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E-learning:
new strategies and trends

Abstract:

The aim of this paper is to present a personal point of view on the possible future trends in distance learning. The starting point of this study is represented by a review of the main innovations in digital and information technologies. This step is necessary since the evolution of distance learning is strictly correlated to the evolution of the technology that can be exploited to increase learning quality.

The main arguments discussed in this paper are: massive open on-line courses (MOOCs), flipped classrooms and the evolution of the learning objects based on web and on internet technology. Concerning MOOCs, a critical analysis of the status of this type of learning is necessary to understand their possible evolution and/or their substitution. A huge number of case studies demonstrated the validity of the flipped classroom and the possibility to adopt this approach into e-learning is surely interesting. The last part of the paper is instead dedicated to future technologies like: mobile learning, 3D virtual laboratories and internet of things. As discussed, this latest innovations can push the evolution of distance learning offering real student-centered solutions.

Keywords: e-learning, massive open on-line courses (MOOCs), virtual laboratories, flipped classroom, internet of things.

Summary

Fecha de entrada: 11-07-2016
Fecha de aceptación: 14-09-2016

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E-learning:
nuevas estrategias y tendencias

Extracto:

El objetivo de este trabajo es presentar un punto de vista personal sobre las posibles futuras tendencias en la enseñanza a distancia. El punto de partida de este estudio está representado por una revisión de las principales innovaciones en las tecnologías digitales y de información. Este paso es necesario, ya que la evolución de la enseñanza a distancia está estrictamente correlacionada con la evolución de la tecnología que puede ser explotada para aumentar la calidad de aprendizaje.

Los principales argumentos abordados en este documento son *massive open on-line* courses (MOOC), *flipped classrooms* y la evolución de los objetos de aprendizaje basados en la web y en la tecnología de internet. En cuanto a los MOOC, realizar un análisis crítico de la situación de este tipo de aprendizaje es necesario para entender su posible evolución y/o su sustitución. Un gran número de estudios de caso demostraron la validez del *flipped classroom*, y la posibilidad de adoptar este enfoque en el aprendizaje electrónico es sin duda interesante. La última parte del artículo se dedica a las futuras tecnologías, tales como el aprendizaje móvil, los laboratorios virtuales en 3D y el internet de las cosas. Como se ha expuesto, estas últimas innovaciones pueden impulsar la evolución de la educación a distancia, que ofrece soluciones reales centradas en el estudiante.

Palabras clave: *e-learning*, *massive open on-line courses* (MOOC), laboratorios virtuales, *flipped classroom*, internet de las cosas.

1. CASE STUDY DEFINITION

When discussing about the next future trends in distance learning, the first step to take into account is the definition of a reasonable time-scale. During last years, we observed an exponential increase not only in the number of students enrolled worldwide in distance courses, but also a rapid changing in the pedagogical and technological techniques used to offer modern and effective courses (Beetham and Rhona, 2013). Due to this impressive evolution, is not possible to discuss future scenarios considering a period longer than 10 years.

Due to these assumptions, in this paper we want to discuss possible future evolutions of e-learning fixing a maximum guess at year 2025, i.e. about 10 years from now.

Before entering into the specific discussion, and with the precise aim to better explain what means looking at 10 years, in the next section we briefly summarize what happened in the last decade.

2. PAST DECADE

For its own structure, the evolution of distance learning is directly related to the evolution of technology. If ten years ago we discussed about internet and web, now we already experienced Web 2.0 (Fuchs *et al*., 2012) and we are discussing about the society changings that can arrive through the use of Web 3.0 (Garrigos-Simon, Lapiedra and Barberá, 2012), semantic web (Li *et al.*, 2013), artificial intelligence (Frankish and Ramsey, 2014), etc. These changings do not mean new improved releases of something already in use but they imply a deep, and often not predictable, revolution in our everyday life.

Taking as examples the most important technologies connected with distance learning, we can try to remember how websites, mobile phones, laptops and video games were in 2006.

2.1. Websites

For the sake of curiosity, in Figure 1 we compare how a well known website, in our example the Italian version of Yahoo, has changed from 2006 to 2016.

For the one who want independently perform this exercise, there are various websites conserving old version of the most known web portals (Wayback Website).

Obviously, the difference of the two versions is not only in the graphical aspect. Due to always increasing use of social networks, portals have integrated these functions directly in their homepage. If ten years ago the social part is restricted to the use of forums and messaging services, now we can login to each social networks directly from the portal being automatically recognized. This permits to create a sort of digital identity card containing our preferences, habitudes, etc.

As clear, the evolution of the web has strongly influenced both teaching and learning aspects offering new solutions and ways of interaction (Rennie and Morrison, 2013).

2.2. Mobile phones

During the last decade, we assisted to the appearance on the market of the smartphones (Falaki *et al*., 2010). These devices have completely changed our way of learn, work, communicate, make shopping, etc. If 10 years ago smartphones were still considered high gamma mobile phones, nowadays they have completely saturated the market. Moreover, the characteristics of these devices have increased tremendously offering now low-cost smartphones with: large display, internet connection, a complete series of embedded sensors, touchscreen, together with a huge number of applications, most of them completely free.

Figure 1. As an example to show how internet technology has changed in the last 10 years, a comparison between Italian version of Yahoo 2006 (first) and 2016 (second) is shown in the picture

Source: Wayback Machine.

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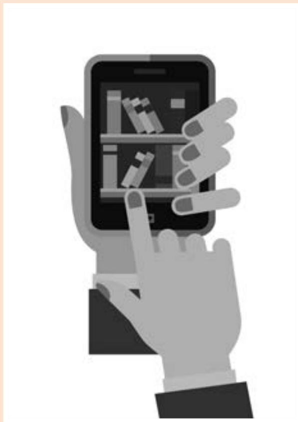

Today, after various years of MOOCs, is necessary to analyze which are the real advantages, **disadvantages and deficiencies** of this kind of courses

Learning directly related to mobile phones is an important sector of e-learning, often called m-learning, and a particular attention of the possible evolution of this trend will be analyzed in the following sections.

2.3. Laptop and video games

The evolution of computer technology, and in particular the one of the portable laptop devices and of the videogames, is well clear and known to everybody. Concerning laptops, as already discussed for smartphones, the main differences between present products and one of 10 years ago are not only in the weight and/or dimensions. The technology presently available permits to have low cost mobile devices that are more powerful than a 2006 top-gamma computer. This «popular» technology is one of the co-cause that has permitted the evolution of the distance learning we have experienced.

Exactly the same evolution has been observed for video games and the reason is well clear when considering the possibility offered by always more powerful platforms when running these applications. As clear, this sector is strictly correlated with distance learning and in fact we speak about gamification in learning indicating the use of game base solution to increase and optimize the learning process.

Starting from these considerations is well clear what are the sectors to be observed to try to guess the possible future evolutions of distance learning.

Focalizing our attention on specific tasks, in the next sections a personal point of view will be reported analyzing the present status and the possible future evolutions of:

- MOOCs.
- Flipped classrooms.
- Multimedia products.
- Bio-customization (intended as active student-centered learning).

3. MOOCs

MOOCs probably represent the most known and famous learning approach in distance learning (Mc Auley *et al*., 2010). The reasons for that are various and surely include the contribution brings to MOOC by the most important universities worldwide. Especially during their first editions, this kind of courses enrolled an enormous number of students since they offer the possibility, for free, to be enrolled (even if you are not really enrolled) in these institutions.

Today, after various years of MOOCs, is necessary to analyze which are the real advantages, disadvantages and deficiencies of this kind of courses.

Surely, the social aspect of this course is not under discussion. In the majority of the case, a student everywhere, only with an internet connection, can access to a university level instruction. Especially in such countries, MOOCs are the only possibility for a large number of students interested in acquiring specific and important knowledge (Rosé *et al*., 2014).

If the social aspect represents a not-under-discussion aspect, the main problem of this kind of course is the very low retention rate (Onah, Sinclair and Boyatt, 2014). In particular, all the possible problems underlined by case studies with MOOC can be contextualized as causes of the high dropout.

(...) massive courses have to be considered not as a mature product but still as a Research and Development (R&D)

Even if data related to MOOCs strongly depends in the specific course, the average number of students arriving to the final certification (or at the end of the course after the completion of the entire didactical path) is always well below 10 %. Which are the origins of this trend? Summarizing information coming from different studies, an always not complete short-list can be:

- Student lack of time.
- Course difficult.
- Lack of support.
- Lack of digital skills.
- No possibility of interaction with peers and instructors.

Even if in the last years some technological features have been included in MOOC to facilitate communication between students, these courses still have important deficiencies to be taken into account.

As known, present approach tends to the creation of a student-centered learning environment universally recognized as the arriving point for an effective learning (Nanney, 2004). Analyzing MOOCs, they are exactly the opposite of a student-centered learning environment. For their own structure, since thousands of students are enrolled in the same course, the possibility of interaction with instructors is practically negligible. Moreover, for a large number of courses, offered especially by traditional universities, activities only consist in face-to-face lessons recorded and delivered online through official channels and/or through dedicated web-services.

As already discussed at the beginning of this section, the social impact and importance of the MOOCs is not under discussion but the learning revolution that these courses should have had did not take place (Aguaded-Gómez, 2013). The reasons behind this are various but principally we can affirm that one of the main problem of this kind of courses, as they are realized up to now, is that the students enrolled in this courses are not the center of the learning-aim but they satisfy what can be considered as the golden rule of internet: if you are not paying for a product, you are the product!

After these considerations, massive courses have to be considered not as a mature product but still as a Research and Development (R&D). To change this consideration different actions and modifications have to take place in order to offer a real free effective learning possibility.

3.1. Possible alternative solutions

In order to solve the evidenced criticisms of MOOCs, various changings have been proposed and are already in use in different institutions.

First of all, the main problem of MOOCs is in the adjective «massive» that has been used as a flag to demonstrate the possibility offered by everyone to access to university level learning.

Having a course with thousands of students imply different problems that produce the deficiencies discussed in the previous section. In particular, each student enrolled in the course should have the possibility to contact his instructors in such a way (forum, mail, synchronous event, etc.). As clear, this is impossible when an instructor is responsible of a course with a large number of students and, even worst, when MOOCs are realized delivering on-line face-to-face lessons.

Moreover, giving the possibility to everyone to be enrolled in a course this produces the result that a student begins the curse and only after a couple of lessons he realize that the arguments of the course do not satisfy his interest. Obviously, in this case this student is enrolled but not active contributing to the dropout rate.

To solve these evidences, the best solution is to include a step-by-step selection in these courses. With «selection» we intend a first access test to verify that the interest of a possible student agrees with the argument of the course. Moreover, the course has to include assessment tests, at various levels, to verify students progresses.

Including these features we have the possibility to select smaller classes with real interested students giving also the possibility to the instructors to guide participants. In this context, MOOCs become selective open on-line courses surely implying a greater commitment both for the institutions organizing these courses and for the instructors but only in this way we can offer something useful for the community. It is not possible continuing offering courses that are free only because they cost zero for institutions. Only changing this trend we can stop universities, instructors and students wasting time and exactly for this reason this proposal has not to be intended as an enemy of the social interest but as a necessary evolution to offer something really useful for society and not only to web services only aiming to transform students into numbers.

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4. FLIPPED CLASSROOM

Continuing the analysis of the current trends of distance learning and trying to imagine what could happen in the next years, we cannot forget flipped classrooms (Tucker, 2012). In every scenario we can imagine, the pedagogical approach used in e-learning is a fundamental aspect to be considered.

As clear to all, in a flipped classroom, some or most of direct instruction is delivered outside the group learning space using video or other modes of delivery. Class time, then, is available for students to engage in hands-on learning, collaborate with their peers and evaluate their progress. Moreover, teachers can exploit this time to provide one-on-one assistance, guidance and inspiration.

As demonstrated by various case studies performed, the flipped classroom approach surely satisfies the desired student-centered learning environment (Herreid and Schiller, 2013).

What are the current problems of flipped classrooms? As partially discussed in MOOCs section, such institutions, not only universities but also secondary schools, realize flipped classrooms moving boring lessons on web and giving to students a room to make their homework. Moreover, exactly as happened for massive courses, the lessons delivered on-line only consist in traditional face-to-face lessons recorded in class and uploaded to dedicated web pages.

As clear, to create a real effective on-line learning, the out-of-class activities must include: video lessons specifically realized, multimedia products to improve learning process, virtual laboratories to show examples and case studies, etc. In other words, the best solution for the on-line activities in a flipped classroom is offered by the products obtained thanks to the R&D realized for distance learning in the last years! This assumption clearly shows the optimal union between distance learning and flipped classroom pedagogical approach.

4.1. E-flipped classroom

The main question now is: is it possible to use this approach in an on-line university? To answer to this question we must consider two different cases: blended or fully on-line courses.

When considering blended courses, surely the flipped classroom approach is simply usable. The on-line part of the course is used to deliver lessons and other activities while the face-to-face slots are used for guidance and for the other activities already discussed.

Completely different is the situation when considering fully on-line courses. In the traditional flipped classroom method, face-to-face sessions are considered mandatory. Today, thanks to the huge R&D done in distance learning and with the tools offered by modern technologies, we can simply supply at this lack miming on-line presential activities.

Just to give some examples, face-to-face lessons can be substituted by multiplayer virtual laboratories to offer hands-on experiences, smartphone based laboratories to offer real hands-on activities especially for Science, Technology, Engineering and Maths (STEM) subjects (Martini, 2014), forums or dedicated hasttag on social networks to offer collaborative virtual spaces under the guidance of the instructor, etc. Obviously, this is only a preliminary list of ideas that can be extended with more activities and solutions.

Following the current trend for the name related to distance learning, we can define this approach «e-flipped classroom» to underline the important role of technology in this technique and to show the fully on-line solutions proposed for both on-line and on-site activities.

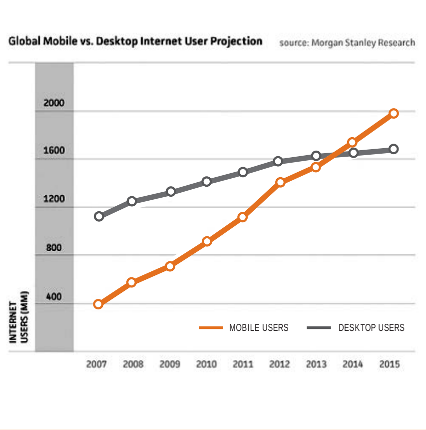
In this case, as in every solution related to distance learning, the role of the teacher is fundamental and he must be the principal engine ready to propose new ideas and solutions. In this sense, the role of teacher cannot be only in lessons preparation, as it was for traditional learning, but has to evolve even more in the next years.

5. NEXT EVOLUTIONS OF VIRTUAL LABORATORIES

One of the most important aspects of distance learning is surely the use of multimedia products realized to facilitate the learning process and to supply laboratory experiences in fully on-line courses. This sector has grown too much in the last decade thanks to the huge work done by institutions and their capacity to exploit the evolution of technologies. To try to imagine what can happen in the next years we have to take into consideration, as done in the previous sections, the present trend in technology.

Strictly considering multimedia products, surely each solution will evolve in a multiplayers form fundamental not only for the reasons already discussed but also to permit to our students to develop teamwork skills. As clear, present and future, labor market strongly requires this ability asking for professionals immediately able to be inserted into teams assuming the responsibility of a specific task. In particular, taking as example a multimedia product reproducing work activity, in the multiplayer form each student has a specific role and his work depends on the activities off all the other students playing the simulation. Obviously, for various field, this is the real situation in which our student will be inserted once started a job activity.

Figure 2. Mobile versus desktop internet users



Source: Chaffey (2016).

5.1. Mobile learning

Today, and even more in the next coming years, mobile technology plays a fundamental role in e-learning activities (Wen-Hsiung *et al*., 2012). As clear, each solution, product or activity is now realized using responsive technology and permitting delivery on every device. This aspect is fully justified observing Figure 2. In 2014, for the first time, mobile users exceeded desktop users (Chaffey, 2016). This fact clearly demonstrates the current trend of our society and obviously it cannot be neglected when thinking about the next evolution of distance learning.

Unfortunately, also in this sector, in the last years we have exploited mobile devices in a wrong way or, at least, under-exploiting their possibilities.

Up to now, also thinking about responsive technology, we have only asked to have solutions usable also on mobile phones. In other words, we have requested products usable on the small screens of our smartphones and tablets completely under-exploiting these devices.

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Figure 3. **Smartphone based experience to measure friction coefficients of different materials**

Source: pictures taken by author during laboratory experience.

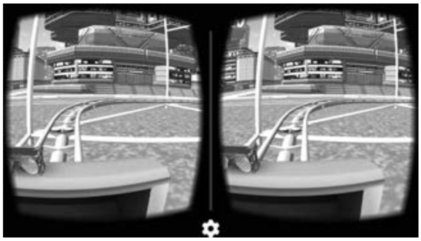
Today, an entry-level smartphone, with price around 100 USD, has a large number of embedded sensors that are used for various applications and features. This equipment includes: gyroscopes, accelerometers, light sensors, pressure sensors, temperature sensors, cameras, microphones, etc., and can be used for the creation of various active laboratory experiences. A large bibliography already exists in this sector (Martini, 2014) but this possibility has been used by distance learning only in minimal part. Just to give an example, in Figure 3 the experimental setup for an inclined plane experience with smartphone is shown. In this activity, students measured both static and dynamic friction coefficient using only a smartphone fixed to settable inclined planes realized with different materials. As clear, this is only an example but the possibilities offered using the smartphones, not only as a passive device to show lessons but also in an active way exploiting their features, are infinite. Surely, in the next coming years this sector will continue to grow-up representing an important part of the didactical laboratories for both traditional and distance universities.

One of the most interesting trend observed in mobile technology in the last years is in the possibility to use these devices to create virtual reality environments

5.2. M-learning 2.0

One of the most interesting trend observed in mobile technology in the last years is in the possibility to use these devices to create virtual reality environments. In particular, different private companies have started a huge R&D to produce smartphone-based visors using a series of lens giving the sensation to be inside a virtual world (Desai *et al*., 2014). The active part of this system is constituted by the smartphone that is used to show specifically realized movies. Not entering in technical details, these videos are produced with two quasi-overlapped views of the same scene, as shown in Figure 4, while the optical system permits the creation of the virtual environment.

Figure 4. Screenshot from a video to realize 3D environment



Source: screenshot from «VR Roller Coaster 3D SBS» for Android system.

Exploiting embedded sensors, the virtual environment can be explored just moving the head in each direction and giving the sensation to be inside the scene.

As discussed, the most promising devices use last generation smartphones as active part. Different companies are also developing stand-alone systems that include high-resolution displays, sound systems and sensors but in this case the price is slightly higher (Oculus site). Moreover, from a distance learning point of view, the solution using smartphone coupled with simple visor is more interesting since students can use their own smartphone directly at home. In particular, this technology can be exploited to produce multimedia products in virtual reality. Just to give some examples, we can try to imagine a virtual lab on Roman history in which a student can be immersed walking into the streets of the ancient Rome directly observing the original form of the monuments, how people work, the clothing and so on (see Figure 5.1). Analogously, a student enrolled in high energy physics courses can enter inside the hall of one of the big experiment now in use, for example ATLAS at CERN, studying single detectors, the path of the particles, the necessary services for the experiment, etc.

Figure 5.1. Example of 3D environment for multimedia lab

Source: «Digital Model of Ancient Rome», project of Chicago University (https://lucian.uchicago.edu/blogs/vrc/2012/04/06/rome-reborn-a-digital-model-of-ancient-rome/).

If the didactical power of these solutions is clear to all, one question that can arise concerns the cost, both for universities and students, and the difficulties related to the realization of these activities.

Figure 5.2. 3D cardboard visors by Google

Source: Amazon.uk.

Starting from the cost, the situation is very clear. At the beginning of this section, we focus the attention on the 3D-visors using smartphones. Why this? As already cited, first of all, in this case students can use their own smartphone since these devices is owned practically to all with a starting price very low. Second, the most common visors have price around 100 USD and also in this case we are considering solutions not too expensive. Moreover, now the market offers new low-cost products made by cardboard. In particular, the most common low-cost cardboard visor is produced by Google with a starting price of 10 USD (see Figure 5.2) (Cardboard site). This assumption makes these solutions absolutely sustainable for students.

Concerning the realization of the multimedia 3D laboratories, we must distinguish between two different cases. The first solution regards multimedia products based on real registrations. In this case, to produce the 3D video the recording requires special 360 degrees camera that are available, now, with very high cost (Camera site). Completely different is the case of multimedia products realized in computer technology for which each image is realized in computer graphics. In this case, the cost is completely equivalent to the one for the realization of multimedia products surely implying the presence of a team including graphic experts. This means that the necessary technology to start this new revolution is already available and ready to be use.

Today, is already available also the so-called LEAP motion system (Weichert *et al*., 2013) that permits the manipulation of objects in the 3D environment. Even if now these systems have still a high price and a not well defined precision, in the next years also this technology will become available for everyone permitting the realization of active virtual labs in which the student will be immersed realizing the indisputable equivalence between real and virtual laboratories.

For the sake of completeness, the actual principal problem of these laboratories is related to the battery duration of the smartphone when it is used inside the visor. In particular, the reduced duration is due to the quite high temperature reached by the smartphone in the closed space inside the system. Also in this case, this problem will be solved in a couple of years since there are under development solution with integrated fans to cool down the entire device. Thinking on the ten years scenario we have declared at the beginning of this article, and considering the evolution we have had in the past years, also batteries technology will constantly evolve offering solution always more performing.

6. BIO-CUSTOMIZATION

The last aspect that will be considered in this article is strictly related to the web evolution. The inclusion of this aspect in this (personal) overview of the future trends in distance learning is obvious. The birth and evolution of e-learning and distance learning are strictly related to the web technology available. Every change in this sector implies modification in the possibility offered to deliver contents and in the way of thinking each learning tool.

Considering the present trend in Information Technology and web, surely an important aspect to be taken into consideration is the so-called «internet of things» (Gubbi *et al*., 2013). Using simple words, in this philosophy all objects (things) are connected to internet and their functioning depends on the status and evolution of all the other objects. Just to give a simple example, try to consider this situation: we have to wake up and use public transportation to go to the airport where we have a flight. The wake up alarm has not to be set when going to sleep since it will be automatically regulated depending on the status of the public transportation, traffics, flight delays, queues in the airport, etc. All these information are communicated by each single object of the network changing, instant-by-instant, the functioning of each node of the network.

Can we adopt this philosophy in distance learning?

6.1. Internet of students

As clear to all, the behavior of each student depends on various factors and also the learning process of each student is different. In this context, and with the precise aim to realize a real student centered learning, we cannot think to have lessons and learning contents equal to every student in every condition but the «system» must be adapted continuously monitoring student information.

This architecture can be surely realized in the very close future acquiring data able to describe student condition. To be effective, this data must be able to identifying the precise condition of a student including: mood, fatigue, desire to study, etc.

In order to satisfy the creation of the sensors network two interesting technologies can be taken into consideration. The first one is offered by the now under development anti-plagiarism systems (Tesla site). As known, these systems are now under study to precisely identify a student when he is connected on-line. The importance of this system is well clear to all and a recognition with negligible error will permit the remote identification during exams and tests performed on-line. Data acquired in these systems include: face recognition, keystroke, voice, etc. As clear, a correct interpretation of this data will permit a precise identification of the status of the student. Systems like this are already developed but their functioning is only limited to the principal mood: happy, sad, cheerful, relaxed, etc. Improving these algorithms we can imagine, in the next few years, to be able to precisely identifying the status of a student calibrating his learning path.

The second interesting solution now in an infant status is the wearable technology (Barfield, 2015). In this context, different devices are already present in the market: smart watches, smart glasses, Radio Frequency IDentification (RFID) chips, etc. Beside their specific function, that depends on the system considered, these devices acquiring important data related to the person wearing them. As an example, we can have information on blood pressure, heart rate, brain activity, etc. This data will represent a second important sample to be used to determine the status of a student.

Concerning the identification algorithm, surely the parameters to be used and their correlation is the most difficult aspects of the IT architecture. The R&D to develop a precise and reliable algorithm is not simple but various scientific fields already develop and use philosophy that can be adapted to this feature. Just to give some examples, in high-energy physics or in astro-particles physics, neural network are often used to disentangle parameters and to determine the exact correlation of the input data (Paterson, 1991). These algorithms can be adapted for student status-recognition thanks to the specific learning that the neural network has to be done for each student.

7. CONCLUSION

Trying to imagine the next 10 years scenario for distance learning is not simple but is necessary, nowadays, to focus the present R&D and to make the investments effective. Observing the evolution we have experienced in the last 10 years we have underlined how internet, computer technology, mobile technology and video games have drastically evolved in a very short time period. Starting from these assumptions we have analyzed different future scenario concentrating our attention on: massive courses, flipped classrooms, multimedia products and wearable technology. Each of these examples offers an overview on important aspects of the distance learning passing through pedagogy, social aims, virtual laboratories and student-centered learning.

> What is clear is that teachers have to modify their status coming down from the chair and evolving into a real guide for the students and this is true not only for on-line universities but also for traditional universities

Concerning MOOCs, surely their social importance is not under discussion but these courses still today, after years of delivery, suffer important deficiency not yet solved. Summarizing the input coming from students enrolled in massive courses, the proposed learning structure appears as not mature and, in other words, still in a R&D phase. Every future evolution of MOOCs will include a step-by-step students selection necessary to permit instructors guidance and point out to student themself what are their interests. Unfortunately, very often these courses are not realized with the not-under-discussion social aim but only to enroll the biggest number of students.

An important pedagogical approach to be taken into consideration is the one offered by flipped classroom. Even if this solution is today used in a wrong way, delivering on-line face-to-face lessons and not giving the correct importance to the onsite activities, the use of this approach in a fully on-line environment is possible exploiting modern technology. In particular, the on-line part of the flipped classroom reaches the best efficiency when is delivered exploiting the solutions already developed for distance learning.

When considering technological devices evolution, each considered scenario couldn't exclude mobile technology. In the past years mobile users have definitively overcame desktop users imposing the passage to a real mobile learning. Unfortunately, when considering the possibility presently offered by online universities, we are using mobile devices in a completely wrong way. In particular, and following responsive technology, we are now offering learning products only usable on the small screens of smartphones and tablets. These devices offer a huge number of sensors that can be exploited for the realization of active and effective multimedia products. In this context, and using the embedded sensors, smartphone can be used to realize real at home laboratory activities. Even if the bibliography in this sector is very rich, these solutions are now used principally in traditional institutions. Moreover, an interesting technological trend now under study aims to realize 3D virtual environments using smartphones. As discussed in the article these solutions are now possible and their cost is negligible both for institutions and students, especially when considering the didactical impact of 3D laboratories on learning process.

The last aspect to be taken into consideration when imaging future e-learning scenario is the possibility offered by internet of things. Trying to couple this philosophy with the possibility offered by anti-plagiarism systems and wearable technology we can think to realize algorithms able to constantly monitor our students changing and adapting their learning path as function of their personal and social status. This medium term scenario will definitively realize what is defined as a student centered learning, with personalized solutions different in every moment.

Surely, each of these scenarios implies a re-organization and an evolution also of the instructors and of the institutions. Despite every consideration related to computer support, the role of the teacher is fundamental in every condition we can imagine. What is clear is that teachers have to modify their status coming down from the chair and evolving into a real guide for the students and this is true not only for online universities but also for traditional universities.

Concluding, the real solution to focus R&D and decide which are the most effective sectors in which invest money and time come interpreting what society is asking to universities through technology. If we are not able to anticipate society needs we will not able to offer right learning solutions.

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