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A Process for Self-Training of Engineering Educators Using e-Learning*

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This article proposes an e-learning process for engineering educators involving a self-training approach. To develop the process, the researchers considered a set of entries to allow enrolled educators to engage in and successfully complete a training program without a lead instructor using an e-learning platform. In addition, the proposed process establishes a set of outputs that are the expected results and achievements that educators would be expected to obtain. In this study, educators play a double role: self-tutors and learners. As a case study, a Massive Open Online Course (MOOC) is used as a self-training program; the topic of the program is web accessibility. The use of this MOOC was proposed to a group of engineering educators. The case study shows how engineering educators can contribute to learning in society about web accessibility and its benefit to people, especially people with disabilities. Finally, the researchers present the advantages of using the proposed e-learning process, as well as its limitations.

Keywords: e-learning; self-training; engineering education; educators; higher education; web accessibility; MOOC

1. Introduction

Currently, educators who continuously train themselves using e-learning methodologies may be the key to successfully facing the challenges of guiding students to develop professional competences to allow them to enter the labour market [1]. There are many reasons why e-learning approaches work particularly well for engineering educators. For example, they allow them to: (a) be up to date with technology, (b) learn new concepts and theories, and (c) mix with practitioners and academics outside their own higher education institutions (HEIs). Furthermore, engineering educators usually must engage in a certain number of hours of training per academic year as a mandatory requisite in their HEIs. For this, self-training with an e-learning method is a good alternative to traditional approaches. The option of using e-learning methods is proposed because engineering educators usually do not have a great deal of time available, and their limited economic resources mean that they cannot cover the cost of traditional face-to-face courses, especially in developing countries [2].

Engineering educators who use e-learning methods for self-training can also learn new teaching-learning practices, which in turn will allow them to improve the quality of their own teaching. In addition, e-learning enables educators to access technical resources from anywhere at any time. Access to resources that complement the educators' level of knowledge and interest is fundamental to improving their knowledge and obtaining an overall satisfaction in terms of the learning experience [3]. When implementing an e-learning method, it is suggested that e-learning platforms be used because their programs provide access to updated information with regard to the subject being studied.

Because an e-learning method is a good choice for engineering educators within HEIs as mentioned in the previous paragraphs, this study proposes a new method of self-training with the use of a specific Massive Open Online Course (MOOC) study program for educators. To obtain an appropriate method, the researchers came up with a logical way for developing the relationship among the requirements, self-training and results. Consequently, an Input-Process-Output (IPO) model was used in order to offer a comprehensive process [4–6].

2. Analysis of the state of the art

Several researchers have published work on e-learning, but no so many have dealt with self-training approaches for educators. In general, researchers propose approaches that include the guidance of a tutor while the e-learning program is being executed. In the process proposed in this work, the learner also assumes the role of self-tutor, guiding and taking full responsibility for their learning.

For example, Mukherjee and Nath [7] present a study of the trends and technologies used in e-learning methodologies. These authors define e-learning as a wide set of applications and processes

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which use all available electronic media to deliver education and training. These authors explain that e-learning can be used as a complement for traditional methods of education, and as a self-learning mode of continuing education. These authors state that instructor-led training is still the most commonly used mode, and that certain types of training will always be more effective face-to-face. However, these authors consider that the advantages of self-directed, just-in-time learning, along with a better understanding of how people learn online, will lead to a growth in the use of e-learning as a cost-effective, flexible training option. These authors describe the self-training method as a personalized learning approach that puts the learners in control, allowing them to select content as needed, and to create their own learning path. Finally, these authors recommend this option for mature learners since, in this approach, learners should have choices as to how they prefer to learn, and they should be able to choose mediums that suit their learning style and pace. In summary, the learner organizes their own learning.

Oddone [8] states that self-training groups are meant to manage their own learning, in terms of both content and process. That is, an individual involved in self-training should be free to decide which learning content to use and which learning process to apply, according to their particular training needs.

Tam et al. [9] present a localized, self-training program for older adults on mindfulness, to make it more widely available to interested learners who would otherwise not be able to access traditional face-to-face classroom training due to various constraints. These authors present a localized self-training program in DVD format. It was adapted from a standard mindfulness program to suit older adults by having a shorter training duration and simplified guiding instructions. These authors explain that the regular instructor-led training program should be relatively short, and provide, as an example, a successful experience where the original instructor-led program was reduced from two weeks to four days. The development of the material was guided by input from mindfulness experts and refined after usability tests. During the two-week intervention, the experimental group practiced mindfulness exercises following the guided DVD program for about 20 minutes per day, five days per week, while the active control group watched an educational video series in a center. At baseline, there were no significant differences between the experimental and the active control groups. After the training, the home-based participants with a higher educational level generally outperformed the center-based participants.

Kim et al. [10] develop and evaluate a mobile-based virtual reality self-training program for social anxiety. These authors worked with a group of 22 patients and a control group. The patients took eight self-training sessions for a period of two weeks. The patients were assessed using the Liebowitz Social Anxiety Scale (LSAS) before and after the training. The LSAS scores decreased in both groups after the training, showing that in this experiment, self-training was at least as efficient as traditional training. The patients at home could operate the mobile-based virtual reality program without any help. Therefore, it was truly a self-training approach.

Vestergaard et al. [11] conduct a prospective controlled trial with a group of 29 individuals who participated in a self-training effort on a pediatric basic life support technique directed to nurses. In this study, the researchers compared with a 2-hour instructor-led face-to-face training course. Two weeks after the training, all the participants were tested. Self-training proved to be not statistically different to instructor-led training in this case study.

Sanchez-Gordon and Luján-Mora [12] propose the use of MOOCs and Open Educational Resources (OERs) for training purposes in corporate settings. These authors define an ecosystem for the lifecycle of training. The combination of MOOCs and OERs is also feasible for the context of HEIs and for the self-training of engineering educators.

Navarrete, Luján-Mora and Peñafiel [13] analyse the use of OERs in e-learning for higher education. These authors explain that for e-learning instruction it is necessary to take into account, not only the technology, but also pedagogical and instructional issues, to configure a complete learning environment.

Sanchez-Gordon and Luján-Mora [14] analyse the use of MOOC in higher education in developing countries. These authors perform a Strengths, Weaknesses, Opportunities and Threats Analysis, and propose a set of strategies with regard to implementing MOOCs.

According to Khalil and Ebner [15], the MOOC dropout rate is around 95% since users enrol based on interest in the topic but with different goals. Students want to know about the course and the kind of resources it offers. Another important factor when it comes to enrolling on the course is curiosity. Curiosity causes students to enrol in the MOOC even without having the appropriate knowledge to allow them to finish it.

Sanchez-Gordon, Calle-Jimenez and Luján-Mora [16] analyse the use of MOOCs in four cases related to public sector training. They also present strategies to address three major challenges: enrolment, completion and web accessibility.

Davis et al. [17] explain that training in the use of e-learning methods is necessary because some educators lack the necessary skills for using information and communication technologies. In addition, the e-learning approach helps to minimize the stress associated with enrolling in a new endeavour, as opposed to face-to-face settings. These authors stress the importance of launching advertising campaigns for the online courses to attract the attention of potential students. The important thing is to learn how to get the most out of such an approach and at the lowest possible cost. The channels can be national and local institution communication systems, social networks, mass media, and human development departments. The summary is in Table 1.

3. Analysis of the engineering educators' needs

This analysis was carried out in the form of a case study at the Escuela Politécnica Nacional of Ecuador, a public higher education institution recognized nationwide for its teaching in engineering. An online survey was sent to the educators of the Department of Informatics and Computer Science, who would be potentially interested in engaging in a self-training program for this case study. From a population of 43 educators, 24 (56%) educators answered the survey. The survey had eleven questions using a Likert scale [18], plus a final open question for suggestions. Table 2 details the answers.

In general, the respondents correspond to a group that has already taken courses online (86%), therefore the information that the researchers obtained from them is relevant as a function of their experience.

According to the results obtained, 78% of the respondents would be willing to take a course of up to 5 hours per week while 79% would prefer a course of up to 4 weeks duration. This will be important when it comes to planning the process that the researchers want to propose.

As far as incentives are concerned, offering a certificate endorsed by the participants' institution was the option with the highest acceptance, additionally zero cost or one under $40.00, and the use of Spanish would be the other motivations for participation in an online course.

As for devices to access the course, laptops with 52% and PCs with 44% of the responses were the devices with the greatest acceptance, regardless of the access location. Finally, with regard to the self-learning process, 64% of the respondents would be willing to make use of this type of training modality. In the open question, there were suggestions as to the mechanism of assessment in order to obtain the certificate.

4. Analysis of the e-learning management platforms

E-learning platforms are spaces of learning and distance communication developed in such a way as to use Information and Communications Technologies and the Internet. These platforms have e-learning training modules that enable learners to carry out courses and engage in activities in terms of their own planning and availability.

The contents of e-learning platforms are available 24 hours a day, so that each learner can access them according to their own time availability and location. The learners who use e-learning platforms usually have a predisposition for learning, and believe in online training and collaborative work. The contents have the property of benefitting from immediate updating [19]. Generally, learners have a guiding tutor who is a partner in their own learning. There are different kinds of e-learning platforms, which could be summarized as follows [20]:

- Content Management System (CMS), focused mainly on the management and administration of websites with content type web pages.
- Learning Management System (LMS), designed

Table 1. Summary of state of the art

References	Contexts	Contribution
[7] [8] [12]	Trends and technologies	Self-training is recommended for mature learners. Relationship between teachers' use of technology, and self-efficacy. The combination of MOOCs and OERs is feasible for the self-training of engineering educators.
[9] [13] [17]	Approaches	Development of center-based self-training program. Include pedagogical and instructional design in a complete learning environment. Training in the use of e-learning methods is necessary to develop learners' skills.
[10] [11] [14] [15] [16]	Outcomes	In an experiment with a control group, self-training was as efficient as traditional training. Self-training proved to be not statistically different to instructor-led training. A SWOT analysis and strategies for implementing MOOCs. MOOC dropout rate is around 95%. Three major challenges: enrolment, completion and web accessibility.

Table 2. Results of the survey of the educators' needs

	Description	Scale	Results (%)
Q.1	Have you followed an online course?	Yes	86%
		No	14%
		Total	**100%**
Q.2	If your answer was yes, how many online courses have you followed?	1–2 courses	25%
		3–4 courses	20%
		5–6 courses	25%
		7–8 courses	5%
		>8 courses	25%
		Total	**100%**
Q.3	How many hours per week would you be willing to dedicate to an online course?	1–3 hours	30%
		1–5 hours	48%
		1–8 hours	9%
		1–10 hours	9%
		>10 hours	4%
		Total	**100%**
Q.4	How many weeks would you be willing to dedicate to an online course?	1–2 weeks	22%
		1–4 weeks	57%
		1–6 weeks	0%
		1–8 weeks	17%
		> 8 weeks	4%
		Total	**100%**
Q.5	What would be the incentive that motivates you to take the course?	Know about the topic	35%
		Recognition of hours	13%
		Certificate endorsed by the institution	48%
		Other	4%
		Total	**100%**
Q.6	Would you be willing to pay for the course? How much would you be willing to pay?	$0.0	22%
		$1.0-$20.9	8%
		$21.0-$40.9	35%
		$41.0-$61.0	22%
		>$61.0	13%
		Total	**100%**
Q.7	What language would you prefer for the course?	Spanish	68%
		English	32%
		Total	**100%**
Q.8	What would be the most usual equipment that you would use to follow this course?	Smartphone	0%
		Tablet	4%
		Laptop	52%
		PC	44%
		Total	**100%**
Q.9	What would be the most usual connection site for access to the course?	Office	22%
		Home	35%
		When you have time independent of the site	43%
		Total	**100%**
Q.10	Would you be interested in participating in courses with this type of learning mode?	Yes	64%
		No	36%
		Total	**100%**

primarily for on-line training tasks, although these platforms cannot automatically generate training content.

- Learning Content Management System (LCMS), which allows the creation and management of the contents of an LMS. It is the integration of the two previous types. It is like having a CMS inside an LMS.

In this study, an LCMS is used. Specifically, the platform used is Udemy. It includes [21]:

- Management and administration of authors, giving appropriate permissions to upload and download content.
- Management of courses to carry out activities, assessment, and registration of user activities.

- Management of communication tools, both synchronous and asynchronous, internal e-mail, forums, blogs, wikis, bulletin boards and announcements. In this way, the training activity is enriched with a multitude of communicative possibilities.
- Contents are incorporated as training materials to be carried out by the learner.

One of the main characteristics of an e-learning platform is the degree of interaction that makes it possible for the learners to feel that they can master their own teaching-learning process. In addition, the Udemy programs could be accessible to non-native speakers. For example, videos can have subtitles in different languages and can have supporting documents such as video transcripts.

Finally, to ensure the stability, efficient resource use, and sustainability of an e-learning platform, in [22] recommends the use of cloud computing as an infrastructure, which provides computation and storage resources as services.

5. Proposed process

One of the goals for the implementation of the proposed process is to increase engagement in learning for educators on specific topics. The proposed process uses the logic of the IPO model to help design, evaluate and refine the self-training process, and to correct any implementation flaws [4–6]. This e-learning process for the self-training of educators includes three sets of inputs, processes and expected outputs, as shown in Fig. 1.

The inputs were obtained from analysis of the state of the art, analysis of the engineering educators' needs and analysis of the characteristics of e-learning platforms. The inputs are of paramount importance to the educator who adopt the roles of both self-tutor and learner, both of which have specific activities that the educator should be aware of. Educators will start their self-training motivated to engage with a topic that is of interest for them. The educators go through the process in order to achieve the desired learning outcomes. The

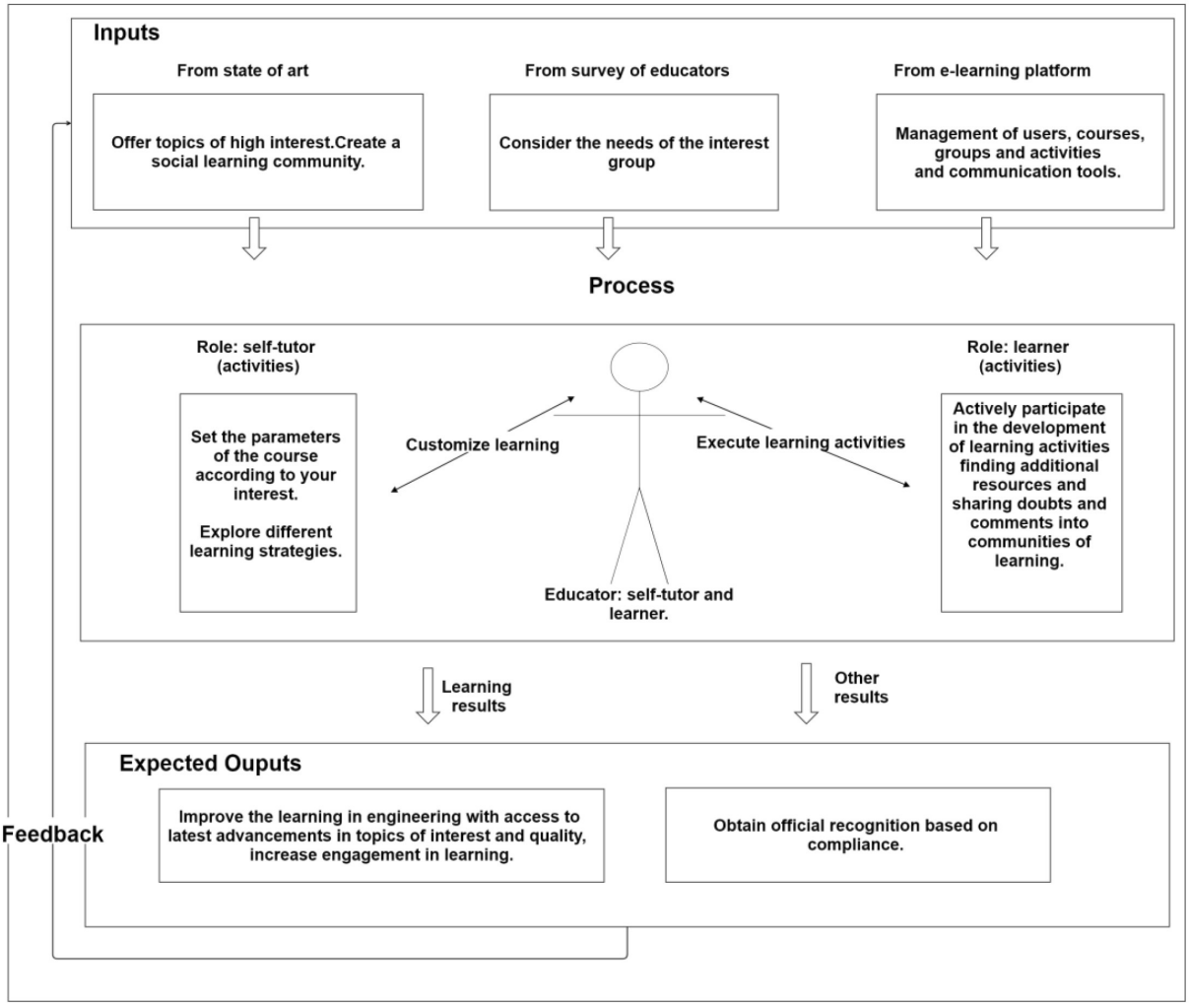

Fig. 1. Process for self-training of educators.

expected outputs are the perspectives that researchers have about self-training. The outputs are based on the learning obtained with regard to the topic of study and teaching-learning practices, among others. In addition, there are other results based on parameters such as the level of satisfaction, obtaining a certificate, and the number of hours of training.

5.1 Inputs

The inputs are the initial parameters that were used to define the self-training process. These parameters comply with the role of requirement gathering with regard to an engineering process. For example, some important inputs are topics of interest, minimum number of hours per week, obtaining certificate, among others. The entries obtained from the analysis described in the previous section are presented below.

5.1.1 Inputs from the state of the art

- The learner will perform better if they have a higher education level [7].
- The learner should be able to select specific content that meet their specific training needs [7].
- The learners should be able to define their own learning path, including the pace of their training effort [7].
- The educational resources and the learning activities should take in account how adult people learn online [7].
- The learning activities should be offered in a variety of formats so that the engineering educators can choose how they prefer to learn [7].
- The learners should be mature learners [7].
- The self-training program on offer should be of a shorter duration than instruction-led training options [10].
- The self-training program on offer should have simplified instructions [10].
- The self-training program on offer should have the potential of execution by the learner without any external help [11].
- The HEI should offer self-training programs with topics that are of high interest to engineering educators [17].
- The HEI should use multiple channels to advertise the self-training programs offered [17].
- The HEI should create a social e-learning community using social networks [17].
- The HEI should offer preliminary free training with regard to developing the necessary digital literacy skills and being an independent learner [17].

5.1.2 Inputs with regard to the educators' needs

- The surveyed educators requested that HEI should offer up to 5 hours per week of dedicated time for the self-training programs on offer (Q3).
- The surveyed educators requested that the duration of the self-training programs offered by the HEI should be up to 4 weeks (Q4).
- The surveyed educators requested that the self-training programs offered by the HEI should lead to a formal certificate of completion (Q5).
- The surveyed educators requested that the cost of the self-training programs offered by the HEI should be no more than $40 (Q6).
- The surveyed educators requested that the language of the self-training programs offered by the HEI should be in their native language, in this case Spanish (Q7).
- The surveyed educators requested that the electronic devices required to access the self-training programs offered by the HEI should be PCs and laptops (Q8).
- The surveyed educators requested that the self-training programs offered by the HEI should be accessible from any place (Q9).

5.1.3 Inputs from the e-learning platforms

- The HEI should upload videos with subtitles in multiple languages and supporting documents with translations.
- The HEI should manage communication systems that incorporate both synchronous and asynchronous learning as part of the e-learning process.
- The HEI should incorporate courses and activities on the e-learning platform that allow the learner to act as a self-tutor.
- The HEI should manage the e-learning platform including availability, security and authentications features.

It should be noted that the three sets of inputs are important in order to guarantee that the educator benefits from good conditions, feels comfortable and is satisfied when enrolling, starting and successfully finishing a self-training effort.

5.2 Process

Figure 1 presents the process that involves the educators and their activities in terms of self-training. First, the educators choose the technology regarding the devices and software tools to be used, depending on the topic that educators want to learn and the educator's experience [23]. Second, educators have two options with regard to applying self-training. On the one hand, educators can enrol in regular, virtual and distance courses. On the other hand, educators can select online resources in the form of self-training programs or e-learning resources with regard to the topic of interest.

Third, educators should be in a position to achieve the learning results [24]. In addition, the e-learning process must be continuously improved, based upon the needs of the educators, the technology that is available, and the feedback of the educators.

5.2.1 Role of the self-tutor

The self-tutor's role should involve performing specific management tasks on the platform, such as personalising learning results, setting up a social learning community leading to an increase in the learning results resulting from collaborative work in groups, searching for effective approaches to increasing learning, and managing time.

5.2.2 Role of the learner

The learner's role should involve performing specific tasks related to learning, such as executing learning activities that are available on the e-learning platform, executing a final test published on the e-learning platform, searching for additional online resources relevant to the topic of study, and engaging in a social learning community.

5.2.3 Expected outputs

Once the educator has successfully completed the activities and achieved a minimum grade in the final test, the educator should obtain a certificate. After the educator has successfully finished the self-training, the e-learning platform should present a survey to ask for the educator's feedback. The analysis of the outputs will be a basis for improving the self-training process for future editions.

5.2.4 Learning results

- Accessing the latest advancements in topics of interest.
- Accessing high quality resources.
- Acquiring new teaching-learning practices.
- Increasing his/her engagement in learning.

5.2.5 Other results

- Obtaining a degree of satisfaction.
- Engaging in a certain number of hours of training.
- Obtaining a minimum grade.
- Obtaining a certificate.

Besides the benefits of MOOCs, the proposed process contributes with the definition of a dual role of tutor and student that allows the engineering educators to develop self-training skills for lifelong learning.

6. Case study

For the case study, the authors selected Udemy as the e-learning platform. Udemy allows the student to work and study at the same time, to configure the material in different languages, and to personalize their learning. Given how important the use of the Web is nowadays, this case study applies a self-training program on the subject of web accessibility. This self-training program is called "*Aprende Accesibilidad Web Paso a Paso*" (Learn web accessibility step-by-step) [25]. This program is open access because this is an input of the proposed process. Currently, this self-training program has 6,810 students, contains 102 lectures and 9 hours of videos, and gives a certificate of completion. As for the countries of the students, the distribution is as follows: Spain 32%, Mexico 15%, Argentina 8%, Colombia 8% and Peru 7%. In this section, the authors present a description of the self-training process. There is not an exact figure of the total of students who in turn are engineer educators because Udemy does not restrict the profile of any participant. For this reason, the results presented below include all the enrolled students. However, the group of students enrolled for the purposes of this case study are engineering educators who collaborated with this research. The estimated time for the self-training program is a total of 20 hours, including quizzes, and the educator can skip lessons and quizzes depending on their previous knowledge and interest.

The training program contains eleven topics. These topics involve web definition, benefits, and relevance of web accessibility. In addition, the program includes guidelines and laws, how to navigate within a web page and between the pages of a website, how to make accessible using a keyboard, and how to make the content of a web page accessible and understandable. Furthermore, the training program makes the presentation of a web page accessible, in terms of colour, contrast and typography for both text and images, how a user can interact with a web page using programming tools, and the analysis and evaluation of accessibility.

7. Main results

The e-learning program started in 2015. Fig. 2 shows a comparison between the newly enrolled students and those active since December of 2016 until half of November of 2017. For example, in September of 2017, the average number of active students was 63%. Several of the students who have successfully completed the course have posted positive comments in the sense that they stated that they liked the topic, and that the e-learning program was well structured and planned. For example, "It has been a great learning at the usability level", "Resources are provided to be able to inquire

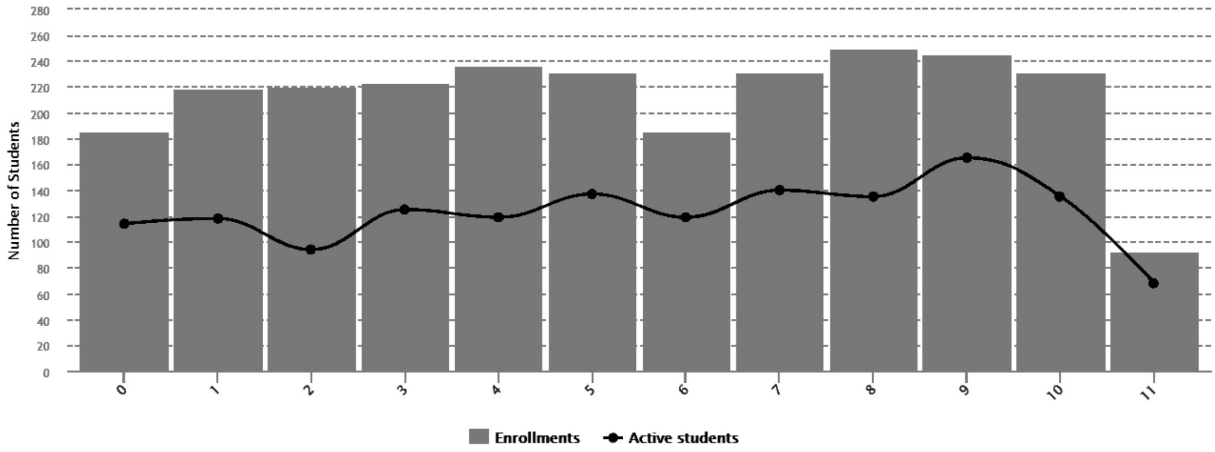

Fig. 2. Registered students vs. active students.

more about the subject", and "The course is very complete. The quality of the materials is very high and the instructors are experts in the field".

As for completion, all the active students (6,810) successfully completed Lecture1; this means 76% of the total registered students. The promotion of the self-training programs is an important input for our proposed process. For example, in this self-training program in 2017, there was an increased number of visits from other platforms, such as Google, Facebook, Twitter, among others.

At the end of the course, students filled an assessment of the outcomes and satisfaction. Fig. 3 shows that students evaluated with 99% the following aspects: value of information, clarity of concepts and expertise of the instructor; whereas, delivery of expectations got 98%, instructor engagement got 94% and opportunities to apply got 89%.

8. Discussion

The researchers have identified some strategies for educators training using a self-training program. One of the main strategies is that the topic should be specific and short and be a topic of interest for the educator and his students. This will allow the educator to complete the program and obtain a certificate. This matches with the results of previous

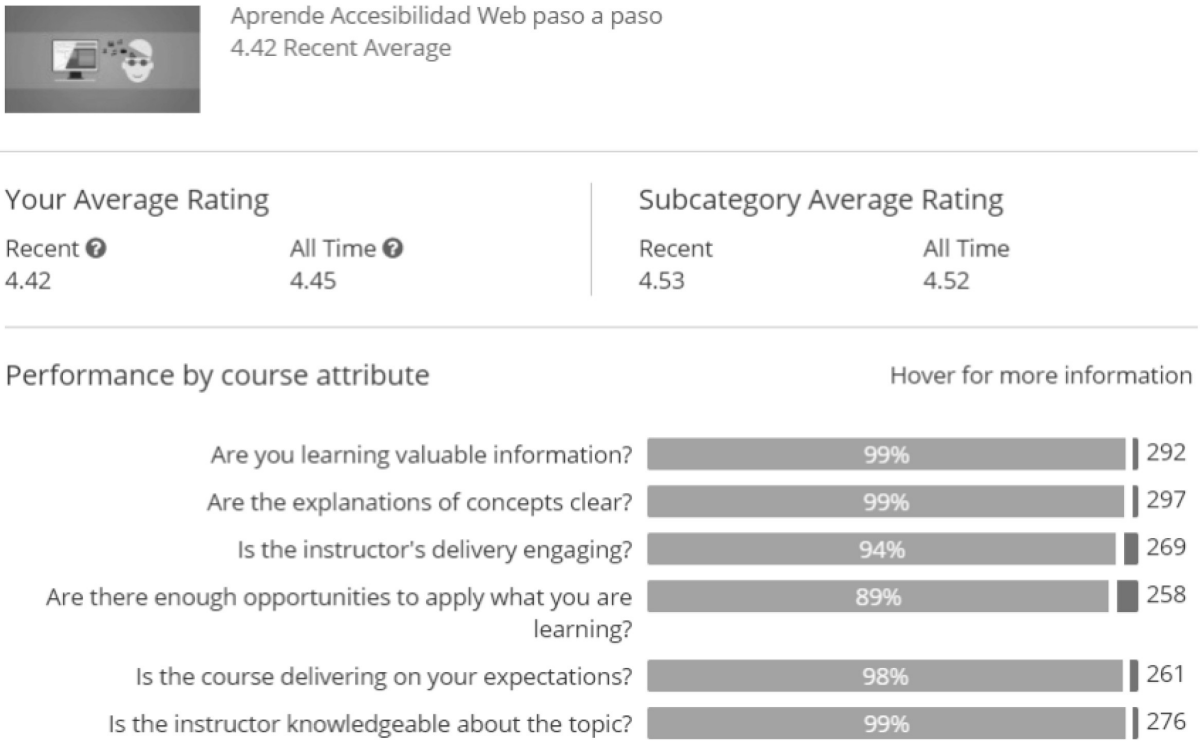

Fig. 3. Students' assessment of the outcomes and satisfaction of the course.

researches of Tam et al. [9] and Vestergaard et al. [11]. In the case study, the topic of web accessibility complies with these characteristics. Another strategy is that the preferred language of the engineering educators is their native language. Therefore, in our case study, the e-learning platform used allows users to configure the interfaces to the language of their choice. In addition, the contents of the self-training program should be delivered in Spanish. An additional strategy is that the platform and the self-training program should allow the engineering educator to decide what contents and resources to use and in what order, in order to optimize their time and focus directly on the subtopics that need to be updated.

This proposed process opens up the possibility that the engineering educators know of new technologies and tools that might already be known by their students. For example, in our case study, the responsive web design subtopic is important for any engineering educator due to the massive use of mobile devices. This helps to bridge the digital divide between the educators and their students. Davis et al. [17] have also addressed this issue.

For the issuance of the certificate of completion of the e-learning program, a good strategy would be for the administrators of the e-learning platform, in this case the HEI, to carry out agreements in terms of the sponsorship of prestigious international universities and organizations. This will help to guarantee the quality of the course content and make them more attractive to educators interested in self-training. Previous researches do not stress the importance of giving a certificate of completion to engineering educators.

The mass dissemination of e-learning programs in different social networks, as proposed by this self-training process, can engage many people. In addition, educators from other universities could benefit, together with their students. As in this case study, the results of visits from other sources outside the e-learning program are presented and are high; it is probable that several of those visiting from other sources have enrolled in our e-learning program.

Planning and developing training programs for small number of educators, e.g., four or five, is very costly for an institution of higher education. In addition, educators may not take advantage of the program because they may not have enough professional support. In the case of this proposed process, developing e-learning programs for self-training can greatly help registered educators. For example, in our case study, the forum has critical mass to allow meaningful discussions among educators and other participants. What is achieved is a synergy resulting from participating in an e-learning program involving many participants, and this makes the educators engage with the e-learning program and achieve better learning outcomes.

9. Conclusions

The e-learning process proposed in this paper allows educators to learn at their own pace, use their preferred learning modalities and receive feedback with regard to their performance to ensure a far higher quality learning experience.

The advantages of e-learning include an increased access to information, better content delivery, personalized instruction, content standardization, online interactivity, confidence, and increased convenience. The disadvantages of e-learning include a considerable investment in technology such as hardware and software, learning material development, equipment maintenance and training.

The inputs of the proposed process are relevant because the inputs are similar to requirements in engineering. In other words, in order for the engineering educator to be interested and engaged, it is necessary to disseminate and promote the advantages that would be obtained if the engineering educators were enrolled in the self-training program.

The proposed self-training process encourages curiosity, research and, above all, self-discipline. Educators learn to solve problems by themselves using the technology and resources that are at their disposal. In addition, the proposed self-training process allows the acquisition or development of concrete skills in a positive and dynamic way.

With the proposed self-training process, the educator is not required to keep pace with a particular group of educators. This process gives them the freedom to devote more time to what really interests them and to spend less time on what they find less interesting. The case study shows an overview of the interests of engineering educators on the topic of web accessibility, and that the learners have successfully completed the proposed program.

Future work to implement new e-learning programs is planned to be executed. In the medium term, it is important to obtain feedback on the process and the self-training programs in the form of information obtained from the participating educators using an extended survey. In addition, the HEI should identify the self-training needs of teachers according to institutional and personal interests. These needs will be planned and managed through educator surveys. The analysis of the surveys will help to identify the topics of interest and the platforms the HEIs will have to manage.

In the long term, the HEIs should institutionalize the self-learning process for engineering educators. The HEIs should manage the issue of certification. The HEIs must recognize a reduction in working

hours for educators that are participating in the e-learning program. The HEIs should engage its educators with the aim that they should be able to successfully complete the e-learning program. Consequently, the educators will be able to access the certificate validated by the institution. In addition, the HEIs should develop a set of self-training programs based on the needs identified for the lifelong learning of engineering educators.

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