Dossier: "The virtual environment student"

The online student on technical degree courses. Motivation, interests and technical problems

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Abstract

Historically speaking, the profile of a distance university student has been that of a person incorporated into the employment world who cannot attend classes, or that of a person who lives in an area where it is not possible to follow the course face-to-face. Face-to-face universities currently also offer online subjects, be they completely in virtual environments or with mixed or semi-face-to-face systems. The latter, together with the great strides in technology and the popularisation of the Internet, has led to the appearance of new student profiles in online training.

The motivations, available time and the way of working of each of these profiles is very different. Similarly, differences can be detected between students of disciplines related to Social Sciences and students on technical degree courses. In virtual campuses, which in principle are designed from the point of view of technology, the profiles of the students who will use them must be taken into account.

Consequently, we will try to get to the crux of the motivations, interests, problems and preferences of online Engineering students and try to reveal which technological tools and which teaching actions will be the most appropriate for the normal development of learning.

Keywords

online student, e-learning, engineering, virtual campus, technical degree student

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Resum

El perfil de l'estudiant d'una universitat a distància ha sigut històricament el d'una persona incorporada al món laboral que no pot assistir a les classes, o el d'una persona que resideix en una zona on no hi ha possibilitat de cursar els estudis en format presencial. Actualment, les universitats presencials també estan oferint assignatures en línia, siga íntegrament en entorns virtuals, o amb sistemes mixtos o semipresencials. Açò últim, unit al gran desenvolupament tecnològic i la popularització d'internet, ha provocat que nous perfils d'estudiants apareguen en la formació en línia.

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Les motivacions, el temps disponible i la manera de treballar de cadascun d'estos perfils és ben diferent. De la mateixa manera, es poden detectar diferències entre els estudiants de disciplines relacionades amb les Ciències Socials i de titulacions tècniques. Els campus virtuals, que en un principi van ser dissenyats des del punt de vista de la tecnologia, han de tenir en compte els perfils dels estudiants que els utilitzaran.

Ací intentarem desgranar les motivacions, els interessos, les problemàtiques i les preferències dels estudiants en línia d'Enginyeria, i intentarem esbrinar quines eines tecnològiques i quines accions docents seran les més adequades per al normal desenvolupament de l'aprenentatge.

Paraules clau

estudiant en línia, aprenentatge virtual, enginyeria, campus virtual, estudiant de titulacions tècniques

1. Introduction

We have come a long way from the image of the student who enrolled on a correspondence course and studied on their own at home without any contact with their fellow students. This was before the popularisation of e-learning, which was at most a decade ago. E-learning has meant that very many people, irrespective of their geographical location, have instant access to the contents of a course. At the same time, it has meant a huge revolution in communication between students and lecturers who do not share a physical space. These technological and methodological changes have led to a boom in distance education and have created a wide range of student profiles that adhere to this model.

Historically, the dominant profile was that of the student who combined studies and work and who could not attend face-to-face classes. The profile of the person who lives in an area where it is not possible to follow the courses face-to-face has also been important. It is now normal for face-to-face universities to offer some of their subjects online, enabling them to incorporate so-called "normal" university students into the world of e-learning.

However, not only are there different types of students depending on their personal circumstances (work, geographical, etc.), but also the discipline of study. Social Science and Engineering students, as two examples of very different degree courses, do not usually have the same preparation, predisposition or requirements when it comes to using the resources of a virtual campus. Neither are the technological needs of each discipline the same. Formulas, graphs, simulations and laboratories are the tools that are most often used for technical degrees and not all virtual campuses allow for their frequent use.

In this article, we will try to give a general overview of the different types of online students and we will pay particular attention to technical degree students and how these profiles affect the design of virtual campuses.

2. Student profiles

Should we want to classify online students into various groups, we would encounter difficulties in finding a single classification. We could differentiate, for example, according to personal circumstances: students who work, students who live in regions where it is not possible to study face-to-face, students of face-to-face universities who are studying some subjects online, students who have not been able to get a place in face-to-face universities or students with physical mobility difficulties.

Besides this initial classification, we could differentiate types of students according to where they come from: secondary school students, students on their second (or third or fourth, etc.) course or students who do not have any university degree but who ended their secondary school studies years earlier.

Even though these classifications are, in principle, independent, there are certain relationships between each of the profiles. For example, students who work are not usually from secondary education but correspond to those studying on their second, third or fourth course or students who finished their secondary education years earlier.

By discipline type, we could make a large division between four groups according to the tools that they use when studying: Social Sciences (Languages, History, Geography, Law, etc.), financial disciplines (Business Administration, Economics, etc.), Natural Sciences (Biology, Medicine, Pharmacy, Chemistry) and scientific-technical degrees (Mathematics, Physics, Engineering, Architecture, etc.).

If we see the range of online degrees that are on offer in the country we won't be long in realising that the degrees of the first two groups take up most of what is on offer, completed at a distance by scientific-technical degrees. The Natural Sciences disciplines are practically outside the offer. There should be no shortage of reasons to explain this.

The possibilities offered by the first virtual campuses permit better degrees to be developed where the vehicular tool of learning is text, such as Social Sciences degrees, but they display certain difficulties for science teaching-learning.

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Consequently, one should think that the needs of technical degree students are not the same as those of Social Sciences students. It should be taken into consideration, then, how studies that can be done online mark these needs.

Students' motivations

In any task that someone does, motivation is a factor that allows the actions of that person to be understood. The scant motivation of primary and secondary school students is a burning issue. In distance education, we can find differences in terms of motivation if we compare its students with face-to-face education students.

Generally speaking, motivation depends on the student profile that we have described in the previous section.

Probably the two most important and decisive motivations that lead a student to enrol for an online degree are those of earning a degree and of learning. A third motive is the possibility of meeting people and of creating a new circle of relationships.

Certainly, and even though we do not have studies that show this precisely, we could say that degrees of a cultural nature such as Humanities, History, Philology, Philosophy, etc. are nourished by students with cultural concerns and for whom the most important motivation is to **learn**. By contrast, in degrees where the application to the employment sphere is more direct and immediate, the **qualification** is a more highly prized asset, and we see students motivated by learning alongside students motivated by attaining a qualification. This group would include the Engineering disciplines, Psychology, Business Administration, etc. Evidently, this statement is very generic and has a large number of exceptions. We cannot forget that there are people who combine both motivations and who are motivated both by the qualification and by the subjects and content that they are studying.

The habits of online students

In the previous sections, we have seen that the types of students that we find on a degree course are varied, and this will be the case with their habits, expectations and actions during their studies.

The first type of student that we may find, which was also the profile of the original distance students, is that of the **free student**: someone who studies autonomously, with occasional queries to the teacher or a classmate, and who sits examinations as a free entrant. Fortunately, this profile is increasingly less usual, among other reasons because new trends in education—of which the Bologna process is an example—promotes group work and the development of transversal skills, not specific to the degrees. However, it is not unusual to find the profile in scientific-technical (Vicent, 2004) **or concentration subjects (Bou** *et al*., 2003) such as Mathematics, Physics or Chemistry (or subjects derived from these), where the intrinsic objectivity of the concepts hinders the animation of debates, contrary to what happens in other

subjects where there are more different hypotheses and theses according to the current of thought and where discussion appears naturally.

However, e-learning has enabled the appearance of a new very **social** profile of **student**, who participates actively in forums and group work, putting forward doubts and problems, resolving those of others, etc. It is someone who both demands the same of their classmates and of the teachers and does not see the university as a place exclusively in which to learn knowledge but also as a place in which to forge relationships with people with whom they will in the future share job affinities, where they can learn how to work, etc. It is a more modern student profile, more in harmony with the new model of university proposed by the European Higher Education Space.

There is no reason for this type of student, who we have called *social*, not to have self-learning skills. They may be a student who is perfectly capable of studying concepts on their own but who likes communication and fostering personal relationships.

With regard to the level of self-learning, we can divide students into **self-taught**, who are automatically capable of understanding the concepts without communication with their classmates or teachers—this type may be usual in concentration subjects—and **non-self-taught**, who need explanations from the teacher to assimilate concepts and who do not have enough with the texts. These students demand face-to-face teacher explanation sessions, telematic videoconferencing sessions and multimedia material such as videos recorded by the teacher or explanatory synthetic videos. These students are used to classic face-to-face education and demand an online model that emulates this type of education.

This last group overlaps with the other two, as there are non-self-taught students who have a scant social behaviour and non-self-taught students who promote and require participation.

These different working manners and habits will have to be taken into consideration when proposing an online model. It has to be considered that according to the technological tools and the methodology that has to be followed, one type of behaviour will be promoted more than another. It is a good idea, therefore, to set oneself objectives, think whether any type of action will be permitted or if it is intended that the main way of studying is self-taught, collaborative, etc.

Technological tools needed

As the behaviour will be different according to the type of student profile, the technological tools will have to be adapted to these behaviours if the aim is the satisfaction of the students, but they will also have to be adapted to the competences and attitudes that the institution expects of them. Normally, universities that offer online subjects try to ensure that their students do not follow the free profile that we described earlier as they will not acquire

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a series of competences necessary for their professional life—and we could say for life in general.

Consequently, in this section we will discuss the different technologies with which the content can be offered and the different communication tools that LMS or virtual campuses have, and will have, for online teaching.

Contents

If the desired student profile is self-taught, there is no need to make a huge effort in communication tools. All we need are good contents. Typically, these are texts in different formats: paper (notes or books) or electronic (HTML or PDF). Normally, when the latter are posted, their first destination is the printer, so transforming them into the former. Portillo (2007) states that when learning contents from memory in order to pass an examination, for example entrance examinations, these formats are the best. We need to consider, however, that for many university subjects the aim is not to learn the contents from memory, but to understand them and solve problems with them.

There are also some universities that offer their contents in audio format, enabling students to study on public transport, while driving or doing all types of other activities. In fact, in terms of features, the audio format is very similar to text format, as it is a spoken text. The Universitat Oberta de Catalunya, together with other institutions, has developed the range of contents in different formats within the *A Medida* framework. This project has grasped that the majority of students use the paper format, but that formats can be combined depending on where they are located.

Another format that does have a definite added value is video. Video makes animated vision possible, which can be very useful when understanding certain concepts. Videos can be recordings of face-to-face classes or lessons recorded expressly by the lecturer to give their view via the Internet, or computer-generated videos which can be highly intuitive examples of processes or experiments, or even documentaries.

In Vicent (2005) the level of achievement of certain specific Engineering competences by students, according to the format used, has been seen. It is obvious that videos are interesting in the learning of certain concepts. It has also been observed that the inclusion of formats other than traditional ones stimulate the student.

The choice of content format may be conditioned by a number of aspects: the subject, the student profile and, evidently, the technological and financial possibilities of the institution that creates them. This last item may limit content creation exclusively to text format.

In terms of the student, we could say that the **textually self-taught student**, who is highly accustomed to studying a range of books and texts, does not need the explanations of another

person to understand the concepts, whereas the **non-self-taught student**, whom we have defined as the student who is used to face-to-face classes and who requires someone to explain the concepts to them, will need other formats. Depending on whether the student is more auditory or visual, the student will prefer the contents in audio or video format. Video will be necessary for technical degrees, as it is very difficult to understand subjects such as Mathematics or Physics in audio format.

We should also consider that, irrespective of the students, videos may be intrinsically better for showing certain phenomena or concepts, particularly in scientific subjects.

Communication

However, if the aim is that university is not simply a way of transmitting contents, but a place where professional development and life skills are learnt, significant emphasis must be placed on communication. And universities must avoid the figure of a free student and promote the social student, for which good communication tools will be essential.

E-mail and, above all, forums have been the means which all virtual campuses have incorporated for communication between students and lecturers, and between the students themselves. Despite the use of these tools, it is quite clear that online students exchange their instant messaging addresses and that they study together and keep in touch outside the virtual campus. This must make us aware of the importance of **synchrony**. Many virtual campuses include basic text chats, albeit not as attractive as the external messaging programmes.

However, these tools, besides being the most simple, only favour transmission and debate about a certain type of subject, which have language as the fundamental information vehicle. No huge effort is required to imagine that scientific and technical degrees are outside this scenario.

In the next section we will take a more in-depth look at the problem of e-learning on technical degree courses.

3. Are scientific and technical degree students different?

The question in the title is obviously a general one, and whether the answer is *yes* or *no*, there are a significant number of exceptions.

To start with, we must stress that fewer universities offer these types of degrees in e-learning format than for Social Sciences. By consulting the data from the two Spanish distance universities, the UNED and the UOC, we can see that diplomas and degrees (*diplomas* and *degrees* need to be understood as different engineering and architecture qualifications) predominate. The data on the number of students (INE, 2006) according to the type of

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degree and study format indicate that at face-to-face universities, technical, engineering and architecture degree students account for 26.5% of the total number of students, while at distance universities they do not reach 15%. Given all this, we should take into account in these statistics the face-to-face universities that offer qualifications in semi-face-to-face or online format, as is the case with La Salle Engineering and Architecture, at the Ramon Llull University in Barcelona, but no studies on this have been found.

With the data that we have, it appears that these degrees do not combine with e-learning as well as others.

Why do they not combine?

At an initial glance, we can extract three fundamental problems:

- practice;
- scientific writing;
- concentration subjects (Mathematics, Physics, etc.), in which there is hardly any room for debate.

Practice

Laboratory practice is one of the principle ways of learning. Students develop a significant number of skills, apart from exclusively technical ones, such as the abilities of design, group work, report writing, etc.

In the field of e-learning, the main problem is the direct use of equipment, which is not possible. Universities adopt two solutions: face-to-face practice, so that the degree is taught in a semi-face-to-face way, or using laboratories on the net.

If the institution chooses this second format, there are two possibilities: **remote laboratories** and **simulators**. In the first, the student actually operates the equipment found in a physical laboratory by means of commands that are transmitted via the Internet (in the same way in which in some cases we can remotely control the central heating or the refrigerator). The second are software environments where the student interacts "fictitiously" with specific phenomena or processes.

In these cases, the student will carry out the simulations themselves, as when they enrol in the online format they usually do so to work at home and it is difficult to meet up physically with their classmates for practice. In any event, they will use the communication tools to draw conclusions or write reports. Only a meaningful teaching strategy by the lecturer can condition the student to conduct the complete simulation with their classmates.

These laboratories are becoming increasingly important with universities, but a lack of industry in this field has been observed. These laboratories or simulators are usually created at the universities, with very few resources.

Consequently, the problem of practice is one of the main obstacles to the online teaching of Engineering degrees.

Scientific writing

Another aspect that hinders teaching and learning in engineering and mathematical and physical sciences in an online environment is scientific writing. Normally, forums and e-mail permit only the writing of text. Today, some virtual campuses or LMS, such as the commercial Blackboard-WebCT®, have incorporated an equation editor on their forums.

However, this is a partial solution because it permits the writing of formulas but it does not facilitate the drawing of graphs and diagrams, which are basic tools in the communication of this type of content.

Also, the existing equation editors on virtual campuses have two limitations: they are not able to write all of the symbols used by the scientific community and they are not comfortable for the quick and informal writing that should be a feature of forums.

Consequently, both scientific-technical students and teachers face many difficulties in expressing themselves in an online environment.

The future, and the present in some universities, may come in the form of tablet PCs, which allow manual writing using a computer. On the La Salle virtual campus (Ramon Llull University, Barcelona), the forums provide the possibility of writing manually on a *virtual blackboard*.

The concentration subjects

A methodological, but not technical, problem of technical and scientific degrees is the great quantity of concentration subjects that there are. In concentration subjects, the student has to attain objective knowledge without any ambiguities. This type of knowledge can be acquired autonomously without communicating with classmates and teachers, unless students want to resolve any doubts. These subjects traditionally promote the figure of what we have called the **free student**, who does not communicate with others unless a methodology is planned that tries to prevent this attitude. Bautista *et al*. (2006) provide a number of strategies for the development and monitoring of online training actions.

This figure is dangerous as community study can motivate and it gives an idea of a person's level of knowledge by comparing them with the others, whereas the solitary student may generate false hopes and bad planning that could end up in failure or drop-out. We are evidently speaking in general terms and there are exceptions with highly disciplined free students who can successfully follow the contents asked of them.

However, as the new European Higher Education Space explicitly states that every university student must attain certain social skills, the engineering disciplines must plan specific work methods in these skills.

For example, in online subjects at La Salle, students have to work together in drafting work. They are advised that the organisation

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and planning of the tasks, the way of managing information on the virtual campus and the way that they communicate between each other is part of their assessment. Also, not only is the correct nature of the results taken into consideration, but also the didactic skill and the presentation of the reports that they draft. This way, in a concentration subject such as Electromagnetic Propagation, the transversal competences that an engineer has to attain are developed and an attempt is made to avoid the figure of the free student.

In other types of common subjects in the engineering disciplines, such as **design** or **dispersion**, where students have to create complex models or systems (circuits, programs) in which more than one solution is possible, debate is intrinsic and it is not difficult for students to collaborate on the design. However, it is necessary to be aware that the communication tools used in these debates also have to enable scientific writing and graphs and formulas.

Synchrony

We have given an outline of some of the technological tools that are required in scientific and technical subjects: videos, equation editors, possibility of manual writing, etc. However, there is one aspect that we have not touched on: synchrony.

The face-to-face student has the possibility of immediate response. When a concept is unclear, they can speak directly to the lecturer and their classmates and establish a series of questions and answers that provide instant clarification of the concept. It goes without saying that debates may be more alive and fluent if there is synchrony (despite the fact that asynchrony, by being more uncomfortable and slower, enables answers to be more reflective and focused on the topic). Also from a human perspective, primarily if there is a videoconference, synchrony strengthens relations.

On virtual campuses, the most commonplace synchrony tool is chat, but it is not sufficient for scientific debate. Chat does not make quick scientific writing possible. Therefore, there is a need for shared blackboards on the web, with the possibility of an audioconference (better if it is a videoconference) to hold synchronous debates of a technical or scientific nature.

To this end, La Salle has also developed the graphical-synchronous virtual classroom that enables communication through free-for-all videoconferencing, and the possibility that everyone can write on a shared blackboard or slide presentations.

Other very useful synchronous tools would be *application sharing*, where different students can work on the same file at the same time, and *desktop transmission*, where all the students can view the lecturer's computer screen.

All of these tools will make it possible for technical profile students to feel comfortable on a virtual campus, traditionally very limited for this type of teaching.

4. Conclusions

It has already been seen that students' profiles are very different according to the criterion that we use to make the classification. We can take into consideration their personal circumstances (especially employment and geographical), their study habits (autonomous, collaborative, etc.) and the disciplines on which they enrol.

From the universities' point of view, all the first and third profiles should be taken into consideration, and thought given to whether any study habit is admitted or not.

In the case of students in technical disciplines, we need to think of the specific technological needs that they have. It is not enough to use tele-training systems that work successfully with a certain type of degree for any other discipline. Specifically, technical difficulties are perceived, especially in scientific studies.

To promote the profile of the social student, the communicative person who wants to learn by collaborating with their classmates and teachers, suitable communication tools are needed that enable both asynchronous communication, the most usual to date on virtual campuses, and synchronous communication. Similarly, it is necessary for the tools to allow the same learning resources that the students have historically used in learning certain resources to be used comfortably, such as the possibility of drawing on paper (albeit electronic).

Other potentialities such as application or desktop sharing are more than desirable for online students, who, if they have timetable availability, will very often coincide in time when they study.

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