now, there are introduced electronic competence evaluation procedures that have a number of advantages that merit consideration: a) it allows participants to evaluate their competences from their home at their ease and beyond privacy breaches, b) results are automatically archived in electronic format allowing fast further processing for the extraction of useful information, and c) it offers the possibility of using a unified metadata and service IT system for promoting the educational materials d) it makes key educational resources shareable, storable, findable and interoperable on a global scale.

This paper describes the designing, development, functionalities and the integrated environment of an Engineering Competence Evaluation Internet Portal (SECEIP), which is being developed within the project ISECRET. The Internet portal provides to the students and professors a research-based online tool that will support and facilitate the exchange of information on learning outcomes, referring to evaluate the graduates' knowledge, skills and e-CF competence upon completion their Master of Science in Software Engineering Program. It also includes unified metadata and advanced IT services to further investigate and promote education and learning process.

2. THE CORE OF SECEIP PORTAL

The SECEIP Portal is an integrated system, which provides students an innovative online methodology to evaluate their competences that they have acquired and the achieved learning outcomes. They are able to provide their feedback but firstly they have to prove their eligibility to participate in the evaluation process while, at the same time, it shares the graduate learning outcome definitions and their competences. SECEIP portal has already used at a small scale as a pilot system for proof standardising the evaluation of higher education qualifications and measuring competences in this novel e-Participation domain. Then, in the near future, the same methodology could be applied to the wide educational communities at all levels in Greece and other partners' countries. The proposed methodology would be the vehicle for managing data about academic learning outcomes (LOs) and e-CF compe-

tences in outcome-based learning e-Participation environment for the academic community; whereby any participant would be able to prove his competence to a specific learning outcome.

SECEIP portal is the main outcome of ISECRET project aiming to foster interchange and cooperation between education and training systems within the European Union. ISECRET reinforces and accelerates the process of innovation in HES by enhancing the universities' capabilities by granting better access to the educational know-how, investigating and setting an effective experimental framework for defining and measurement Educational Outcome for a specific Master Programme in Software Engineering & Software Technology at European level.

2.1. The Need of e-competence evaluation

Competence of a specific knowledge, skill or attitude is a critical asset for students, employees and businessmen. Building basic knowledge, skill or attitude on computer engineering on under graduating or after graduating educational curriculum and improving the quality as an engineer, is essential. It is also crucial to ensure, that the knowledge, skills or attitudes taught at an academic institution, are relevant, suitable and up-today for the industry and entrepreneurs. In addition to this, employees have to maintain, expand and further improve their skills during working life in a recognizable way by the labor market. As a result the adoption of an electronic competence evaluation system has various advantages:

- Makes more attractive the education and training programs;
- Provides a professional evaluation environment inside the education institutions;
- Provides online self-assessment system;
- Makes students more skilful to be able to meet the current needs and requirements of the labor market;
- Promotes lifelong learning;
- Helps students to effectively plan their careers and change their career objectives, if necessary;
- Introduces an effective experimental framework for defining and measuring Education (Learning) Outcomes;
- Boosts innovation in Higher Education by enhancing the universities' capabilities;
- Makes the educational resources sharable, storable, findable and interoperable on a global scale;
- Introduces competence evaluation applications;
- Enforces the members of educational institutions to describe, analyse and include the proper learning outcomes in their teaching and assessment procedures.

2.2. Towards Electronic Competence Evaluation

The clarification and definition of the concept of competence initiates with a short overview of the research field. Recently, there is a rapid evolution of the competence topic in science and its application as a powerful instrument for managing and developing human resources. Nowadays, definitions of competence are as manifold as their use in various contexts. A wide range of scientific papers deals with competence and its underlying concepts, as well as with the challenges of competence development, competence assessment, and competence management.

Berge introduces and describes competencies based on Pedagogical, social and managerial dimension [1]. Richey et al in [12] introduce a design and development of competencies and present their implementation. Authors in [4] and [16] present competence communication and its interaction. Klen et al in [7] give a more general perspective to communication properties of competence by including professional foundations like legislations and credibility. Shark in [13] tried to present a design for competence facilitation and evaluation. Smith in [14] presented competences based on course perspective. Many scientists work on the technologies and methods of adaptive learning (see [2, 3, 5, 6, 8-11, 15]). However, most of these approached do not focus on computer engineering domain and they do not present a unifying experimental framework for defining and measuring Education (Learning) Outcomes and providing an approach for self-assessment.

Here, we present a web portal, which includes services for learning outcomes information exchange and support between graduate students. The portal aims to examined the graduates' knowledge, skills and competence upon completion of the Master of Science Program in Software Engineering. The scope of the portal is two-fold: (i) to give a detailed description of a unified competency framework that is included in the Master of Science Programs in Software Engineering and (ii) to provide competency evaluation capabilities through an electronic competence evaluation system for educational institutions that determines the participants' competence in a specific knowledge while, at the same time, guarantees the reliability and validity of those evaluations.

Our point of view is that a competence evaluation system must help Educational administration and generally policy makers to define policies related to e-Skills development in education and in the work place. The European e-Competence Framework (e-CF) [18] provides a common, European framework to support organizations and training institutions in learning programs, competence needs analysis, assessment, and recruitment. Our proposed model uses the e-CF European Qualifications Framework in order to combine professional competences along with learning outcomes.

To achieve these goals, the portal presents to graduate students, the predefined specific set of learning outcomes and competencies for MSc program in Software Engineering attesting that the program provides the specific knowledge, skills and attitudes to the students. The set of competencies and learning outcomes are clearly

defined, measurable, and related to the knowledge, skills and attitudes needed for software engineers. The set of competencies correspond to a particular learning outcome. Moreover, in order to achieve as much as possible accuracy in the evaluated competencies of the participants, SECEIP portal defines in detail each competence and clearly links it to material covered in its assessments.

SECEIP has the ambition not just to train master students how they would fulfill the requirements to succeed in their exams. But at the same time to create their own learning schedule, learn independently and manage their own learning process. Students will log into the portal to prove the acquired knowledge, skills and attitudes. They are encouraged to give feedback with respect to usability and effectiveness of the competence evaluation portal, so that to gather information that will be useful for developers and will result in suitable adjustments of the competence evaluation system to meet their remarks and expectations. This opinion gathering is important for updating the SECEIP, receiving comments by the students/users because till now there was only available the feedback on a theoretical basis by the designers, developers and their peers and not by actual users.

Beyond the current usage of the portal as a competence evaluation system, our envision is for its broaden success, where any educational institute will be able to run their own online competence evaluation process. Thus, SECEIP is compatible and based on LMS Moodle educational databases ([17]).

3. THE SOFTWARE ENGINEERING E-COMPETENCE EVALUATION PORTAL

The most significant feature of the SECEIP is the incorporation of the procedures for evaluating the learning outcomes of MSc program in Software Engineering, being the heart the competency-based curriculum.

3.1. Main components of the portal

The architecture of the portal course evaluation system is consisted on the following main components:

- Link to the home page
- Template for a Joint Master Program
- e-CF competences decomposition template
- The Forum of the MSc Program
- Help links to users' manual, training course, and video on the use of the portal
- Two user-interfaces one for professors and one for students
- The core of Software Engineering Competence Evaluation application.

The portal architecture is consisted of various components that have different and complementary functionalities and roles. In the following, we will give a detailed description of the portal:

Home Page: This is the main informational web page. Through this web page, Users would navigate and be informed about the system's functionality and operation. It provides to the users the necessary links to other components of the system (e.g. Master Program Educational Outcome structure). Every time a user desires to interact with the system, the first action to take is to visit the url of the portal and then he can perform various actions (e.g. evaluate a competence, browse a study subject etc.). Home Page is accessible through <http://moodle.kic.teiep.gr> (see **Error! Reference source not found.**).



Figure 1. Home Page

Professors Interface: A professor could log into the portal and access the interface shown in **Error! Reference source not found.** in order to:

- Edit/Insert data in a specific Study Subject
- View a Study Subject
- Add Announcements
- Edit/View Rubrics
- Edit the contents on the evaluation area
- Insert/edit e-Competence
- Insert new academic competence

Graduate Student Interface: A graduate student could log into the portal and access the interface shown in **Error! Reference source not found.** in order to:

- View a Study Subject
- View Announcements
- View Rubrics
- Access the evaluation area
- Participate in self-evaluation of a selected academic or professional competence
- Submit evaluation

- View evaluation results
- View the set of professional and academic competence

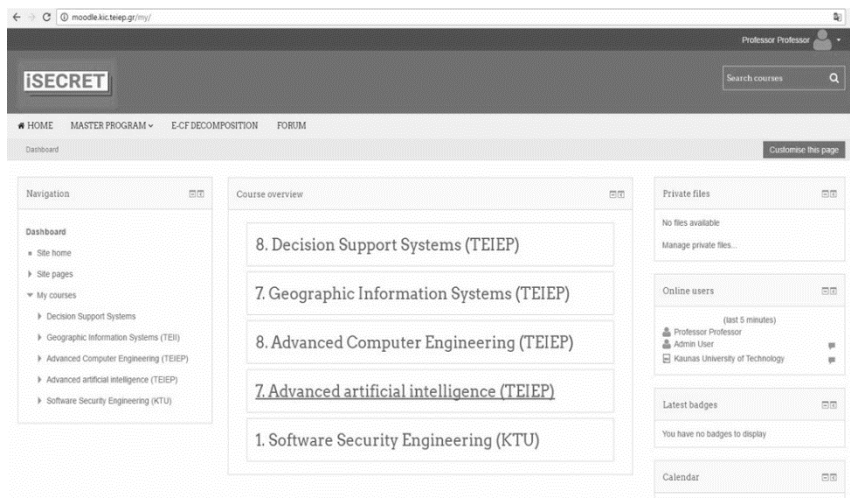


Figure 2. User Interface

Master Program: This component includes the index of all the provided study subjects and their links. Students are able to browse either part or all the provided study subjects through this web page. There are two categories of study subjects the Major study subjects and the specialized study subject (see **Error! Reference source not found.**)

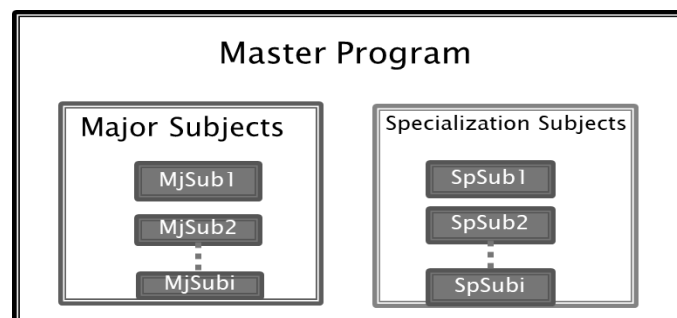


Figure 3. Master Program Study Subjects

3.1.1. Study Subject Components

Each Study Subject component consists of the following subcomponents:

1. *Study Subject's Description:* This component includes a detailed description for each study subject as shown in the master program template that introduces the structure of Master Program Educational Outcome.

2. *Announcements*: This component includes and presents all the uploaded announcements for the specific study subject.
3. *Learning Outcome*: This component describes the Learning Outcomes for each study subject of the Software Engineering / Software Technology (SE/ST) Master Program.
4. *Rubric Tables*: This component helps students to understand what actual learning outcomes have acquired by every specific study subject. Professors are responsible for constructing these tables. Each rubric table contains different normalized weight factor to each knowledge, skill and attitude that is included in decomposition table (see **Error! Reference source not found.**).

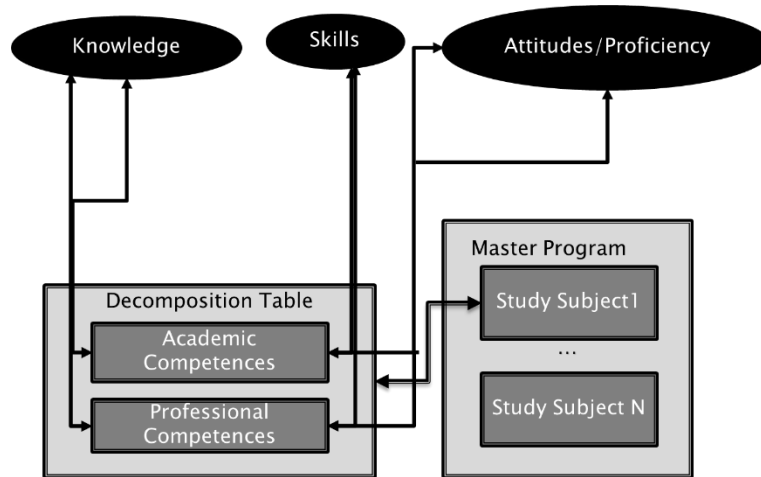


Figure 4. Rubric tables

5. *Evaluation of Study Subject's competences*: This component is responsible for the realization of a remote evaluation of competences in a study subject of the Software Engineering / Software Technology Master Program. It is mainly used for implementing the functionality of competences that are included in professional and academic competences.
6. *e-CF competence decomposition template*: This component presents the user's knowledge, skills and competence upon completion of a Master of Science Program in Software Engineering.

For each study subject professor is responsible for constructing a table that contains (see **Error! Reference source not found.**):

- A set of professional competencies
- A set of academic competencies

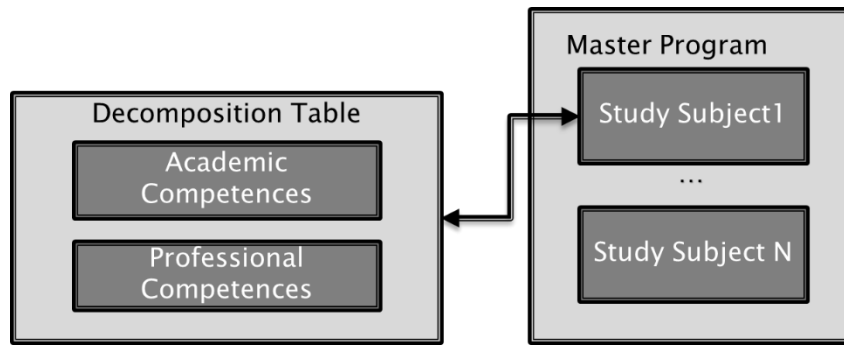


Figure 5. Competencies Decomposition

Master program can contain major and specialization subjects. Both types of subjects will have the same structure, however with more emphases on professional skills in specialization subjects. The professional competences must be described in terms of professional competence factors to show the general applicability of the subject. The academic competences are expected to be defined by the university to show the specifics of the subject.

The whole system is emerging by the decomposition and utilization of the European competence factors and an advanced suggested Rubrics scoring system to identify competence for: Knowledge, Skills and Attitudes/Proficiency (see **Error! Reference source not found.**). For each competence the weights should have the following property:

$$\sum_{i=1}^M w_i = 1,$$

where M is the total number of the defined set of Knowledge, Skills and Attitudes.

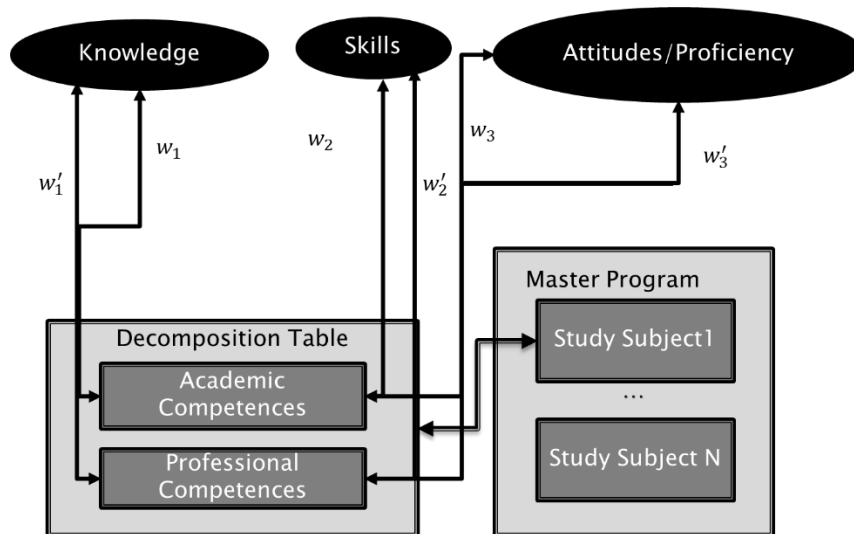


Figure 6. Rubrics Scoring System

3.1.2. Software Engineering Competence Evaluation Application

The main component of SECEIP is the Competence Evaluation module, a web-based application that implements the evaluation of the software engineering study procedure. The procedure is the following, a master student could select a study subject and run the competence evaluation procedure. Through the Learning Outcome link, he/she will see the list of the expected learning outcomes (knowledge/skill/attitudes) for the chosen Study Subject. When the obtaining competences phase has finished, then the master student is able to evaluate any chosen academic or professional competence. Whenever a student wants to evaluate a competence, he/she can access the Portal through his/her computer and complete the quizzes. After completing the evaluation, the student is informed about the evaluation result and his/her learning portfolio will be updated automatically.

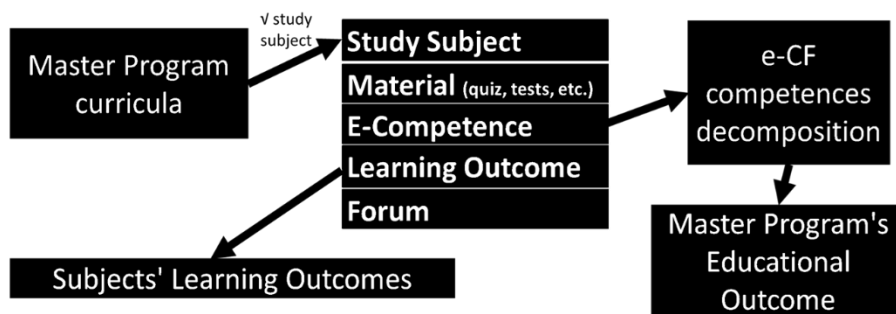


Figure 7. Competence Evaluation modules

4. BEYOND SECEIP

This paper describes the main characteristics and functionality of Software Engineering E-Competence Evaluation Portal (SECEIP) being useful for the students on one hand so that to better understand how to evaluate themselves and where they should concentrate on and to lectures on the other hand, who through SECEIP will be able to detect blind spots in their teaching methods and approaches by students' evaluations. One of our ambition is to extend the usage of SECEIP to a full-edged environment for supporting more academic areas and institutions. A challenge is to increase the flexibility of the system so that to integrate more efficiency in changing and expanding the list of Learning Outcomes and study subjects and promote it to the broaden European academic community. Moreover, our ongoing plans include the facilitation of usage and portal availability and proceed to the evaluation of portal's scope and usability by several other academic institutions. Another step is, to promote the use of this electronic competence evaluation environment by various academic institutions where master students could work on attaining their competence and carry out tasks as 'real employees'.

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