Anatolian Journal of Education
e-ISSN: 2547-9652

October 2022 ● Vol.7, No.2
www.e-aje.net
pp. 123-134

The Challenges of Providing Massive Online Extension Courses: A Case Study

João Alberto Arantes do Amaral
Prof. Dr., Federal University of São Paulo, Brazil, *jarantes@alum.mit.edu*

Luciana Massaro Onusic
Prof. Dr., Federal University of São Paulo, Brazil, lucianaonusic@gmail.com

In this article we present our findings regarding the challenges of offering a massive university's free-of-charge online course. The online course "Introduction to data science (with R)" was offered by one professor at the Federal University of Sao Paulo, Osasco Campus, Brazil, from 11 to 28 of January of 2022, to 680 students from all over the country. This course had the goal of providing educational opportunities for those who otherwise would not be able to afford one. The course followed a problem-based learning approach. In addition to delivering the course content on data science, we wanted to investigate the challenges involved in structuring and delivering the course. Data was collected by means of questionnaires and from the professor's notes. Our findings were as follows: 1) the process of creating an online extension courses can be complex, time-consuming and laborious; 2) handling multiple social media applications and communication tools in order to publicize the extension courses is challenging; 3) the drop-out rate can be high and the completion rate can be low; 4) obtaining the participation of students living in disadvantaged conditions is challenging; and 5) the use of problem-based learning approach facilitated the learning.

Keywords: extension courses, problem-based learning, free-of-charge courses, massive courses, online courses

INTRODUCTION

In order to provide broad educational opportunities to the communities, Federal University of Sao Paulo campus Osasco (thereafter Unifesp-Osasco) allows its professors to deliver online extension courses.

Online extension courses are free-of-charge certified University courses, offered to the broader community (people not enrolled in regular university courses).

In this article we discuss our findings related to the challenges involved in the delivering of massive free-of-charge extension course "Introduction to Data Science (with R)". This course was designed and delivered by one single professor.

This free online course was designed to provide basic concepts of Data Science and of the programming language R. The course was designed in order to be understood by people with little knowledge of Statistics and Programming. The authors of this article worked together in designing, delivering the course and conducting this research. Our goal was to offer a quality online course for those who otherwise would not be able to afford one. We wanted to reach the greatest number of people possible.

Since the course was not a regular academic course, it followed a procedure that is applied to all extension courses of Unifesp-Osasco. The course followed a double analysis and approval processes:

Citation: do Amaral., J. A. A., & Onusic, L. M. (2022). The challenges of providing massive online extension courses: A case study. *Anatolian Journal of Education*, *7*(2), 123-134. https://doi.org/10.29333/aje.2022.7210a

first the professor wrote the course proposal and sent it for analysis and approval of the Extension Chamber of the Unifesp-Osasco, a committee of professors and administrative staff. After their approval, the proposal went to the Dean of Extension Chamber of the Unifesp for further analysis and approval. The entire process took approximately one month. The course was approved on December 25, 2021 and was immediately advertised on the University's online catalog of extension courses. The course quota (the number of places available) was 1000. There was no selection criterion; anyone who enrolled in the course could participate. There was also no age restriction; however, it was recommended that the students should be at least 10 years old. The communication team of the university publicized the course on university social networks and on the university website. The professor also announced the course on several Facebook groups and sent emails to his former students. From December 25 to January 10 the course was open for enrollment. Six hundred and eighty students enrolled in the course. The course began on January 11, 2022 and ended on January 28 of the same year.

The commonly used online courses may involve synchronous activities, asynchronous activities and pre-recorded video lectures.

The course we provided was designed to be totally asynchronous, based on 70 pre-recorded video lectures. Each lecture had the duration of, on average, 10 minutes. In order to foster knowledge sharing among the participants, the course also had a discussion forum in Google Classroom.

The course content was divided into three parts: in the first week the students learned how to set up the R Studio programming platform and the basic concepts of R language (types of data, graphical data entry interfaces, basic mathematical operations, loops and conditionals, loading and exporting data in multiple formats). In the following week they learned how to manipulate datasets (doing operations such as filtering, sorting, selection, sampling) and performing calculations with the elements of datasets. In the final week the students learned how to use R to perform descriptive statistics calculations (such as mean, median, standard deviation, quartiles) and to create graphs (scatter plots, pie charts, bar graphs and histograms).

The course followed a problem-based learning approach: every week the students were required to answer the "Challenge of the Week" (one electronic questionnaire with 10 multiple choice close-ended questions related to the studies of the week and one open-ended question where the students should write their doubts/comments to the professor). The close-ended questions of the Challenges of the Week were graded on score from 0 to 10. During the week, the students clarified questions with the professor in a forum created in the Google Classroom. In addition, the professor sent feedback about the Challenges of the week, by e-emails, in video format.

The first and the second Challenges of the Week were not obligatory. Only the final one was obligatory (for the students pursuing the course's certification).

Theoretical Review

Extension courses (online, face-to-face and blended) are offered by universities and colleges with the goal of promoting knowledge sharing between scholars and community members (da Silva, 2020; Lenox, 1990). However, there are several challenges related to the delivery of extension courses (Nazarzadehzare & Dorrani, 2012). Researchers report that the dropout rate can be high and the course attendance can be irregular (Ngoma et al., 2004; Zahn, 1964). In addition, scholars (Arantes do Amaral, 2017) have pointed out that the professor´s workload in extension courses can be greater than in the standard courses and the bureaucracy involved in obtaining the university's endorsement can be time consuming.

Due to the COVID-19 pandemic, this course was offered in online format. Online courses bring additional challenges to the students and teachers (Gillett-Swan, 2017). The students may have difficulties understanding the course goals (Dhawan, 2020; Song et al., 2004); they can become disconnected and unmotivated (Fregni, 2019); and they may have trouble accessing a stable internet connection (Yusuf & Ahmad, 2020). In addition, due to the COVID-19 pandemic, the students may also face mental health problems and social isolation (Elmer et al., 2020). The teachers may also suffer under the heavy workload involved in teaching online courses (Tynan & Lamont-Mills, 2015) and the lack of familiarity with educational software tools (Jacobs, 2013). On the other hand, online courses may bring benefits to the students (Atack & Rankin, 2002): they may study at their own time and pace (Sit et al., 2005), and they may use discussion forums to exchange ideas with the teacher and their peers (McNeil et al., 2000).

Free online courses can be provided in a massive way, to hundreds of students, in Massive Open Online Courses (thereafter MOOCs). MOOCs usually are open access and free-of-charge courses, designed to allow large number of students, generally provided by one institution, with support of several faculty members (Aljaraideh,2019). MOOCs have all the previously discussed benefits of online courses. However, free of charge MOOCs generally do not provide students with adequate feedback from the professors; in some cases, there is no feedback at all (Elizondo-Garcia et al.,2019). More than that, researchers (Glass et al.,2016; Kizilcec et al.,2017) point out that, in general, the majority of learners of MOOCs are well educated and qualified professionals rather than disadvantaged learners. Researchers (Hansen & Reich,2015) also conjecture that MOOCs may be contributing to aggravate the discrepancy between the well-educated and the disadvantaged learners.

MOOCs may have different number of facilitators, it depends on the institutions' goals, the business model, the number of the students, the budget available, the technology and level of interactivity desired (Fisher et al.,2014). Providing a massive course with high level of interactivity has a cost: the more people and resources involved, the higher the expenses will be (Baker & Passmore, 2016; Head,2014). Therefore, a MOOC with fewer number of facilitators would bring economic benefits for the institution which provides it.

Although there is substantial research discussing the challenges of MOOCs and online courses, it seems there is a lack of information about the challenges involved in providing massive university's certified free-of-charge online courses offered by a single professor. Our research question then became:

What are the challenges involved in providing university- certified free-of-charge online extension courses to a single professor?

METHOD

The researchers' roles

The first author was responsible for the course design, the content creation and the delivery of the course. The second author participated in the delivery of the course and gave suggestions of course's improvements.

Research design

We followed a convergent parallel mixed method approach. In this method the researcher can collect quantitative and qualitative data simultaneously. By doing so, the data can be combined, compared and interpreted, given to the researcher a integrated view of the possible answers to the research questions (Demir & Pismek, 2018; Edmonds & Kennedy,2016).

In our research the quantitative and qualitative data were collected by means of two questionnaires and from the professor's notes. First, both data sets were examined individually. After that, the outcomes were contrasted and analyzed (Creswell, 2014).

Participants

There were 680 students that enrolled in the course. The youngest was 10 years old, the oldest 68 years old. The average age was 33 years-old, a standard deviation of 10.4 years. Table 1 presents the data related to their characteristics (gender, and educational level).

Table 1
Students' characteristics

Gender	Number of Students	Percentage
Male	345	50.7%
Female	335	49.7%
Educational Level		
Undergraduate	253	37.2%
Master of Science	157	23.1%
Master of Business Administration	118	17.4%
PhD	65	9.6%
Post-doctorate	24	3.5%
High school	60	8.8%
Primary school	3	0.4%

Data collection tools

The data was collected from the professor's notes and from two questionnaires sent to the students. Each questionnaire had questions that aimed to collect quantitative data and qualitative data. The quantitative data was collected by means of five points Likert Scale questions and by multiple choice questions. The qualitative data was collected by means of open-ended questions. The first questionnaire had the goal of collecting demographic data about the students, their academic background and study conditions. The second questionnaire had the objective of collecting data related to the students' learning style and effort of learning. It also aimed to collect feedback about the level of the difficulty of the course and if the course met the students' expectations.

The professor registered in his notes information about the time spent on the following activities: creation of the course proposal, creation of the video-lectures, obtaining course approval and publicizing the course. In addition, he registered information about the number of students that enrolled in the course and the number of students that were able to successfully complete the course. He also took notes related to the number of students that completed the Challenges of the Week and the average grade of the students who completed the challenges.

The first questionnaire, sent during the first week of the course, had twenty questions. Nineteen questions aimed to collect quantitative data, one question qualitative data. The questionnaire aimed to confirm the enrollment and to collect information about the students (their gender and age, their academic background, years of professional experience) and how they had learned about the course. In addition, the questionnaire also had the goal of collecting information about their background in R programming language and Statistics and the reasons that led them to choose this course. It also had the goal of collecting data about the problems the students were facing that could have an impact on their online learning experience. Finally, it included one open-ended question, allowing the students to share their thoughts (questions, comments and suggestions) about the course.

The second questionnaire had fourteen questions and was sent at the end of the course. Thirteen questions aimed to collect quantitative data, one question collected qualitative data. The questionnaire aimed to investigate the students' learning style and their effort of watching the video-lectures and the professor´s feedback. It also aimed to obtain students' opinions of the difficulty of the video lectures and of the challenges proposed. Finally, the questionnaire aimed to find whether the course had met the students' expectations or not. Finally, it included one open-ended question, asking the students to share their thoughts about the course.

Data analysis procedures

The students rated aspects of the course using Likert scales (from 1 to 5 and from 1 to 3). This quantitative data was collected and then summarized by means of diverging bar charts.

The qualitative data was analyzed by the five-step language processing method proposed by Yin (2015). The sentences of the answers of the students were broken into small segments, each segment containing only one idea. After that we created clusters, grouping similar segments. Finally, we create recurrent themes (thereafter RT), that aggregated the main ideas of each cluster.

Validity and reliability

This research followed a mixed method approach. Therefore, we took measures to assure qualitative and quantitative validity and reliability. The reliability of the qualitative research can be assured by the trustworthiness of the investigation (Poth & Creswell, 2018). In other words, the research is detailed in a way that allows other scholars to follow. In this study we detailed every aspect of the research, ensuring qualitative reliability. The validity of the qualitative research was obtained using of a five-step method (Yin, 2015), a standard analysis method used in qualitative research.

The reliability of a quantitative research can be assured by the accuracy of the instrument of the measurement (the questionnaires). We used the Cronbach Alpha to measure this. The Cronbach alpha was 0.73 for the first questionnaire and 0.68 for the second one. These values are high (Taber, 2018), therefore assuring the quantitative reliability. The validity of the quantitative study is related to the concepts being accurately measured (Heale & Twycross, 2015). In our research we measured each construct by using a well-defined set of questions related to each Likert set of items, therefore the assuring the validity.

FINDINGS

Data related to the course organization

Table 2 presents the data collected from the professor's notes about the time spent on the bureaucratic processes involved in obtaining course approval, preparing the course, and advertising it.

Table 2
Data related to the course planning and the approval process.

Actions taken	Responsible for the action	Time spent
Creating the course proposal	Professor	1 day
Obtaining the University´s approvals	Professor/ University´s extension chambers	14 days
Creating the course video-lectures	Professor	14 days
Publicizing the course	Professor/University´s communication group	17 days

Data related to the course development

Table 3 presents the data collected from students' enrollment and dropouts.

Table 3
Data related to enrollment and dropouts.

Number of students that enrolled to the course	Number of students that successfully completed the course	Dropout rate
680	323	52%

Table 4 presents the data related to students' engagement in doing the "Challenges of the Week" and their average grades.

Table 4
The students' engagement and performance in the challenges of the week

Challenges	Number of students that answered the Challenge	Average grade
Challenge of the first week (Not obligatory)	353	8.2
Challenge of the second week (Not obligatory)	238	8.3
Challenge of the third week (Obligatory for certification)	323	7.6

Data collected from the first questionnaire

Table 5 summarizes the answers from the first questionnaire, in three categories: the way the students used to find the course, the previous knowledge in R and previous knowledge in Statistics.

Table 5
Answers to the first questionnaire

Category	Data gathered (number of students and percentage)	
Means used to find the course	Unifesp's website:	220(32.4%)
	WhatsApp:	150(22.1%)
	Recommendation:	115(17.0%)
	Facebook:	50(7.4%)
	Google:	22(3.2%)
	Linked in:	22(3.2%)
	Twitter:	22(3.2%)
	E-mail:	16(2.4%)
	Other social network:	26(3.8%)
	Other sources:	37(5.7%)
Previous knowledge in the R programming language	No knowledge at all:	312(45.9%)
	Little knowledge:	286(42.1%)
	Medium knowledge:	74(10.9%)
	God knowledge:	8(1.2%)
	Expert:	0
Previous knowledge in Statistics	No knowledge at all:	46(6.8%)
	Little knowledge:	261(38.4%)
	Medium knowledge:	302(44.4%)
	God knowledge:	66(9.7%)
	Expert:	5(0.7%)
Years of professional experience	None (students who don't work):	200(29.4%)
	From 1 to 5 years:	158(23.2%)
	From 6 to 10 years:	102(15.0%)
	From 11 to 15 years:	78(11.5%)
	More than 16 years:	142(20.9%)

The diverging bar chart (Figure 1) shows the students' agreement or disagreement to eight questions regarding reasons they chose to take the course. We collected the answers using the five-point Likert Scale (1-Totally Disagree, 2-Disagree, 3-Neither agree, nor disagree, 4-Agree, 5-Totally Agree). The chart follows the color convention: the brown bar corresponds to the answer "totally disagree," the light brown corresponds to the answer "disagree," the grey color corresponds to "neither agree, nor disagree," the light green corresponds to "agree" and the dark green corresponds to "totally agree."

The main reasons students took the course were as follows: to learn data science (99%), to achieve a professional development (97%), to learn how to code (73%), to use R programming language in research purposes (69%), for professional needs (67%) and for obtaining a course certificate (53%). Few students (25%) answered that the main reason for taking the course was to follow someone's recommendation (25%) or to obtain extension activities' academic credit (15%).

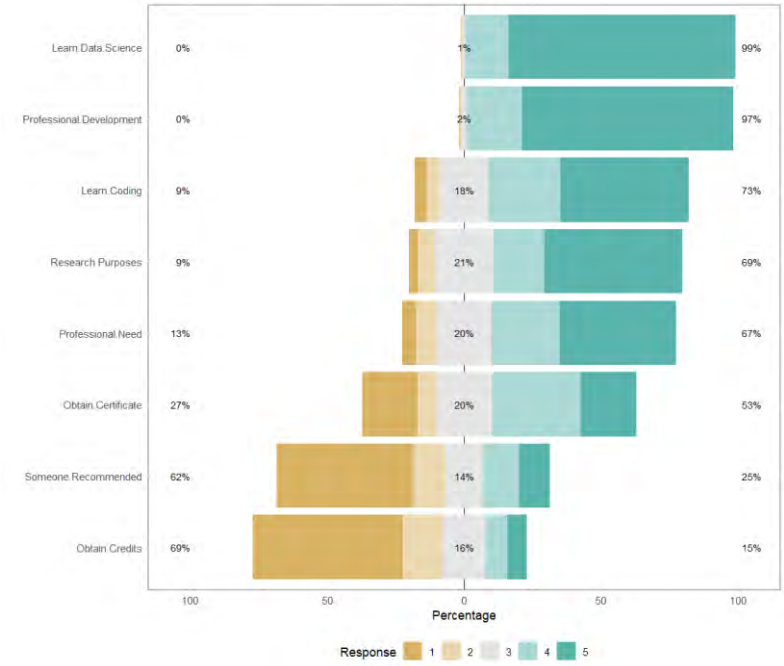

Figure 1
The diverging bar chart of the answers to the question regarding the reasons the students chose the course

The diverging bar chart (Figure 2) shows the students' agreement or disagreement to eight questions related to their learning conditions. The data shows that 98% of the students declared to have adequate internet connection, 92% had a computer available to perform the coding exercises, 82% had adequate place to study, 79% considered that they had discipline of studying and 60% acknowledged that they had enough time to study the course materials.

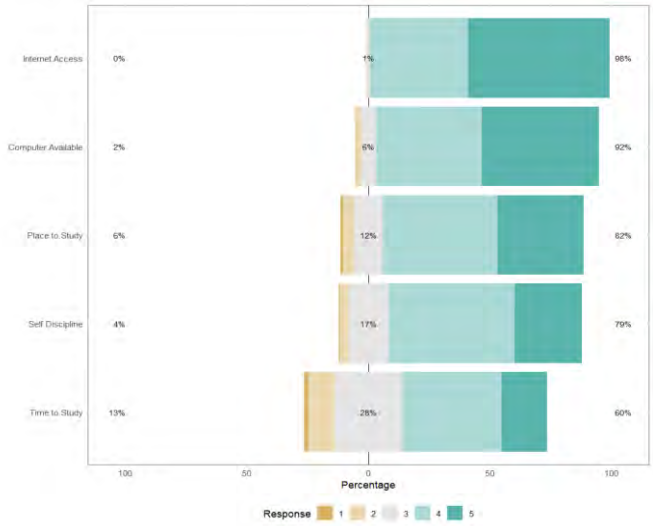

Figure 2
The diverging bar chart of the answers to the question related to the students' learning conditions

Data from the second questionnaire

The diverging bar chart (Figure 3) shows the students' agreement or disagreement to six questions related to their effort to study course and their learning. We collected the answers using three-points Likert Scale (1-Low, 2-Medium 3-High).

Fifty-six percent (56%) of the students rated the amount they had learned as high, 44% acknowledged that their effort (time spent on watching the video lectures) was high. On the other hand, only 27% acknowledged that their effort of watching the feedback (in video format) from the professor was high. More than that, for 62% of the students reported that the level of difficulty of the video-lectures was low, and 85% of the students acknowledged that the level of difficulty of the challenges of the week was medium.

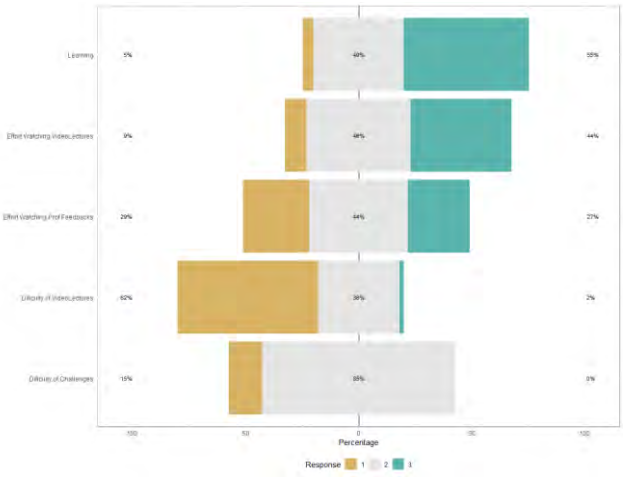

Figure 3
Students' effort and learning

The second questionnaire had a final (close-ended question) asking if the course met the students' expectations. Twenty-seven percent of the students responded that the course exceeded their expectations, 68% answered that the course met their expectations and 5% that the course did not meet their expectations.

Data from the open-ended questions

Three recurrent themes (thereafter RT) emerged from the analysis of the students' answers.

RT1: The problems presented (the "Challenges of the Week") facilitated the learning.
RT2: The video lectures were short and easily understood.
RT3: The professor's feedback facilitated the learning.

DISCUSSION

The data related to the course planning and the approval process (table 2) revealed that the process was complicated, since it involved the approval of two University Committees and the publicity by the University Communication team. The whole process long since it took 17 days. In addition to that, it took a lot of effort from the professor to create the videos and to obtain all the necessary approval. This led us to our first finding: ***the process of creating online extension courses can be complex, time-consuming and laborious.*** This finding is similar to findings of other researchers (Alario-Hoyos et al., 2014) involved in the creation of MOOCs.

The data also revealed aspects of the complexity of the course's publicity process (table 5). It involved the use of social networking sites (such as Facebook and Linkedin), messaging applications (such as WhatsApp and Twitter), email services (such as Gmail) and websites (like the Unifesp's and the professor's websites). This led us to our second finding, that ***it is a challenge to handle multiple social media applications and communication tools in order to publicize the extension courses***. This finding was aligned with the findings of other scholars, who pointed out (Arantes do Amaral & Hess, 2017, Ntanis, 2014) the importance of using social media tools in order to enhance course enrollment.

Regarding the enrollment and the dropouts, the evidence presented (table 3) shows that the course had large enrollment and a completion rate of 48%. What does this rate indicate? Scholars who have researched completion rates of MOOCs (Gütl et al., 2014; Jordan, 2014 ,Ho et al., 2014) pointed out that the completion rate is usually lower than 10%. Therefore, the completion rate of this course was above the average of MOOCs courses, but still could be better. This led us to our third finding: ***the number of drop-outs can be high and the completion rate can be low in online extension courses.***

In relation to the participants (table 1), the percentage of males and females were almost the same; the mean age was 33 years. The data (table 1) also revealed that they were well educated, since more than a half of them had completed their graduate studies, more than a third were undergraduate students, and only one tenth of them were students from high school or primary school. In addition to that, the data (table 1) also showed that around half of the students had more than five years of working experience. Moreover, the data revealed that most of the students took the course for reasons related to professional development (Figure 1, the diverging bar chart). Furthermore, the data (Figure 2, the diverging bar chart) also revealed that most of the enrolled students met all necessary conditions to take the course (computer available, reliable internet connection, adequate learning environment).

Therefore, based on all evidence presented, we may affirm that most of the students who enrolled in this course were well educated or seasoned professionals, people who were seeking professional development and career development and had the necessary technological tools to follow the course.

The profile of our students is similar to the profile of people who usually attend massive open online courses (Christensen et al., 2013; Emanuel, 2013), professionals with high qualifications.

We reached the conclusion that our effort of publicizing the course was successful in achieving a large enrollment, but that it failed to reach disadvantaged people who would really benefit from taking this free-of-charge course. This led us to our fourth finding: ***it is a challenge to obtain the participation of people in disadvantaged conditions in online extension courses.*** This finding is in accordance with the findings of other researchers (Hansen & Reich,2015; Laurillard, 2016), who point out that the learners of MOOCs are usually qualified professionals rather than disadvantaged learners.

Regarding the learning, the data revealed that the students were able to obtain high scores in all of the challenges of the week (table 4). In addition, the majority of the students rated the amount they had learned as high (Figure 3) and the course met or exceeded their expectations. The qualitative data (RT1) helped us to understand that problem-based learning approach motivated the students to learn by doing, by creating code in order to solve the exercises proposed. More than that, RT2 let us understand that the professor´s feedback helped the students to understand the exercises and facilitated learning. In addition, RT3 revealed that the students appreciated the video-lectures, which they found to be concise and objective. This led us to our fifth finding: ***the use of problem-based learning approach facilitated the learning.***

CONCLUSIONS

Coming back to our research question (What are the challenges involved in providing a university-certified, free-of-charge online course?), we found challenges that are somehow interconnected. The initial challenge is to overcome all bureaucratic hurdles related to the course approval and publicizing processes. The next challenge is to publicize the course adequately, in order to foster the enrollment of disadvantaged learners who could most benefit. In this course we were not able to fully achieve the goal of getting the enrollment of a large number of disadvantaged learners. We tried by all means to reach them, however, our efforts were not very effective. We may speculate that disadvantaged learners had difficulties to access the internet, therefore they did not know about the course. We may also conjecture that even if they had the information about the course, they did not to have time and conditions to take it. The next challenge is to use the appropriate teaching and learning approaches, in order to keep the students motivated to complete the course. The final challenge is to deal with the high-number of drop outs and the low completion rate.

We suggest for future research that the researchers should try to figure ways of reaching a greater number of disadvantaged learners. Maybe the publicity process of a course like that should involve other actions rather than the use of social networking sites, messaging applications, email services and websites. Maybe the course should be also publicized by non-governmental organizations and schools that worked with disadvantaged learners. We may also suggest that the course' designers should experiment new ways of reducing drop outs, by offering attractive educational resources, such as gamification experiences that would enhance the motivation of the students.

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