

## Developing Open Courses in Piraeus University of Applied Sciences

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### Abstract

According to various international reports the need for education in the 21st Century will be enormous not only because of the increase of the population but mainly due to the increasing demand for lifelong learning. Moreover, as we are moving from the industrial-based to information-based economy the requirements of our education systems must respond to this change. Towards this direction, there has been proposed a number of best practices like personalized learning, problem-based learning, inquiry-based learning, assessment for learning and so forth as methods that could drive the underlying educational change. The open courses and open educational resources paradigm is another hot trend that many countries around the world support as a mean for open and free education to each citizen thus contributing in making education more accessible, especially in societies where financial resources for the development of learning content is scarce. In this paper we present the development of the Open Courses Project in Piraeus University of Applied Sciences (PUAS), its unique characteristics and innovations as well as the first evaluation results after the three years of development. The project supported the development of about one hundred open courses which correspond to twenty five percent of the PUAS' courses while the engagement reached the forty two percent of the academic staff of PUAS.

**Keywords.** Open Courses, Open Educational Resources, Video Lectures, Multimedia Content.

### 1. Introduction

Open courses are probably the world's most prevalent trend in education as a result of an increased need for lifelong learning and training. Their characterization as "Open" is based on the notion of open and free education. A concept which, although is not a new conception, just in the past decade has gained the required international recognition by governments or non-profit institutions and organizations, trainers and trainees, due to the enormous diffusion of digital online courses.

Today, there are plenty of options available for both teachers and students to find high-quality open courses and/or open educational resources such as open textbooks (Hilton, 2016). In Greece, under the frame of Operational Program "Education and Life Long Learning" co-financed by Greece and European Union it has been developed more than 3500 open courses (Greek Academic Open Courses, 2016). Moreover, at the "Kallipos" action (Hellenic Academic Ebooks, 2016) which was aimed to the production and delivery of Open Access electronic books for the Greek Universities' students, there are more than 500 books and more than 700 of learning objects available.

The concept of open and free education includes practices and initiatives that broaden the traditional, formal learning and education that is offered by the formal education systems. It is consistent with the desire towards

the free distribution and acquisition of knowledge, the procurement of learning without temporal, demographic, geographic or economic barriers. They enable and allow course attendance regardless of the creation cost, the space and the time that education takes place, the level of knowledge of the learner, the number of people attending, the curriculum in which the course is probably integrated.

Open courses and open educational resources offer the learning content through free licenses, usually «creative commons», thus facilitating the use, the revision, the translation, the improvement and the sharing of content by anyone. In the name of Open Education it is an essential factor that cultivates the perception of participation in learning by forming a culture based on joint creation, sharing and collaboration and thus satisfying requirements that characterize the rapidly evolving technological societies. In this way they promote a culture that accelerates innovations in education as teachers benefit from the good practices of their colleagues. Moreover, they contribute in making education more accessible, especially in societies where financial resources for the development of learning content is scarce. The International Council for Open and Distance Learning (ICDE) points out that these new models for learning and teaching are equally important for both emerging and developed economies, "mature" societies that rely on knowledge (Mulder & Rikers, 2008).

However, as open courses and open educational resources (OER) in general are moved from theory into practice the discussion in the academic community regarding whether they contribute to knowledge development and improve the learning experience is a burning issue (Hilton, 2016). Although there are several studies examining the influence of OER on student learning outcomes with promising results there are certain gaps that need to be overcome in the future evaluation studies. In this paper we focus on the open courses project at Piraeus University of Applied Science (PUAS). In the next section we describe the developments and trends in the field of open on-line education and then we describe the development of open courses at PUAS. We present the innovative characteristics of the project and finally we present the initial evaluation results after the three years of development as well as some conclusions and future development.

## **2. Developments and trends in the field of Open on-line Education**

The inconceivable recognition of Open Courses worldwide has created fertile ground for a series of efforts and initiatives that mark the context of Open and Distance Learning Education. The distance learning made its appearance very early, with the first attempts to be recorded in the form of correspondence courses for stenography. The first official appearance was made in 1828 when the University of London offered the first curriculum of distance education that could lead to an official degree (Rothblatt, 1988). Later it took a new form in 1920 with the advent of new technologies in education where we have the creation of educational programs on radio and television and the emergence of the term online (Mohanty, 1984).

The Distance Learning was established with the institutionalization of Open Universities when the first Open University in the United Kingdom accepted its first students in the early 1970s, with the delay of a decade from the initial conception (McAndrew et al. 2009). The Open University of the United Kingdom was the precursor for the adoption of distance learning and the formation of Open Universities worldwide.

The development of the Internet in 1990 revolutionized and gave a new dynamic in the way we communicate and interact. It provided us with the ability to search and learn about almost anything. However, it took a decade of testing in order to use internet technologies widely in education. In 2000 the use of internet technologies had a substantial impact on the educational process, signaling a new era (Allen & Seaman,

2014). The infiltration of internet technologies and multimedia in education presents a wide range of applications ranging from Computer Based Training (CBT) to Recommendation Systems.

In 2001 the Technological University of Massachusetts (MIT) announced the free distribution of almost all of its courses on the Internet and introduced the term "Open Courses/Open CourseWare" (Materu 2004). A groundbreaking initiative which combined with a similar one made in 2002 by the university Carnegie Mellon, the "Open Learning Initiative", introduced the movement "Open CourseWare", that was later followed by internationally recognized universities such as Yale, the State University of UTAH, the University of Michigan and the Berkeley University of California. The "Open Learning Initiative" (OLI) of Carnegie Mellon is the university's commitment at the heart of which lies the research for human learning and development of technologies that incorporate what we call "Learning Science and Engineering". Also in 2002, United Nations Educational, Scientific and Cultural Organization (UNESCO) organized the first Global Forum on "Open Educational Resources" (OER), promoting the homonymous trend that aims at the sharing and free use of learning resources. The funding for the movements of "Open CourseWare" (OCW) and Open Educational Resources (OER) came from a private foundation, the Hewlett Foundation (Hewlett, 2013), which ranks among the four richest institutions in the US which through grants supports programs concerning many dimensions of human life as for example, education, environment, charity, etc.

In a similar initiative to the one of MIT for OpenCourseWare in 2006 the UK's Open University, founded "OpenLearn" recognizing the importance and highlighting a continuous trend for Open Education. In 2007 the International Council for Open and Distance Education (ICDE) emphasizes the "golden combination", i.e. the combination of open, flexible and distant education and "Open Educational Resources" (OER) to create mass educational opportunities in developing countries. A definition for "Open Educational Resources" by the Organization for Economic Cooperation and Development (OECD) is: "digitised materials offered freely and openly for educators, students and self-learners to use and reuse for teaching, learning and research" (OECD 2007). UNESCO and Commonwealth of Learning (COL) (2011) define Open Educational Resources (OER) as: "OER are teaching, learning and research materials in any medium that reside in the public domain and have been released under an open licence that permits access, use, repurposing, reuse and redistribution by others with no or limited restrictions" (Atkins, Brown & Hammond, 2007). Another definition for "Open Educational Resources" provided by the Hewlett Foundation for "Open Educational Resources" is the following: "OER are teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use and re-purposing by others. Open educational resources include full courses, course materials, modules, textbooks, streaming videos, tests, software, and any other tools, materials, or techniques used to support access to knowledge." (Hewlett, 2013).

In 2008 the "Cape Town Open Education Declaration" constitutes a movement that promotes the idea of cooperation and highlights the prospects of Open Education in all its dimensions without being limited to Open Educational Resources (OER). According to the Declaration: "We have an opportunity to dramatically improve the lives of hundreds of millions of people around the world through freely available, high-quality, locally relevant educational and learning opportunities. We move closer to a world of open, flexible and effective education for all." (Shuttleworth Foundation/Open Society Foundation, 2008).

The term "Massive Open Online Course" MOOC (Massive Online Open Course) was formally introduced in 2008 as a result of a course offered by the University of Prince Edward Island called "Connectivism and Connective Knowledge" (Hill 2012). Learners attended the course utilizing a range of collaborative tools weblogs (blogs), discussions in forums, meetings in the virtual worlds, etc. while the learning material was available exclusively with RSS feeds. Along with the formal introduction of the term we also have the

classification of MOOCs based on the pedagogical models that they reflect. The "xMoocs" are MOOCs which follow a content oriented model while the "cMOOCs" are MOOCs which have as basis the connectivism theory, a notion that argues that learning occurs as a result of participation and interaction within a community of professionals. The process of learning according to connectivism theory does not lead to predetermined results and it does not have specific learning content that can be transmitted to the learner (Moore and Kearsley, 2012). Analogous pedagogical approaches with those of MOOC that were developed in an attempt to simulate the traditional courses and at the same time to provide the learning process with flexibility are: SPOCs (Small Private Open Courses), the DOCCs (Distributed Open Collaborative Course) and the SOOCs (Social Online Open Course or Small Open Online Course).

In 2011 the European Association of Distance Teaching Universities (EADTU) recognizes the combined strength of the classic Open Universities and the "Digital openness". EADTU specifies the term "Open" in the digital world as free and online available courses highlighting four dimensions: the "Open Source" with respect to the Software (Open Source), the "Open Access" (Open Access) regarding their scientific results, the "Open Content" (Open Content) regarding the creative results and "Open Educational Resources" (Open Educational Resources) concerning the learning material (Mulder, F., 2011). The globalization and internationalization of education presented new market opportunities resulting in the foundation of non-profit organizations such as Edx, the Coursera, the Udacity, and so on (Yuan and Powell, 2013). In 2012, the collaboration of the universities of MIT and Harvard contributes to the establishment of Edx, an internet platform for MOOCs with the aim to massively, freely and without cost offer courses that cover a wide range of scientific disciplines. On the occasion of Edx, Google makes a committed to the development of OpenEdx, an open code version of Edx where universities and educational organizations will be able to supporting online education initiatives without having to install the system. The same year in a similar move, the UK's Open University creates the first MOOC platform with the name "FutureLearn" that has state-run character, involving 26 universities and also includes as partners the British Museum, the British Council and the British Library. Other examples of large MOOC providers whose status however is commercial are the Coursera, the Udemu, the Udacity, etc. These provide a range of paid-for services, including learning support on demand, qualitative feedback on assignments, and certification and formal recognition - credits (Yuan and Powell, 2013).

In 2013, the European Commission in collaboration with the EADTU creates the first pan-European initiative for MOOCs, by the name "OpenupED". Upon the establishment of OpenupED, the European Commission promoted the initiative entitled "Opening Up Education", which widens the previous interpretation of "Open Education", introducing a more student-centered character that frame the needs for lifelong education and training. The European Commission and the EADTU are trying to set a framework for "Open Education" that embraces a decentralized model which recognizes and strengthens the diversity and the identity of the Academic Institutes by allowing them to retain the primary reason in decision making for Open Education determining for example for the number and the topics of the courses that are going to be offered as Open (Mulder and Janssen, 2013).

Unavoidable, criticism came along with open courses and the mixing of formal and informal learning by elite educational institutions, in the form that their usage is nothing more than instruments to increase the profile of the institutions and attract more students. Indeed, while the notion of blending formal with informal learning sounds attractive for many elite educational institutions the inability to evaluate learning beyond the classroom feeds criticism and adds complexity to their attempts. The evaluation of informal learning that has been the focus of many researches over the years has proven to be fruitless in the attempt to establish a foundation to objectively and unbiased define learning outcomes and experiences out of the class.

The added value of Open Courses is not only that emphasize on Open, Flexible and Distance Education but in that it approaches learning in a way that satisfies the learners' needs and at the same time accommodates and adapts to their current situations. The large number of new pedagogies, theories and models for learning that are being introduced in the academic community reflects the numerous opportunities that are presented by Open Courses. The surface of those pedagogies and theories brought competencies to traditional educational systems related to cost, student engagement, graduation rates, and so on.

### 3. Developing Open Courses in Piraeus University of Applied Science

The Project "Open Academic Courses in Piraeus University of Applied Science" started in 2012 and completed in 2015 under the frame of Operational Program "Education and Life Long Learning" co-financed by Greece and European Union (European Social Fund). The aim of the project was the development and distribution of open digital educational material and the promotion of the asynchronous learning as reinforcing action of the conventional education provided by PUAS. The overall objectives of the project were:

- the acceleration of the rate of integration of the ICT in PUAS in order to upgrade its educational process based on international practices and standards,
- the promotion of open access and of the socio-educational role of PUAS to the public.
- the cultivation of a common culture as it concerns the use of these new opportunities by all teaching staff members,
- the creation of a suitable support mechanism for the sustainability of the action and its integration as a service within the existing structure of PUAS, and

the number of open courses developed in the project was ninety seven (97), a very high score if we consider that this number came from eight (8) departments as shown in Table 1.

Table 1. Distribution of open courses per department

Department	A-	A	A+	Total
Accounting and Finance	7	0	3	10
Automation Engineering	5	1	8	14
Business and Administration	11	0	5	16
Civil Engineering	6	0	5	11
Computer Systems Engineering	6	0	3	9
Electrical Engineering	6	0	0	6
Electronics Engineering	11	0	5	16
Mechanical Engineering	11	0	4	15
<b>TOTAL</b>	<b>63</b>	<b>1</b>	<b>33</b>	<b>97</b>

The columns "A-", "A" and "A+" denote the three different categories of the developed open courses and they are characterized according to the kind of the educational content that include. More specifically:

- the "A-" category provide the learner with course description and goals, keywords and glossary terms, educational material organized in course units, notes or/ and presentation slides, and bibliography,
- the "A" category in addition to "A-" provide podcasts that are synced to presentation slides,

- finally, the "A+" category in addition to "A" provide exercises and quizzes, digital resources and multimedia educational material."A+" courses are the only courses that include video lectures as part of the educational material.

### 3.1 Developing and Delivering Open Courses

The development process had to be carefully organized because the resources of the project were limited in relation to the goals set. We have organized the development process of an Open Course in an evolutionary life cycle that includes three general phases:(a) Authoring phase, (b) Assembling phase and (c) Publishing phase (see Figure 1). The outcome of the authoring phase was the production of a set of digital learning content in various formats such as SCORM, video files, slides, pdf files, and so on according to the requirements of the project. During the authoring phase the development team in collaboration with the responsible professors has followed an evolutionary cycle which included a series of steps in the following three axis: (1) collection and conversion into digital form of the material used by tutors in the didactic process (such as exercises, lecture notes, lecture slides, and so on), (2) development of new learning material, and (3) qualitative and quantitative amendment of existing content.

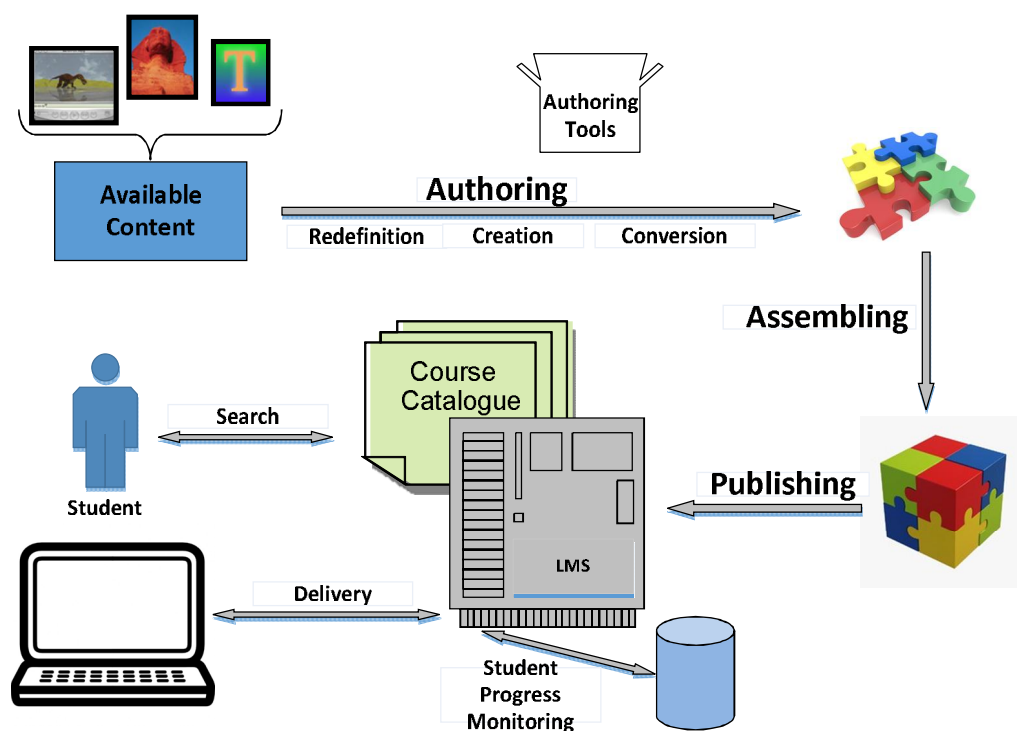


Figure 1. Developing and delivering open courses.

The most demanding task was the preparation of the multimedia material produced by video's recording of the lectures in classrooms. Such a task had to be prepared carefully by a specific team which had to be available at specific time periods in order to perform the recording and then another team had to perform the final editing in order to "clean" and improve the end product. The "cleaning" concerns all segments of a video that need cutting or improvement by appropriate montage. Moreover, the final video had to be synchronized with the slides and other material of the tutor as well as to be cut into smaller functional segments according to the underlying learning objectives.

The final videos were being uploaded to YouTube organized in playlists through the channel "Open Courses of TEI Piraeus" that was created for all open courses of PUAS. The delivery of the videotaped lectures to

students is achieved through the institutional e-learning platform with appropriate links along with the necessary metadata. The development team in order to meet the extremely high demands of the videotaped learning material purchased special software which was capable to perform live montage and synchronization of the trainer material (such as slides) with the live recording and presentation of the trainer himself. The underlying software saved valuable time which was used in the development of interactive multimedia learning content. The authoring process was supported by specific tools such as Wirecast (for live streaming and montage of the video lectures), Sony Vegas (for video editing) and Articulate Studio 2013 as well as Articulate Storyline (for the creation of interactive multimedia learning material).

During the assembling phase the development team was responsible - always in collaboration with the underlying professors - to assemble all digital learning content into appropriate learning objects and organize the learning objects in a structure that complies with an open course category ("A+", "A" or "A-") along with the necessary metadata. Moreover, at the end of this phase, the certification team was involved in order to test the compliance of the learning material to Project's standards. Any inconsistencies found by the certification team resulted in the return of the material to the development team and the teacher in charge to make the necessary changes.

Finally, the publishing phase includes the actual activation of the open course by giving access to all stakeholders such as teachers, tutors, and students. The IT team was responsible to provide the necessary access rights to everyone and parallel to provide support to all of them especially to teachers who were novice in the use of the LMS platform. PUAS developed two open source LMS platforms (a) Moodle and (b) Open eClass. Moodle is the official educational platform of PUAS and hosts both undergraduate and postgraduate courses of all curricula. These courses are only open to the members of PUAS who use a single sign-on service to access all services/applications of PUAS. The Open eClass platform hosts only the Open Courses of PUAS available for public access. In such a way, the teachers who were developing open courses and at the same time they were using learning material that have access rights only for their students didn't have to maintain different access rights to these groups (students of PUAS and other students or public) in one platform.

### 3.2 Project team organization

The "Open Courses" project's staff was organized in teams according to their responsibilities (see Figure 2). A dynamic model was followed which allowed for effective functionality and fast feedback.

The main responsibilities of the underlying teams involved in the project were:

- Administration team: included the project and technical manager. All sub-teams reported to project manager who had the responsibility of coordinating and monitoring the project's progress while technical manager had the responsibility of all technical issues related to the project.
- Video recording team: was responsible for design, direction and implementation of every live recording.
- Authoring team: The members of this team worked on the creation, conversion and development of the courses' digital material to various formats such as SCORM, video, pdf, and so on, using authoring tools (such as Articulate Storyline) following the Project's accessibility and design guidelines.
- IT team: The IT team was responsible for the installation, configuration and management of the necessary e-learning platforms (Moodle and Open e-Class) as well as the underlying authoring tools. Also, the IT team offered continuous support throughout the project to all users.
- Departmental coordinators team: The team was responsible for coordinating the communication between the Professors and the project's development team. Also, responsible for collecting extensive courses' metadata.

- Responsible professors: Professors were responsible to provide the necessary learning material, record their lectures or add narration to course slides (for "A+" and "A" courses), and organize the pedagogy and the content of the course.
- Certification Team: The certification team was responsible to check the content of each course in order to ensure that comply with the standards of the underlying category (A-, A or A+).

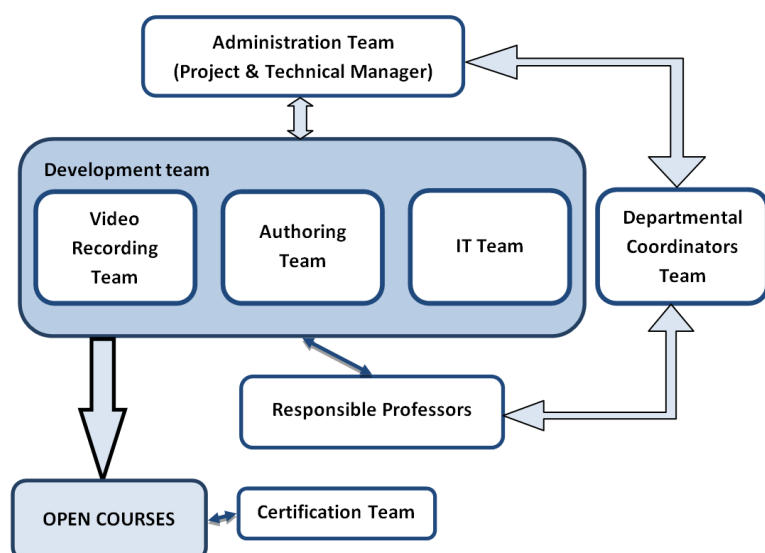


Figure 2. Organization of the project team.

### 3.3 Innovative Elements

The Project includes three innovative elements that are worth mentioning: (a) live streaming and montage, (b) interactive multimedia content and (b) the development of a learning analytics plugin ("Advanced Logs Plugin"). The Project had limited resources in order to meet the extremely high demands of video recording of lectures in amphitheaters and at the same time be able to develop interactive multimedia content for distance learning. The most demanding task was undoubtedly the video recording and editing of lectures and the synchronization of the live teaching with the slides and other learning material (e.g. a simulation software) of the instructor. For this purpose the Project created a special team for the recording of live lectures. The underlying team was responsible for the design, direction and implementation of every live recording in a way similar of a live television program. In such a way the end product don't require further processing except in isolated cases of a failure. The team used special software (Wirecast 5.0) which enabled direction, production and composition of multiple sources in a live streaming ready for live broadcasting (through a media server software) and recording (see Figure 3). Although the purpose of the Project was not the live broadcasting of every lecture this happened in isolated cases such as in workshops and special lectures. PUAS gained valuable experience from this initiative which allowed today the creation of a special service for live lecture broadcasting and recording.



Figure 3.Live Streaming and Montage.

The second innovative element was the development of interactive multimedia content for on-line web-based education. The Project used special authoring tools for rapid developments such as "Articulate Studio 09"® and "Articulate StoryLine"®. Because most teachers use learning material that is powerpoint-based (powerpoint slides) using Articulate Studio it was very effective for the development team to convert the static content of these slides into interactive multimedia content. Moreover, the underlying authoring tools include an extended library of templates related to various content types as for example process, media, timeline, drag and drop, and so on, which allowed the rapid development of interactive content (see pictures in Figure 4).



Figure 4.Developing interactive content.

The most advanced innovative element of the Project was the development of the "Advanced Logs Plugin". The process of obtaining feedback in e-learning courses constitutes a critical task not only during the implementation of the course (formative feedback) but also during its final assessment (summative feedback) and its redesign. The teachers need specialized tools that can provide smart reports about the use and the exploitation of the various educational resources and activities that the learning environment monitors. The development of the "Advanced Logs Plugin " was aimed to assist teachers in obtaining such valuable feedback from their students both during and after the completion of the e-learning course as well as to provide to the management of our Institution special indicators for the evaluation of the specific action in the enhancement of the educational process. The underlying plugin provides the ability to display for a particular course various usage statistics either by user or by group. In particular, the user-teacher can form a well focused statistical report regarding different types of learning activities and resources in specified time

periods. The statistics are equipped with suitable graphics helping further the teacher to monitor the course progress (see Figure 5 and Figure 6).

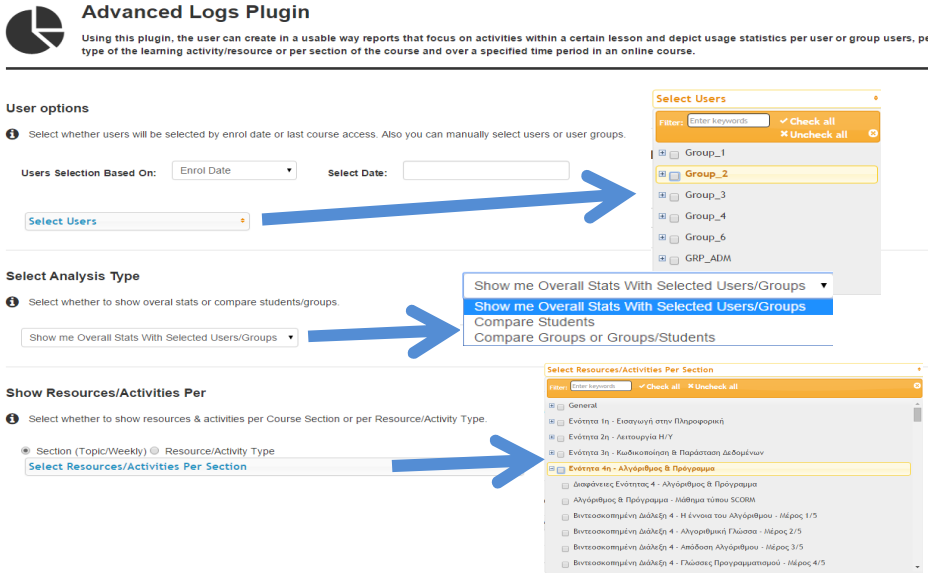


Figure 5. "Advanced Logs Plugin" main menu.

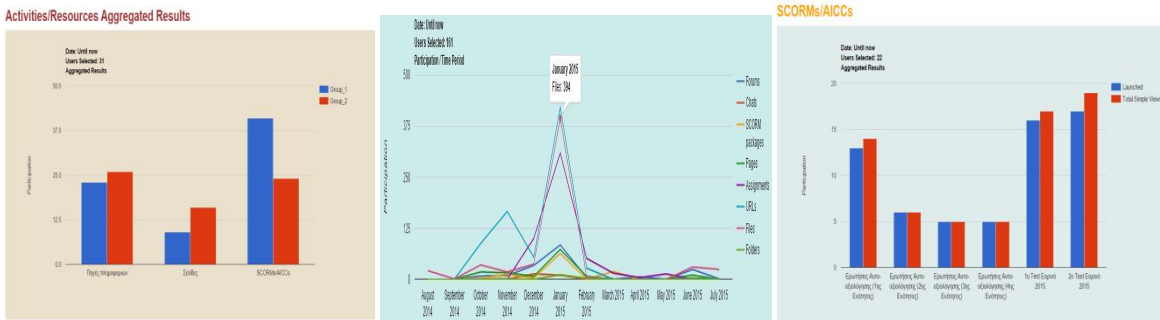


Figure 6. Statistics from "Advanced Logs Plugin".

#### 4. Evaluation and Conclusions

The e-learning platform of PUAS receives high traffic as well as high acceptance among the students. According to the usage statistics of the underlying log files of the platform from October 2012 till now we can see a high increase of unique users from approximately 900 users on October 2012 to 7.200 users within the examination period of June 2016 while at the same period the views reached to 241.000 from 13.000 (see Figure 7).



Figure 7. Usage Statistics of the e-learning platform.

Moreover, the Open Courses staff developed an on-line questionnaire in order to measure the usability and acceptance of the e-learning platform as well as the usage of the platform in relation to the different kinds of learning material included in open courses. The questionnaire was completed during the last month of Spring 2016 by 549 students (187 men, 362 women) and it was included both closed-ended and open-ended questions. The open-ended questions related to students' likes and dislikes and suggestions for improving the on-line material.

The general impression about the students' experience from the usage of the e-learning platform as well as the learning material included in the open courses was positive. The students didn't find any difficulty in using the e-learning platform and the environment was rated as user friendly. By analyzing the answers of students of both closed-end and open-ended questions as well as the log files of the platform we can summarize the following conclusions:

- The majority of students were satisfied with the content included in their lessons.
- All kinds of the learning material were used by the majority of students.
- The video lectures were very useful to students especially to those who were workers.
- The majority of students that didn't attend lectures in classroom were workers.
- The students seem to prefer more face to face communication. However, we have to check this preference in relation to the tutors (for example, if the tutors were raised enough questions for discussion and if they were answered frequently to student queries).
- The students prefer the lack of restrictions in time and place in terms of studying the learning material.

Some characteristic answers of students related to the usefulness of the recorded video lectures were:

- "As I am a worker the recorded video lectures were a major aid to successfully attend the module!"
- "I had to attend modules which had live lectures at the same time and this capability was awesome!"
- "I lost some lectures and it was very useful that I had the opportunity to attend them online at my own pace"
- "I watch the on-line videotaped lectures in order to deepen more in the subject matter as well as to fill some gaps of the subject matter of the lesson"
- "When I study in my own pace I concentrate more on the subject matter."

Other characteristic answers of students related to the question on what they liked more on the open courses were:

- "Rich content in every section of the lesson!"

- "For me the self-assessment exercises helped me at most in understanding the subject matter."
- "The laboratory exercises and the self-assessment test were a motivation for me to continuously check the level of understanding of the topics of the lesson."
- "The well-organized material into sections with a variety of resources such as multimedia, video, and self-assessment exercises made easy the comprehension of the topic."
- "I could have practice at any time and in any place."
- "I wish I had the same material to all my courses!"

The development of the Open Courses Project had had multiple benefits to PUAS. In general, we can summarize the following benefits:

- Upon the completion of the Project about twenty five percent of the PUAS' courses include organized content in digital multimedia form that completely covers the whole content of the courses;
- The Project succeeded to engage about the forty two percent of the academic staff (teachers) of PUAS;
- PUAS has gained considerable experience and expertise in tools and methods of use of technology to improve the educational process;
- PUAS has developed new innovative services integrated with the existing ones (live lecture broadcasting and recording, development of interactive multimedia content using rapid development authoring tools) that improve the educational process;
- The almost one hundred open courses which are free to the public emerges even more the socio-educational role of PUAS as well as the underlying educational work carried out.

The initial evaluation results of the Open Courses Project in Piraeus University of Applied Sciences after the three years of development were very encouraging. Today, there are plenty of open educational resources in various forms such as courses, textbooks, videos, journal articles, and so on that are usually available online (typically with a Creative Commons license) and they can be used, reused, and adapted to satisfy the needs of both teachers and students (Johnstone 2005; Bissell 2009; D'Antoni 2009; Hewlett 2013). We believe that this paradigm needs sophisticated and well-focused evaluation studies in order to identify the impact and effectiveness on learning in relation to students' preferences in order to help the future development. In the near future, we design an extended evaluation study for the open courses developed at PUAS in order to analyze the students' preferences in relation to three essential dimensions: (1) the quality of the learning resources included in open courses, (2) the behavior of students in the learning environment by using the "Advanced Logs Plugin" developed in the Project, and (3) the performance of students i.e. their achievements in the underlying courses. Such an approach will provide significant feedback for the redesign process of the open courses and it can be an important tool for the development and improvement of the various online open educational resources.

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