

Educational Trend in Engineering: Perspectives in the use of Digital Manufacturing and 3D Printing

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Abstract - New technologies are increasingly present in our lifestyles with continuous technological changes that lead us to update constantly. These have been modeling current society and have had a special impact within the educational landscape, becoming a pillar for the construction of knowledge. Digital manufacturing and 3D printing emerge as new tools within engineering, generating new possibilities and perspectives. An analysis of the benefits provided by these technologies is made, opening the possibility of further lines research.

Keywords –Engineering, Technology, Digital Fabrication, 3D Print, Education.

1. INTRODUCTION

The incursion of new information and communication technologies (ICT) in education has involved the implementation of new tools that support teaching activities and knowledge acquisition.

One of the great bets in this territory has been the arrival of three-dimensional printers, now 3D printers, as an educational and didactic tool. These, applied in a practical way and with the help of certain teaching units can become the link between the new technologies of learning and knowledge (TAC) and the specific subjects of the university.

In this way it enables students to show in a more practical way the theory applied by teachers and understand concepts that at a level with digital or traditional format is more complex to understand.

Beyond being a learning tool also influences as an element of motivation for students to generate knowledge[1].

The student will find a greater degree of motivation when the subject is more attractive, enjoyable and fun and where it allows the student to investigate in an easy way and afterwards experiment with different technologies.

In this way, new strategies for teaching and knowledge management through the use of ICT have been incorporated into education in recent years.

2. CONCEPT

Digital manufacturing is a method that is based on making a three-dimensional design on a platform or digital

medium, usually from a computer to later be manufactured and made into a physical and tangible object.

The tool or the means to generate the object or product is the 3D printer, also called additive manufacturing. These are cataloged in a group of manufacturing technologies that, from a digital support, allow to work automatically and controlled different materials and adding layers to build an object in three dimensions[2].

MakerBot [3] defines 3D printing as the process of additive manufacturing in which the object is built by stacking layers of material together, creating the object printed in three dimensions.

These manufacturing technologies are increasingly present in all areas of society. This has been possible not only to the cheapening of printers and printing materials to use. Also, to the emergence of projects called open source that have allowed the implementation of software and hardware for free use and free of charge.

3. 3D PRINTING IN EDUCATION

In a theoretical context, curricular education is part of a process in which two agents intervene, the teacher who has the responsibility to educate and teach and the student whose purpose is learning. For its realization there are multitudes of methodologies and tools. In a generalized way it can be said that the teacher imparts the theoretical concepts of a subject and the student synthesizes them in a series of exercises.

UNESCO [4] states that the teacher will assume a new role of "teacher" from being a transmitter of knowledge to become a knowledge facilitator. The incorporation of ICT in the classroom has led to the emergence of new digital technologies that favor this change.

In the UNESCO international report [5] on the use of technology, it refers to another report (Horizon Report) that identifies new emerging technologies that can be used for education. And at the same time analyzes the impact that for the development of learning and knowledge.

The report NMC Horizon Report: Edition on Higher Education [6], defines the needs of higher education institutions where they describe the emerging technologies that will influence the field of international education in a

five-year environment. Among them, it carries out a study with the beginning of the incorporation of 3D printers in a period of four or five years.

It indicates that one of the reasons for which the incorporation of this tool can be done has been the great decrease in price, becoming an affordable product for everyone. At the same time, it affects the work of MakerBot Industries, promoting the idea of "opensource", offering products that anyone with minimal technical knowledge can manufacture.

But the most significant advances to the challenges proposed by 3D printing occur in the university environment. The report describes that for the present (year 2018) the most promising progress will be in higher education corresponding to institutions that use this technology to invent innovative tools.

At the same time that 3D printing gains momentum in education, universities are designing laboratories and initiatives dedicated to exploring uses of these technologies. An example of this is the FabLab program, carried out at the MIT Media Lab as a learning and digital manufacturing space, which has launched the world to the development of new similar spaces.

Another example is the "Do it" project, an initiative of FabLab Barcelona for the development of the Horizon report planned for 2020. It is constituted as an initiative with the aim of empowering innovative students in a digital world open to multiple skills and tools.

4. PERSPECTIVES DIGITAL MANUFACTURE AND 3D PRINTING

Currently, ICT have become a necessary and indispensable tool for the development and academic practice. But its use in this teaching process has focused on current education, which is the responsibility of traditional learning methodologies. Not in new proposals and development of activities [7].

3D printing as we have seen above allows through a three-dimensional model digitally generated by a computer, to produce a real product where the student can analyze and experiment. Roque and Valverde [8], said that incorporating these 3D printing systems in the teaching methodology allows the student to appreciate through observation, the similarities and discrepancies between a computer-created image and its physical representation.

This methodological strategy allows to relate the two working spaces where new technologies influence: the virtual and the physical. This new environment encourages the use of new instruments and allows to appreciate through practical demonstrations the necessary concepts to understand the space where we relate.

The incursion of new technologies into education has allowed the emergence of new didactic resources, alternative to the manipulation directly with the object as was traditionally done. Now the student can interact with an object in 3D without having it physically. New tools allow it, for example, through the use of smartphones or tablets [9] or more recently the use of augmented reality and virtual reality glasses.

Saorín et al.[10], indicates that a new trend is currently taking place: BYOD (from the acronym of English Bring Your Own Device) that promotes the use by students to use their own devices to access to innovative learning resources such as complement to traditional teaching in the classroom. This leads universities to prepare and generate new applications that facilitate access to learning and knowledge.

5. BENEFITS

3D printing is increasingly present in today's society. Few people are unaware of their ability to work and how far they can go. What can be confirmed are the data that the Horizon report showed in 2013. The arrival of this technology in the educational field is already a fact. More and more centers are beginning to experiment with this technology.

According to the magazine Mundo Digital cited by Núñez [11], this technology is increasingly present becoming one of the great bets for the next few years in the sector of engineering and education. This is thanks to the possibility it offers to experience and develop a real-life object or product.

Although we still cannot talk about scientific data about the contribution of 3D printers as an educational tool if we can cite behaviors and experiences through projects carried out by several authors coinciding in the same results. These can be classified into:

Foster creativity: The emergence of new techniques of prototyping and manufacturing to convert ideas into digital designs and later on objects and real products from 3D printing, offer a great opportunity for the development of creativity [12].

Autonomous learning ability for solving problems: The use of this tool for the manufacture of a product, refers to a type of project-based learning. The student will work the entire cycle of the object, from the idea to its manufacture. The problems that arise are the center and the stimulus for the development of the exercises. In this way the student becomes the protagonist of his own learning where he generates curiosity, doing and how to solve problems[13].

They capture student interest and motivation: 3D printing as an educational tool facilitates the task of converting

learning into a more dynamic, fun and interactive visual process to develop students' abilities. This transformation of turning theory into practice within educational engineering has contributed to the improvement in the quality of the teaching-learning process and to reduce dropout rates[14].

Generate more participation: According to Marc Torras cited by Jon Núñez[11], 3D printers make the learning experience a much more playful and participatory process. Some engineering colleges create common spaces for use in which students can explore together. The role of the teacher for its development is very important.

They complement other subjects and facilitate the teacher's task: Engineering subjects such as science, technology, engineering and mathematics present 3D printers as allied material, since they allow concepts to be transferred to a real scenario, which are sometimes difficult to explain. 3D printers can also be used in other educational areas.

Didactic concept through the activity: According to Lütolf [15] learning becomes possible during the development of the project. Starting with an idea and ending with the manufactured object. The 3D printer becomes a safe tool with no risk to be used by students. This project process says that it is the right one to give classes since the designs can be adapted and manufactured at any time. Therefore, and consequently to this, a product can be developed step by step, being a good alternative to traditional methods of learning.

Change in the role of teachers: As happens with the incorporation of ICT in the educational field, the teacher is faced with a new scenario that leads to a learning process. For Cabero and Marín [16], these transformations of educational institutions have not only been limited to the introduction of ICT and TAC, but also to the incorporation of a new type of student that has been born and has grown in a digital and technological society. Today, the absence of 3D printers in the classroom is not an issue of economic cost, since today a 3D printer desktop is at relatively small prices but is marked by ignorance on the part of the teaching environment, and that you need the proper training to be able to take advantage of this new technology.

6. CONCLUSIONS AND FUTURE SCOPES

From the point of view of the possibility of introducing digital manufacturing and 3D printing as a tool in different subjects of the education system, it represents an evolution in the way of incorporating science and technology in a society in continuous changes.

It becomes a means to experiment and generate direct communication between real-life problems and projects carried out in engineering.

Digital manufacturing and the use of 3D printing allows the experimentation of knowledge, generating a motivation in the student and teacher. In this way creativity and the desire to do.

The incorporation of these technologies opens new perspectives for the development of projects. The research of new methodologies for their incorporation into the educational system is proposed.

The integration and advancement of these tools within the university, generates new scenarios and laboratories where education based on new technologies is applied.

A reference example would be the FabLab concept and all the spaces linked to digital manufacturing. These are becoming in a very short time a powerful tool for society. More and more university centers are opting for its incorporation [17].

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