REVIEW OF THE CUTTING-EDGE TECHNOLOGY EMPLOYED IN MEDICAL EDUCATION

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Abstract

The new technologies have advanced astonishingly in the last few decades. There are more and more Medical Schools adopting new tools to teach Medicine to undergraduate students or even to teach the continuous training for professionals. Not all the Universities adopt these technologies at same level or same grade of the speed but as a result it seems that they will adopt more and more often the new technologies as part of the curriculum.

This paper wants to be a review of the state of the art technologies that have stepped in the Medical Schools in the last decade. Overall, we want to describe the function of these new tools, how all of them have been adopting to teach Medicine answering most part of the demands of physicians and how they could be evolved in the future to continue making the medical education a new revolutionary industry in continual progress. Not only that, it makes the engineering biomedical a field very interesting to explore and to be invested on, as they could enhance the skills of new professionals of Medicine to be prepared for the digital environment where they will work on. It is important to notice that the advanced technologies are enhanced at more speed than the education is able to adopt in. Sometimes, the reason could be the unawareness of these technologies. Occasionally, it could be the money needed to invest and from time to time it could be that the leaderships of Medical Schools are not convinced enough that the new technologies will work.

Keywords: Higher Education, mobile apps, mhealth, technology, biomedical engineering, mobile devices.

1 INTRODUCTION

The use of new technologies in Medical Schools is becoming a growing tendency. Step by step, Medical Schools have been adopting different tools or new technologies to enhance the methodology for teaching and even for learning. Some countries and leaderships are more proactive to implement them [1].

The new technologies are emerging very fast and they have reached to some limits that we have ever thought before. Besides, there are some tools or machines that are used now by physicians when they used to do it in another way. All these tools appear motivated basically by the demands of the users (physicians and students) in order to make a good service to the Society. Besides, they may be encouraged as well by Educational Institutes in order to improve the quality of the studies as they will make the recent graduates be the best prepared for the “real” work. Moreover, medical education is even a field that have evolved a lot but contain yet a great potential for the future with new ways of enhancing the learning [2]. Maybe, this could be a reason that the Medical Engineering is currently becoming more relevant.

The aim of this paper is make a brief review of the main technologies that have been appeared in the last decade, how they could be included by the Universities in the curriculum and the main reasons for not doing it.

The study is divided in three parts. First, a brief introduction of the different machines and tools that have appeared in the Medical Engineering and have been used in education. Second, it covers the reasons for not implementing these emerging technologies and finally, the conclusion of the analysis.

2 NEW TECHNOLOGIES

In this section we want to show the main structural technologies that have been evolved for the last decade and they are currently available for physicians. Due to the great amount of them, this paper is

only focused on the main three lines that we consider to be more relevant and more functional for the academic environment.

- Atlas of Anatomy. These tools are very useful for physicians. Traditionally, this atlas was printed in books. However, the new technologies allow people to access the atlas using other type of devices (such as computers, mobile devices, etc.). The digital atlas is a computer program that allows student to analyse the different parts of the body that are presented in the three basic planes of the brain (axial, coronal and sagittal). It is possible to visualize the images in any spatial position.
- Simulation. The simulation tools are becoming more and more sophisticated tools for learning and relevant for students of medicine. They could simulate the application of the theory in order to avoid that the first time that they have to tackle with a patient, they did not know what to do as at least they already have an experience the most similar to the real one.
- Google Glass. These tools were launched on April 2012 with a prototype. It has multiple applications and they allow the developers to create different apps for this new wearable device.

2.1 Atlas of Anatomy

The origin of the atlas of anatomy could be considered with the introduction of MRI (Magnetic Resonance Imaging) Technology in the early 1980s [3]. It was the first step to evolve this technology obtaining higher quality medical images that have been used in different applications (clinical studies, surgical planning) [4].

The aim of the anatomical atlas book is “to compile medical observations and give a qualitative description convenient for a skilled physician” [5]

There have been very researchers about the digital anatomical atlas [6-13]. Some years after the National Library of Medicine (NLM) decided to support a project, they set up a library of biomedical images and it was called the Visible Human Project [14]. The project was completed on 1995 and the images were used in different disciplines, even virtual reality [15]

The evolution of these tools has been astonishingly relevant for the last years. For example, one collaboration between physicians from University of Salamanca and University of Barcelona created new computer software in 3D and interactive for anatomical image viewer and it was a categorical success. From that first development, the authors wanted to improve this application in order to study new pathologies. With this information, they created a new viewer about Parkinson illness. As the authors explained: “They want to give a solution with an anatomical aspect for a clinical problem” [16]

As a result, the anatomical image viewer and atlas are being considered critical in many aspects for medical education. Not only that, the atlas was traditionally accessed printed on paper, after that, it was possible to consult the information using computers and they are evolving to be running on different devices as smartphones, or tablets. All of these steps provide some evidences that the evolution of the technologies is constantly in progress and they are following overall the different necessities and demands on society, and in this particular case, on undergraduate students and medical professionals.

2.2 Simulation Environment.

According to the reference [17], definition of simulation could be: “A method used in health care education to replace or amplify real patient experiences with scenarios designed to replicate real health encounters, using lifelike mannequins, physical models, standardized patients, or computers”.

There are different types of simulators. According to the reference [18], they can be categorized as:

- Standardized patients. Using actors during a medical examination.
- Partial-task trainers for specialized skills.
- Mannequins. It is a full-body robot managed by a computer.
- Screen-based computer simulators. They are displayed on a computer screen.
- Virtual-reality simulators. They help in training showing 3D images of organs and anatomy.

Toward the end of the 20th century, the human patient was introduced in the simulation. This milestone could be considered a big step in the evolution of medical education [19]

The interest for the evolution of this tools is relevant, and most part of the Medical Education have adopted new gadgets for their students as they are considered as good instruments for enhance the students' knowledge.

2.3 Google Glass

They were launched on 2012. This gadget was considered a revolution within the wearable techniques and the potential they could achieve, we think it is still unknown. However, this is the main reason we took it into account to include in this paper. Besides, we think that this gadget has to demonstrate yet its talent dormant.

One definition of Google Glass could be a gadget that "provides an experience known as augmented reality, where images are superimposed over what the user sees in real life" [20]. The utilities of these new tools could be very varied: from sports, driving, cooking, and even medical education. It could create an ecosystem with their own apps completely connected with Android Mobile devices.

This tool was used by different Schools of Medicine (such as University of California, San Francisco UCSF). The Ohio State University Wexner Medical Center used them for different applications in the operating room. For example, they utilized them in an operation where it was needed the assistance of a person outside of the room. [21]. University of Arizona Medical Center, for example has used the Google Glass to photograph angles in surgery that they did not know how to reach [21]

Thus, the possibilities for the Google Glass are very relevant for teaching surgical techniques; there are a lot of possibilities and scenarios where the physicians could use it. In fact, it is possible that the functions are still unknown. What it is a reality is they have an incredible potential for the future, but we think that this is something that it is needed to be demonstrated yet. Although there are some Medical Schools that are using them, the Google Glass have been harshly critized. They have a lot of limitations (such as the privacy and data security), the quality of voice is very poor, and it is very slow [22]. The experience of user has to be improved. This made the gadget be on stand-by until probably a new launch expected to be on 2015 [23].

3 REASONS FOR NOT ADOPTING

There are some researchers than reported the student acceptance of technology or even mobile technology in particular in education. They have to face a lot changes and are very open-minded to new technologies. As a result, they are ready to embrace new information, medical and educational technologies, even they could be considered as "digital native" learners [24]. In addition, the reference [24] commented as well that students demand suitable infrastructure [25] [26]

Considering these results, we would like to analyse in this paper the main reasons for not adopting new technologies in Medical Learning. Following our criteria, we must summarize the reasons of five relevant topics:

- Complex technology. The new technologies should be a little difficult to understand for faculties or students. Sometimes they complain that their main responsibilities are taking care of patients not machines. But it is important at least they know how to use them in a user level, as they should be considered as tools to help them in their future work.
- Investment Funding. In order to adopt these new technologies in the curriculum of Medical Schools, it is necessary to invest a great amount of money. This should be a problem, overall since the last years the budget of all or most part of the institutions has been reduced drastically and it is necessary to prioritize other necessities in the University (as employees, basic resources, etc.). In fact, the reference [24] reported that simulation cost is very high, because of that, institutional budgets cannot absorb these costs alone. In the US, there is some extramural funding for simulation researchers.
- Time. The new technologies should be new for everybody. It is necessary to take some time to understand how they use, their benefits and how they could be implemented in the curriculum for the course. It is not easy and it requires that the persons are completely involved in the process and convinced that this would be a success. This theory is also confirmed by the article published in [27]. The authors made an analysis about these new technologies in Castilla-León (Spain). They obtained that the students are very willing to use this technology, even use their free-hours to learn how to use it. The problem is that these tools are not spreading in these regions due to the cost that implies its implementation as we commented in the last point.

- Lack of trust (from leaderships). Sometimes the leaderships of the Universities do not believe that these new technology is going to provide some benefits to the School or the students, increasing their skills or enhancing their knowledge [24]. In other cases, the leaderships want to include them but they do not find any support from faculty, so this new methodology is going to be doomed to failure The article [25] commented that faculty as well must be integrated into the process
- Technology is not mature enough. In some cases, the technology is completely innovative and creative. However, it could be that it is too soon to implement in Medical Schools and they must use only a prototype. If the user experience is not good enough, it is a risk for the product; it could make Universities not spread the technology. For example, this could be the case of Google Glass.

4 CONCLUSION

This paper is a brief introduction of the main technologies evolved in the last years and adopted by Institutions in the curriculum. They were wide spreading very fast, although is not implemented in all Medical Schools due to different reasons that we have commented in this study. Money and lack of trust could be considered the main reasons, although there are other factors as the time and the complexity of the technology that also influence the Institutions.

The conclusion drawn of this study suggests that the new technologies are powerful resources for the Universities making the students more prepared for the new millennium. Although they find some difficulties to adopt them, it is a reality that some Schools of Medicine or even Hospitals are convinced of the benefits to include them to make the Institution more competitive and more prepared for students. Undergraduate students besides are very willing to adopt these tools as they live in a "digital" area considering normal the use of them. They are completely convinced that these new tools are going to make their work easier that it is the main objective of it. Besides, the technology is evolving some fast that probably this tools (simulators, digital atlas etc.) would become in some years basic resources for learning, appearing other new ones, more sophisticated and more complex to fulfil the new demands of the new generation of physicians.

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