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# DESIGNING AND IMPLEMENTING A BIG OPEN ONLINE COURSE BY USING A 3D VIRTUAL IMMERSIVE ENVIRONMENT – LESSONS LEARNED

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## Abstract

Open Education (OE) is a distance learning approach that was strategically chosen by the European Commission (EC) to encourage cost-effective training, upskilling and reskilling of large population groups and workforce with speed and flexibility. Institutions and businesses design and offer Open Online Courses (OOCs) to address skill gaps, organizational and societal needs. OOCs and especially Massive OOCs (MOOCs) are suffering from high rates of attrition, which is attributed to various factors such as learner isolation and lack of motivation to complete the course. Recommendations to address the retention gap in MOOCs include adopting a participation-driven approach, using game design techniques in the courses' pedagogical design and supplementing the predominant asynchronous learning paradigm in MOOCs with synchronous learning activities and virtual meetings.

The University of Patras (South Greece) organized an innovative, motivation-enhanced Big Open Online Course (BOOC), the first of its kind in Greece, with title "Open Workshop on Information Literacy". During the course, over three hundred (300) participants acquired information literacy skills using available open learning environments and the three-dimensional virtual immersive learning environment Second Life. In this paper, the authors describe the instructional approach based on Problem-Focused Education (PFE) and Game-Based Learning (GBL), the participants' results and the course outcomes, and the necessary pre-requisites for successful outcomes. Further, the participants' feedback, evaluation outcomes and lessons learned are discussed.

In summary, the participants achieved their set learning goals, experienced a community of practice atmosphere and appreciated the variety of active learning modes. The open publication mode of most learning activities facilitated social agency that lead to additional motivation. Finally, the course demonstrated that the effective use of virtual immersive learning environments for rich, synchronous learning, both formal and informal, can enhance OOCs.

Keywords: E-Learning, Virtual Immersive Environments, Open Education, MOOC, Second Life, Gamification, Problem-based Learning (PBL), Problem-Focused Education (PFE), Game-Based Learning (GBL)

## 1 INTRODUCTION

Open Education (OE) is a learning approach that emerged from the need for open access and distance mode learning that was initially provided by Open Universities. Recently Open and Distance Education (ODL) aspired some of the values and culture of Free/Libre Open Source Software (FLOSS) [1] to facilitate the access of all to education and social learning. Initially the movement for openness in education was focused on content, namely Open Educational Resources (OER) [2] and Open Courseware [3]. Next, the attention was shifted to Open Educational Practices (OEP), such as Open Access (OA) to research results and/or publications and the Open Online Courses (OOCs), educational programmes that are mostly free and accessible for all via the Internet. Especially after 2011 one evidences the emergence of Massive Open Online Courses (MOOCs) as the means to help thousands of people all over the world learn online. Notably, universities, organizations and business companies design and offer OOCs to address skill gaps and organizational and societal needs while policy makers encourage the adoption of OE and MOOCs. For instance, the European Commission chose OE as an official strategy to encourage rapid, flexible, cost-effective training, upskilling and reskilling of large population groups and workforce [4] [5].

Currently MOOCs are considered as the vehicle of training innovation and as a de facto efficient channel for dissemination of educational content. As a result, more MOOCs are being produced and offered by an increasing number of providers and attract millions of enrolments [6]. However, MOOCs are suffering from extremely high drop-out rates [7], [8], a phenomenon which is attributed to various factors such as *low quality of instructional design*, *learner isolation* and *lack of motivation* to complete the courses [9]. This is a phenomenon with serious implications for learners and MOOCs providers as it affects the learners' lives negatively and impacts the business model of MOOC providers, to mention but a few stakeholders. Already, major MOOC providers are transforming "common", free MOOCs into courses with entrance fees or limit the access to courses to "view-only" [10]. Failure to the sustainability challenge of Open Education could mean a significant backlash in the development of the learning subject fields.

Recommendations to address the retention gap in MOOCs include adopting a participation-driven approach [11], using game design techniques in the courses' pedagogical design for the enhancement of participants motivation [12] and supplementing the predominant asynchronous learning paradigm in MOOCs with synchronous learning activities and virtual meetings [13].

In this paper the authors will describe how they designed and organized an OOC for a higher education institution implementing among others the three above-mentioned advanced pedagogical approaches to overcome the pitfalls of OOCs and achieve a high quality learning experience. Next we present the design and results of a research study.

## **2 LEARNING DESIGN**

The staff and collaborators of the Library & Information Center of the University of Patras, Peloponnese (South Greece), designed and implemented the Open Online Course "Open Workshop on Information Literacy" (OWIL). This was a collaboration project with other interested in the delivery results parties. The OWIL course emphasised the focus on learning outcomes and active hands-on learning. It was the first Big Open Online Course (BOOC) that was organized in Greece [14]. That is, the "Big" means less than 500 participants, while the "Massive" means hundreds, thousands, tens of thousands and more participants [15]. The OWIL course was designed by the following three approaches:

### **2.1 Socio-constructivism for Deep Learning**

Humans are socially curious beings. Humans' learning is considered to occur mostly within and through social interaction with others. Thus, learning is considered as a cultural and social process. It occurs in the context of human relationships and activities rather than just in the minds of individual learners. Hence the socio-cultural context affects what is learned and how people learned. Deep learning emphasizes more durable learning than surface learning. That is, a learner using deep learning approaches attempts to understand the learning content and process. Deep learning can lead to transformation of current understanding rather than confirming it. However, excessive workload and cognitive overload can put a learner in a position to choose a surface learning approach in order to survive. Nonetheless, deep learning occurs when students are actively involved in the learning process and are given opportunities to construct meaning [16]. In so doing, they should be able to transform the course's concepts to personal (learning) experiences. This also suggests a competence-based design approach [17].

### **2.2 Motivational Design through Game-Based Learning (GBL)**

Motivation is one of the most important aspects of learning. There is no, however, general agreement about the nature of motivation. One framework emphasises that motivation is determined by environmental conditions while another framework emphasises that the learners control motivation through active self-regulation strategies. The third way has been presented by social cognitive theory by asserting that the level of motivation is a result of the interaction between the learner and environment. Motivation enhancement strategies [18] are essential to engage participants in active learning experiences. Strategies such as Game-based learning (GBL) and Gamification [19] have been applied in education [20] and e-learning [21] with various degrees of success. There is a great deal of commonality between the characteristics of games and the characteristics of effective learning experiences such as challenging, goals, outcomes, interaction, exploration and safe environment. Yet, the aspect of competition might shift the focus from learning to winning, which might not be motivating for some learners. In the OWIL course we utilized playful design in 3d Virtual Immersive Environments

(3d VIEs) with the purpose to create a friendly, playful and inviting atmosphere for learning. 3d VIEs can enable rich social interactions empowered by the role of the digital self [22] for formal and informal learning leading to the creation of virtual communities of practice [23].

### **2.3 Problem-Focused Education in E-learning**

Problem-based learning (PBL) is a form of active learning that supports the idea of learning from problems with collaborative ways. It first became popular during the 1960s as a response to the mainstream approach of content-transmitting teaching practices [24]. Organizing learning around real-life problems and problem finding and resolving activities and processes has apparent value and interest for vocational training and adult education. One promising variation of PBL [25] is problem-focused education (PFE) [26]. While PBL focuses on skills and employability, PFE adopts a wider and more flexible view by stressing manifold thinking (critical, creative, caring and reflective thinking) and wisdom [27]. That is, the focus is more on the problems of living rather than the problems of knowledge. PBL has successfully been used in Higher Education through the assistance of 3d Virtual Immersive Environments [28].

### **2.4 Designing the Open Online Course**

The scope of the OOC was to create a learning experience, tailor-made on the needs of advanced academic library users, including postgraduate students, doctoral candidates and researchers. The course was designed with two fundamental objectives in mind: a) to encourage participants to acquire useful knowledge and skills for their academic evolution and professional career, and b) to provide authentic, enjoyable and effective learning through the effective use of e-learning technology.

Embracing an open attitude, the workshop's curriculum was designed after detecting and analysing the learning needs of the target audience. The learning needs detection was carried out through an online questionnaire and by selective unstructured interviews. The course's modular scheme included the following five modules (learning units): Research Innovation & Creativity; Information Literacy; Research Methodology; Authoring, Publishing & Presentation of Scientific Papers; Professional Career Development.

In OWIL we used a blended learning approach combining asynchronous and synchronous e-learning activities. For the asynchronous part we used an open and collaborative learning web-based environment, a wiki. Again, the choice of an open environment over a traditional "closed" learning management system was deliberate to stress the democratic character of the course, since the course instructors and participants had equal rights to modify the course pages and create content. In the wiki unit leaders uploaded all resources and learning materials and the participants posted openly their individual and group assignments.

OWIL also featured one weekly 2-hours synchronous, online meeting that took place in the 3d VIE platform Second Life. The 3d VIE was selected over 2d platforms owing to its enhanced capabilities for playful learning techniques. Each session took place in a suitable environment that facilitated the character of the module i.e. with the use of metaphors. For example the Research Methodology module took place in the steampunk lab of a virtual renaissance castle. There participants had the capability to communicate via multiple channels: chat, instant messaging), voice and virtual kinesthetic communication (avatar movement, clothing, gestures etc.) The sessions were also broadcasted simultaneously live over the web using streaming technologies so as to accommodate users with mobile devices. Each session was organized on the premises of problem-focused education. It featured a series short 10-minute individual and group learning activities based on real-life problems to engage participants. The activities were based on prepared questions of comprehension of the educational material as well as short case studies. The weekly meetings were recorded and made available later in the wiki. For the management of the OOC and the support of participants, we used a blog and a Facebook page as communication channels. Prior to the beginning of the course, we organized training sessions to help participants and faculty to use the platforms effectively.



Figure 1. Playful group activity in OWIL's virtual steampunk lab

The course was voluntary, open for anyone interested. It had a duration of 18 weeks, and it was delivered with the synergy of collaborators and faculty from the University and other institutions such as the University of London, the University of Helsinki and the University of Washington. Each of the six sequential modules had a duration of 4-6 weeks without breaks apart from public holidays and exam periods. The order of the modules followed the life of a research project; inception of an idea – literature study – research – authoring – presentation – professional development. In order to complete successfully the Open Workshop each participant had to produce assignments or create artifacts related to the learning outcomes of each session and module. The assignments were posted openly in the wiki. Participants were encouraged to comment on their peers' assignments, post questions and share resources. The participants that completed the course successfully received a certificate of attendance and completion from the university.

### 3 RESEARCH METHODOLOGY

The purposes of this mixed methods research [29] were i) to identify if academic community members would be interested in participating in Distance Education and Open Online Courses, which are not a mainstream learning option in Greek higher education at the moment, and ii) to understand about the effect of motivation enhancement in open education. For this there was a need for designing and implementing a course of 18 weeks duration: "Open Workshop on Information Literacy" (OWIL). The course was delivered twice during the subsequent academic years and we called them as OWIL I and OWIL II. A rather long course could probably demonstrate the potential drop out rate of the course. The high rate of drop out is considered as one of the main negative trends in MOOCs. For this reason, our additional aim was to understand the ways of helping to sustain the course participants' engagement for achieving their learning goals. That is, capturing their level of satisfaction from the course and its components. Thus, we could subsequently evaluate the effectiveness of the employed instructional method and its pedagogical potential. More specifically we aimed at answering the following research questions:

RQ1. Can a motivation-enhanced environment in an Open Online Course have a positive impact on completion rates?

RQ2. Can a motivation-enhanced environment in an Open Online Course have a positive impact on the quality of learning?

The hypothesis for RQ1 is that a playful, relaxed learning environment, friendly atmosphere and communication will help to maintain the interest of students throughout the course. Similarly, we assumed that the same approach will motivate the students positively for learning more and better.

The majority of the participants in this study were female (60%). Concerning their level of education, postgraduate (31%) was the predominant category followed closely by Phd candidates (26,2%) and undergraduates (14,3%). As far as age is concerned, the two main categories were 25-34 years (66,7%) and 35-44 (19%). Participants were from 23 departments of the University of Patras. The strongest representation came from the departments of Chemistry (6 participants), Primary Education, Mathematics and Biology each with 4 participants.

We used a sequential strategy for data collection/fact finding. First, we collected data through an online questionnaire, which was designed by one of the authors. It consisted of 56 question items organized in three sections: The overall evaluation of the participants' experience, assessment of the impact of the used methods, and participants' demographics. We used predominantly closed, five-level Likert scale questions such as what is your degree of agreement with the following statement: I acquired new knowledge?, What is your degree of satisfaction with the following aspect: Asynchronous E-learning (wiki)?. Participants (N=73) completed anonymously and voluntarily the online questionnaire; 25 in OWIL I and 48 in OWIL II. The results were analyzed statistically [30]. Second, two to three weeks after the course's completion, we collected data by using semi-structured interviews. One of the authors interviewed 27 course participants either in person or over the phone; 8 interviewees were from OWIL I and 19 from OWIL II. Each interview lasted around 10 minutes and it was held in the author's office room. During the interview notes were taken. The interview focused on participants' views and experiences about the design and implementation of the course, their learning and performance, notable incidents, and suggestions for improvement. All the 27 interviews were done in 2 weeks. The results were further processed utilising content analysis' techniques. All interviews were held in Greek and the questionnaire was written in Greek language. The translation into English was carried out by one of the authors.

## 4 RESULTS

### 4.1 Survey results

The survey generated an ordinal dataset that was analysed using non-parametric statistics [29]. For each question item we calculated the median, the mode, the interquartile range (IQR) and the variation ratio. The median and the mode are expressions of the central tendency of data while IQR and variation ratio measure the dispersion of responses. Also, for the final interpretation of the responses we clustered similar question items to solidify and test their consistency.

The participation and completion rates appear in Table 1.

*Table 1. OWIL participation and completion rate*

	Participants (Admitted)	Participants (Completed)	Completion rate
OWIL I	92	30	32,61%
OWIL II	219	71	32,42%
Total	311	101	32,48%

The completion rate of both iterations of the OOC remained steady and significantly higher than average MOOC success rates that according to various reports fluctuates below or slightly over 10% [30].

*Table 2. OWIL learning impact*

	Median	Mode	IQR	Variation Ratio
Q3.1 I liked it	4	4	1	0,57

Q3.2 I acquired new knowledge	3	3, 4	2	0,77
Q3.3 I acquired new skills	4	5	2	0,68
Q3.4 I will apply what I've learned	4	4	2	0,61
Q3.5 I found the course useful	5	5	1	0,70
Q3.6 I would recommend the course to my friends	5	5	1	0,71

Table 3. Overall satisfaction with OWIL components

	Median	Mode	IQR	Variation Ratio
Q8 Open Workshop Overall Quality	4	4	1	0,46
Q6 (aggr.) Open Workshop Sessions Quality	4	4	1	0,45
Q7 (aggr.) Teaching Quality	4	4	1	0,49

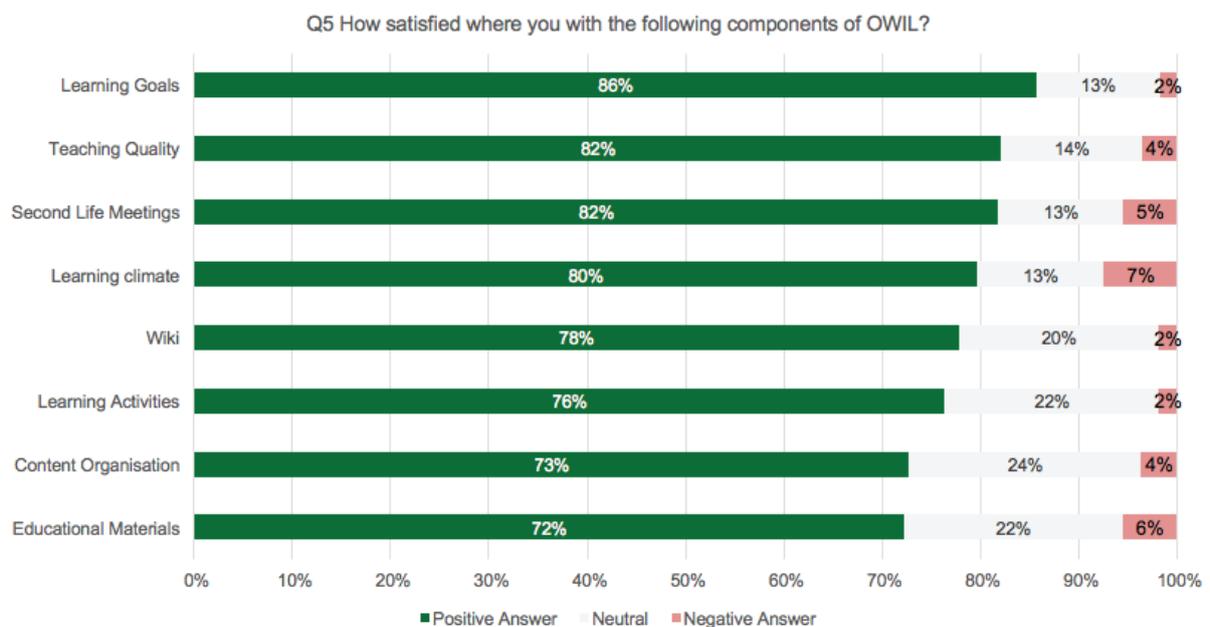


Figure 2. Satisfaction level of participants with OWIL components

High overall satisfaction with the course design and delivery was shown in Tables 2, 3 and Fig. 2. The quality of the course, of teaching and sessions (table 3) was graded as very good. More impressive are the self-assessment results (table 2) reporting the acquisition of new skills and the willingness to apply them in practice. The strong fluctuation in Q3.2 can be attributed to the following factors, as qualitative comments in interviews suggested: weak curriculum focus on theoretical data, high degree of participant heterogeneity and high level of participants especially in OWIL I. (OWIL II: Mdn=4, IQR=2, VR=0,70). More importantly, the fact that over 80% of the responding participants expressed very high satisfaction with all factors that are associated with the synchronous component of the course (Second Life meetings, teaching quality, and learning climate) support the hypothesis for RQ2.

Another notable side product of OWIL was the significant impact of its resources for informal learning. The open nature of the course led to the production of a significant number of open educational resources (OER). The quality of the digital content and its free access resulted in remarkable dissemination and popularity on the Internet, beyond the boundaries of the University of Patras and of

the course. More specifically, the presentation files of the course attracted a number of visits that was twice the size of the total university students' population within 6 months of the end of the course.

## 4.2 Interview results

The interviews were further processed by content analysis' techniques deployment. The participants' responses were grouped into four predefined categories, which are shown in Table 4.

Table 4. Predefined interview categories

Technology / technical	Design / Organization	Teaching / Learning	Other
8	6	15	2

Concerning technology/technical issues, participants mentioned difficulties they faced related to either the platforms used or their equipment and Internet access.

*I found Second Life difficult to use at first but delightful later, especially modifying and moving my avatar and flying! (P9)*

*My computer was too slow to run Second Life but I was able to watch the live stream and participate via chat (P17)*

Concerning design/organization issues participants appreciated the playful approach and the open nature of the course and confirmed the acquisition of new skills.

*I enjoyed the weekly meetings, they were informative and fun even though I couldn't always attend. The video recordings were very helpful. (P2)*

*Being able to stop at times when I was busy and catch-up helped me continue with the course. (P11)*

Concerning teaching/learning issues, the participants raised many different points of view. First, the participants' experiences about the group work and its quality vary a lot.

*One complaint I have is that two team members didn't join us in time for the group assignment so me and another girl had to do almost all the work. (P21)*

*I had great conversations with my team members with different studies than mine. (P10)*

*I appreciated the enthusiasm of everyone in the course, professors, and participants. (P5)*

Apparently, the modules that emphasized group work led to higher engagement and satisfaction with peer learning. In contrast, there were cases where group members were not committed to their role and participation and this led to frustration of the remaining, active members and to the potential dysfunction of the team.

Second, the participants realized that they were introduced to a plethora of new tools.

*Posting my assignments openly so that everyone could see them pushed me to spend more time to produce something of high standard. (P15)*

Third, the participants raised the request for more study materials.

*Study materials were ok but I wanted more to learn about statistical analysis methods with SPSS. (P18)*

In summary, regarding RQ1, the course achieved sustainable high completion rate, comparable to empirical evidence from a MOOC with a different motivation-enhancement method [31], demonstrating that the novel pedagogical model deployed with motivation enhancement methods was able to address and overcome common pitfalls of MOOCs, such as anonymity, learner isolation and lack of feedback. Thus, we can deduce that the hypothesis is confirmed. Regarding RQ2, participants achieved their learning goals, experienced the working atmosphere of a virtual community of academic practice. They appreciated the variety of active learning modes and acquired new skills for virtual team work. The open publication mode of most learning activities facilitated social agency that led to additional motivation. Finally, the course demonstrated that the effective use of virtual immersive learning environments for rich, synchronous learning, both formal and informal, can enhance OOCs. Therefore, the hypothesis for RQ2 was also confirmed.

The potential explanations for the high completion rate and for achieving the learning goals could be: i) the OWIL course was long enough and ii) it was held in the participants' mother tongue; iii) the use of virtual reality brought a sense of newness, iv) emphatic engagement through role-playing and v) the course met the participants' initial expectations.

## **5 LESSONS LEARNED, RELATED WORK AND CONCLUSIONS**

Although there are several proposals to integrate games and gamification structure or elements into MOOCs [32]–[34], so far there is little empirical evidence to assess their effectiveness [35]. One MOOC that used serious games achieved higher than average completion rates of 31% [31]. OWIL provided an opportunity to derive valuable lessons for open online courses' design and implementation. First, 3d VIEs are instrumental for the creation of a warm, motivating learning atmosphere and the facilitation of informal learning. In the virtual space each participant had an individual and representative presence, thus breaking the anonymous, distant, isolated feeling of participants in MOOCs. Therein teachers and organizers appeared as "equals", they did not have –visible- privileges over course participants; sometimes tech-savvy participants often assisted the instructors. Additionally, the pervasive character of the environment, the fact that they could enter, leave and move in the virtual space created and enhanced the sense of agency.

Second, synchronous activities in the 3d VIE Second Life supplement well courses with social constructivist emphasis on active learning and creation of content. Meetings became quickly the weekly reminder of the course and meeting point of fellows. It also offered a chance to solve any questions related to the course with the organizers, an informal office hour. The playful design of the course; surprises, virtual gifts, games, change of meeting locations, virtual excursions and other elements of playful design helped to maintain an academically defined space that was relaxed and warm with a friendly community atmosphere. 3d VLE enhanced the live participants' interactions and user experiences beyond the standard classroom experience, through the availability of multiple communication channels such as voice, private voice sessions, public and private chat, movement, apparel and gestures of the avatar.

The interdisciplinary composition of the team of educators and participants was an unprecedented experience for all the involved parties. This resulted in the cross-fertilization of the collective learning process through the creative exchange of experiences, views, knowledge and competences.

The current trend of combining fun and learning emphasizes the production of entertaining learning materials and activities. However, this might increase the learners' expectations that learning must be always fun and enjoyable. That is, learners might equate learning so strongly with fun and enjoyment that if they feel that they are not enjoying themselves, they are not learning. Thus learners might be developing a new attitude toward learning at the expense of content and process while emphasizing fun and enjoyment.

New technologies to assist the learning process have constantly been sought by researchers. Virtual reality has been identified as one of them. Virtual reality is a unique computerized technology which may be of great value since the physical counterpart may be unavailable, too dangerous, or too expensive. That is, it can overcome the traditional limitations of learning-by-doing. It offers a truly new way to engage learners and provides unique experiences which are consistent with successful pedagogical strategies. However, virtual reality might be expensive to produce, and access and accessibility might not be guaranteed; the latter bring obstacles in the full use of virtual reality and MOOCs in education.

## **6 LIMITATIONS AND DIRECTIONS FOR FUTURE STUDY**

To some extent, the highly noticeable satisfaction level of the participants could be attributed to the opportunity alone to learn and study for free and from distance, a new experience for most of them. They, in turn, would be satisfied with the given chance regardless of shortcomings in some areas of delivery. Additionally, this pedagogical model was applied in a smaller scale of a BOOC instead of a MOOC with thousands or tens of thousands participants. Another important potentially limiting factor could be the longer (compared to average) duration of the course and its modules. Safer conclusions about the effect of the applied pedagogical approach could be deduced by comparing the results of two simultaneous iterations of an OOC with audiences of comparable characteristics: one standard (control group) versus another iteration gamified/playful interventions. Other problematic aspects of MOOCs that influence the participants and might intervene in their motivation (enhancement) should

also be researched; such issues are the reasons for giving up the courses and modules and the attendance rates.

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## REFERENCES

- [1] E. S. Raymond, *The Cathedral & the Bazaar: Musings on Linux and Open Source by an Accidental Revolutionary*. O'Reilly Media, 2001.
- [2] OECD, *Giving Knowledge for Free: The Emergence of Open Educational Resources*. OECD Publishing, 2007.
- [3] C. Vest, "Why MIT Decided to Give Away All Its Course Materials via the Internet.," *Chron. High. Educ.*, vol. 50, no. 21, pp. B20--B21, 2004.
- [4] E. Commission, "Report on web skills survey. Support services to foster Web Talent in Europe by encouraging the use of MOOCs focused on web talent." 2014.
- [5] European Commission, "Commission launches 'Opening up Education' to boost innovation and digital skills in schools and universities," 2013. [Online]. Available: [http://europa.eu/rapid/press-release\\_IP-13-859\\_en.htm](http://europa.eu/rapid/press-release_IP-13-859_en.htm). [Accessed: 29-Apr-2017].
- [6] "Massive study on MOOCs," *Harvard Gazette*, 2015. [Online]. Available: <http://news.harvard.edu/gazette/story/2015/04/massive-study-on-moocs/>. [Accessed: 15-May-2017].
- [7] K. Jordan, "Initial trends in enrolment and completion of massive open online courses," *Int. Rev. Res. Open Distance Learn.*, vol. 15, no. 1, pp. 133--160, 2014.
- [8] C. Parr, "Mooc completion rates 'below 7%,'" *Times Higher Education*, 2013. [Online]. Available: <http://www.timeshighereducation.co.uk/news/mooc-completion-rates-below-7/2003710.article>.
- [9] A. Margaryan, M. Bianco, and A. Littlejohn, "Instructional Quality of Massive Open Online Courses (MOOCs)," *Comput. Educ.*, vol. 80, pp. 77--83, Aug. 2014.
- [10] EdSurge, "Coursera to Charge Fees for Previously Free Courses," 2016. [Online]. Available: <https://www.edsurge.com/news/2016-01-25-coursera-to-charge-fees-for-previously-free-courses>.
- [11] J. Ross, C. Sinclair, J. Knox, and H. Macleod, "Teacher Experiences and Academic Identity: The Missing Components of MOOC Pedagogy," *J. Online Learn. Teach.*, vol. 10, no. 1, pp. 57--69, 2014.
- [12] S. Mystakidis and C. Herodotou, "Addressing the Retention Gap in MOOCs: Towards a Motivational Framework for MOOCs Instructional Design," in *16th Biennial EARLI Conference for Research on Learning and Instruction*, 2015.
- [13] S. Mystakidis and E. Berki, "Participative Design of qMOOCs with Deep Learning and 3d Virtual Immersive Environments: The case of MOOCAGora," in *Can MOOCs save Europe's unemployed youth? Workshop. ECTEL 2014 Conference, Graz, Austria*, 2014.
- [14] S. Mystakidis and G. Tsakonas, "Innovative Information Literacy Blended Open Elearning Course in Virtual Worlds," in *21st Pan-Hellenic Conference of Academic Libraries*, 2012.
- [15] Edutech Wiki, "MOOC," 2017. [Online]. Available: <http://edutechwiki.unige.ch/en/MOOC>. [Accessed: 30-Apr-2017].
- [16] V. B. Weigel, *Deep learning for a digital age: technology's untapped potential to enrich higher education*. 2002.
- [17] L. Guàrdia, M. Maina, and A. Sangrà, "MOOC Design Principles. A Pedagogical Approach from

the Learner's Perspective," *eLearning Pap.*, vol. 33, pp. 1–6, 2013.

- [18] J. J. Williams, D. Paunesku, B. Haley, and J. Sohl-Dickstein, "Measurably Increasing Motivation in MOOCs," in *Proceedings of the 1st Workshop on Massive Open Online Courses at the 16th Annual Conference on Artificial Intelligence in Education*, 2013.
- [19] S. Deterding, D. Dixon, R. Khaled, and L. E. Nacke, "From Game Design Elements to Gamefulness: Defining 'Gamification,'" in *MindTrek'11*, 2011.
- [20] K. M. Kapp, *The Gamification of Learning and Instruction*. Pfeiffer, 2012.
- [21] Y. An and C. Bonk, "Finding that SPECIAL PLACE: Designing Digital Game-Based Learning Environments," *TechTrends*, vol. 53, no. 3, p. 43, 2009.
- [22] N. Yee and J. Bailenson, "The proteus effect: The effect of transformed self-representation on behavior," *Hum. Commun. Res.*, vol. 33, pp. 271–290, 2007.
- [23] E. Wenger-Trayner, "Intro to communities of practice," *Wenger-Trayner*. 2013.
- [24] M. Savin-Baden *et al.*, "An evaluation of implementing problem-based learning scenarios in an immersive virtual world," *International Journal of Medical Education*, vol. 2. pp. 116–124, 2011.
- [25] D. Margetson, "Can all education be problem-based; can it afford not to be?," in *Problem-Based Learning Forum*, 2001.
- [26] J. Valtanen, E. Berki, E. Georgiadou, M. Ross, and G. Staples, "Problem-Focused Higher Education for Shaping the Knowledge Society," *Int. J. Hum. Cap. Inf. Technol. Prof.*, vol. 2, no. 4, pp. 23–37, 2011.
- [27] J. Valtanen, E. Berki, and E. Georgiadou, "Problem-focused higher education for shaping the knowledge society," *Int. J. Hum. Cap. Inf. Technol. Prof.*, vol. 2, no. 4, pp. 23–37, 2011.
- [28] C. Beaumont, M. Savin-Baden, E. Conradi, and T. Poulton, "Evaluating a Second Life Problem-Based Learning (PBL) demonstrator project: what can we learn?," *Interact. Learn. Environ.*, vol. 22, no. 1, pp. 125–141, Feb. 2012.
- [29] A. Strauss and J. Corbin, *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*, vol. 3. 2008.
- [30] K. Jordan, "Massive open online course completion rates revisited: Assessment, length and attrition," *Int. Rev. Res. Open Distrib. Learn. Vol 16, No 3*, Jun. 2015.
- [31] M. Thirouard, O. Bernaert, L. Dhorne, S. Bianchi, and L. Pidol, "Learning by doing: Integrating a serious game in a MOOC to promote new skills," in *Proceedings of the European MOOC Stakeholder Summit 2015*, 2015.
- [32] S. Mystakidis and C. Herodotou, "OpenQuest: Designing a Motivational Framework for MOOCs Instruction," in *MOOCs in Europe*, 2016, pp. 141–145.
- [33] O. B. Gené, M. Martínez Nuñez, and Á. F. Blanco, "Gamification in MOOC: challenges, opportunities and proposals for advancing MOOC model," in *TEEM '14 Proceedings of the Second International Conference on Technological Ecosystems for Enhancing Multiculturality*, 2014, pp. 215–220.
- [34] M. Freire, A. del Blanco, and B. Fernandez-Manjon, "Serious games as edX MOOC activities," in *2014 IEEE Global Engineering Education Conference (EDUCON)*, 2014, pp. 867–871.
- [35] M. Romero and M. Usart, "Serious Games Integration in an Entrepreneurship Massive Online Open Course (MOOC)," in *Serious Games Development and Applications SE - 21*, vol. 8101, M. Ma, M. Oliveira, S. Petersen, and J. Hauge, Eds. Springer Berlin Heidelberg, 2013, pp. 212–225.