International
Journal
Of Advanced Research in Engineering& Management (IJAREM)
ISSN: 2456-2033 || PP. 44-49

Social contradictions in the use of 3D Computer Graphics in the university education field

José Manuel Izquierdo Pardo[1], José Manuel Izquierdo Lao[2]
**Software and technology development department, Universidad de Oriente, Santiago de Cuba*
*** Manuel F. Gran Pedagogical Studies Center, Universidad de Oriente, Santiago de Cuba*

Abstract: This work aims to analyze some of the social contradictions related to the use of 3D Computer Graphics in society, with an emphasis on university education. This type of graphics is based epistemologically and the social impact that they have had, in the university education field, is analyzed, particularly in the training of the professionals of the Universidad de Oriente, Santiago de Cuba, Cuba. The deficiencies that are identified in this regard are revealed and the reflection on how this situation should be improved.
Keywords: 3D Computer Graphics, university education

I. INTRODUCTION

The current so-called information and knowledge society is marked by the use of Information and Communication Technologies (ICT), which have changed the way we think, the way we work, how we interact and how we learn. The introduction of these technologies in society, has resulted in a set of transformations in all its spheres, including education and, in particular, higher education, which is why university teaching institutions have been forced to rethink their formative processes.

In relation to the above, universities must be capable of self-preparation and adaptation to the changes imposed by technological advances, the search for knowledge and management to access, manage, process and use the multiple information that is constantly generated, as well as the development of communication skills. This is today a primary requirement to train quality professionals.

In this sense, all the changes that are necessary in the training processes of the professionals of the different university careers, ranging from the conception of the process, the contents that are taught, the methods and the didactic mediators used must be systematically and effectively implemented, as well as the change of the roles and attitudes of the participants in this process, mainly of students and teachers.

In university education, in the teaching of professional content, two-dimensional or 2D representations have prevailed as didactic means, that is, projections in the plane and digital or printed images, which historically has negatively affected levels of understanding complex or abstract contents of objects and phenomena of nature, society and thought.

Fundamentally in this 21st century, the development of computer equipment hardware led to the emergence of a new branch of graphic arts, made through special 3D or three-dimensional design software: 3D Computer Graphics or 3DCG (3D Computer Graphics, by its acronym in English) that make it possible to represent any object or phenomenon in a three-dimensional workspace.

These potentials have gradually changed the conventional way of thinking and teaching by several leading-edge teachers from different parts of the world, which have been incorporating, for their advantages, 3D Computer Graphics in teaching-learning processes as didactic mediators, bringing better teaching results by students.

The foregoing acquires particular importance for different careers in which professionals who relate to 3D Computer Graphics are formed not only as a means but as an object of study and work, such as Architecture and Urban Planning, Engineering and Design, for only cite some examples.

At present, despite the vertiginous advances in science, the development of ICTs and particularly of 3D Computer Graphics, it has been found that the latter have not been systematized in the training of university professionals, evidencing inadequacies in students of different careers in relation to the understanding of the contents of the profession, mainly those that are complex and abstract, which is an expression of the contradiction between the advent of this advanced technology and its use in the university environment.

The above is a problem that this researcher intends to solve through the scientific research he is developing as part of the PhD in Educational Sciences of the Center for Pedagogical Studies "Manuel F. Gran" of the Universidad de Oriente.

This research aims to develop a didactic strategy, based on a model of the dynamics of the teaching process of professional content learning, mediated by 3D Computer Graphics, from an efficient use of them in that process and thus contribute to better levels of assimilation in university students, managing to develop in these, meanings and senses regarding professional content.

Hence, proper training with these technologies becomes an imperative as demanded by the current times of the digital age that humanity is going through.

Based on the above, the objective of this paper is to analyze some of the social contradictions related to the use of 3D Computer Graphics in society, particularly in university education, emphasizing the training of university professionals of Universidad de Oriente.

In the development of the work, an epistemological foundation is made on the 3D Computer Graphics and the social impact that they have had, particularly in the university educational field, is analyzed.

Subsequently, a critical analysis is made of how these graphics have been used in the training of the professionals of the Universidad de Oriente, the deficiencies that are observed in this regard and reflect on how that situation should be improved.

II. 3D COMPUTER GRAPHICS. ITS SOCIAL IMPACT IN THE UNIVERSITY EDUCATION FIELD

A very important branch of Information Technology and Communications (ICT), are 3D Computer Graphics, which include: the work of graphic arts made with computers and special 3D work programs; to the process of creating the graphics and also to the field of study of techniques and technologies related to 3D graphics.

The process of creating 3D Graphics by Computer can be divided into four basic phases: modeling, scene composition, animation and rendering. In these phases the computer networks are present, as well as the interdisciplinary collaborative work between virtual counterparts (subjects with common interests that interact via the network).

These graphics are created by a large number of object transformation tools, where the final result can have several utilities depending on the needs of man, his creativity or his fantasies.

3D computer graphics are the result of human scientific and technological development. These allow us to understand and transform reality; they contribute to personal and social training and development; they have their own language of concepts, principles, strategies and values that facilitate the construction of information and its use by humanity; They develop the socialization of knowledge and the relationship between thought and action.

According to Morelli [1], until recently, the conventional practice of teaching representation systems was to represent the concerted views of the objects in the 2D or 2D system, that is, the projections in the plane, remaining for the end of the process, the construction of the 3D drawing, global communication image of the volumetric idea.

According to the author, the aforementioned practice was maintained even with the emergence of CAD (Computer Aided Design) systems, more than 20 years ago, which replaced the drawing board, winning the process in terms of productivity and accuracy, but always with predominance of 2D routines.

Consequently, the development of digital graphics software led to the emergence of three-dimensional design programs that make it possible to directly model the volumetry of a solid in 3D, leaving the drawing of the flat views or projections for the end of the process, being the same calculated and drawn automatically by the software.

However, 3D computer graphics are changing the conventional way of thinking and teaching the design process, both in Architecture, as in engineering and design in general. This creates a contradiction between the efficiency of the new workflows in the design and the conventional way in which the contents are still taught in the university classrooms, similar to the methods of manual drawing in the workshop, which extrapolated to the computers. Based on the above, the teaching-learning practices of design subjects and representation systems in schools and universities arise new competences to achieve in students and professors, which creates a contradiction between the appearance of new content and the expiration of traditional content.

At the discretion of Castro, et al. [2], Graphic Computing is one of the areas of Computer Science most dependent on technology and without a doubt, in recent years there have been incredible advances in the technological field that directly affect it, which forces to structure its contents maintaining the balance between the fundamentals and traditional objectives and the accelerated changes that occur both in the academic and cultural context in which the teaching takes place, as well as in the professional activity, all of which stands in a contradiction not yet resolved.

This criterion is shared, however, in the opinion of this researcher, the main difficulty lies in the lack of didactic strategies or methodologies that contribute to perfect the teaching of Graphic Computing, which does not depend exclusively on the design of the content of the courses that are taught.

Nowadays, with the great advances in the technologies of acquisition of three-dimensional information, the objective of recreating in the memory of a computer a faithful representation of a real object, conserving the greatest amount of physical characteristics, is increasingly feasible.

In this regard, works such as Mesa, et al. [3], in which all the stages of three-dimensional reconstruction are exposed, applied to a set of pre-Columbian pieces belonging to the university museum of the University of Antioquia. Some of the most representative works that have been developed in the area of cultural preservation is also described, which, in the opinion of this researcher, are important exponents of everything that can be developed from the use of 3D computer graphics.

The process of creation and dissemination of three-dimensional objects for the delivery of different contents, is opening wide possibilities for the improvement of the teaching-learning processes. The practical case of Saorín, et al. [4], in which worked on the Canarian marine fossil heritage as an important didactic material for the teaching of paleontology, in which 3D digitalization of a selection of 18 fossils was achieved.

The files generated from the aforementioned educational experience were made available to students in an online environment, allowing their download, visualization and interaction on multitouch mobile devices, also giving the possibility of printing them in 3D if the student preferred it.

Another of the edges of 3D computer graphics is the so-called Virtual Reality, which has become an important didactic alternative to be used in teaching-learning processes.

Thus, it coincides with De Antonio, et al. [5] in which virtual educational applications must also consider teaching methods, objectives, types of content and learning styles so that student-centered applications can be developed and not just content.

Forero, et al. [6], alludes to the fact that the direction of undergraduate work under the theme of digital design and manufacturing at the Faculty of Design, Image and Communication of the Universidad El Bosque de Bogotá (UEB), aims to consolidate the skills of the trade Industrial designer in training, with a strong technological component, strengthening their interaction and communication skills with third parties.

The aforementioned, contributes to their cognitive training and the execution of interdisciplinary design projects with other fields of knowledge traditionally not explored, in this specific case, in health science education and particularly for teaching processes - anatomy learning in its different areas and particularities.

As initial experimental theme, the development of three-dimensional physical didactic material was selected to contribute to the educational approach of the dental anatomy and morphology classes of the Faculty of Dentistry, which served as a stage of experimentation and that triggered the implementation of several similar projects with different departments in the university, trying to facilitate the teaching-learning experience.

Consequently, it was intended to guarantee students a theoretical-practical training through three-dimensional tools and resources - reality simulators -, having as a characteristic a better appropriation of information, based on direct interaction with knowledge.

The aforementioned authors seek to exemplify the use that can be given to digital design and manufacturing technologies, to expand the range of opportunities that from the academy can be transmitted to students and can begin to permeate untraditional fields of knowledge for the trade from the industrial designer, demystifying his profile as a shape configurator only.

Through the planning of a design project and with molten deposition modeling (FDM) printers, complex didactic models can be created. They highlight the direction of degree projects, with the theme of digital design and manufacturing and as a strategy to boost the results of Doctoral Research in Design, Manufacturing and Management of Industrial Projects of the Polytechnic University of Valencia (UPV), called "Technology Implementation of design and digital manufacturing applied in the teaching of Anatomy. Case Study: Universidad El Bosque de Bogotá - Colombia".

For its part, Francesc, et al [7] states that one of the essential conditions for the development of the digital teaching competence of future teachers is to provide them with learning situations that allow them to exercise such skills, knowledge and attitudes in contexts similar to their future professional reality 3D virtual environments, highly immersive and interactive, are a promising technology to simulate real scenarios and offer such learning opportunities. In this regard, the aforementioned author presents the design of a 3D environment for the development of teaching digital competence, focused on the analysis of: technological and graphic usability; the adequacy of the content of the activities and the practicality and pedagogical utility of the environment.

Following the research methodology for the design, in the aforementioned research a validation process was carried out with different groups of key informants: technology experts, teachers related to educational technology and students of education degrees, who also were administered a questionnaire on the perception of pedagogical utility.

The results show that at a technological level the environment worked smoothly, although the graphics were limited. At the didactic level, the proposed activities were adequate, realistic and current and despite the initial complexity in the control of avatars, the high motivation of the students stands out due to the similarity of the environment with their future professional practice. The main conclusion is that 3D environments are viable scenarios for the development of educational activities that favor the acquisition of digital teaching competence.

Other authors such as Veraszto, et al, [8] present the preliminary results of the use of computational tools oriented towards the development of 3D content, in particular for education, in a Higher Education Institution in Brazil with the intention of using a set of tools based on free software, of excellent quality and with great potential for the development of the proposed applications.

As the first result of this project, the creation of new "cells" for the development of animations and simulations with the participation of students interested in this professional field, whether they are professionals acting in the area of computing, or not, is planned.

According to Francesc [9], at the present time, the role of teachers is essential to empower students using all the potential offered by technologies. To do this, teachers need not only to have a basic digital literacy, but they must be able to integrate Information and Communication Technologies (ICT) into their teaching practices (digital teaching competence) and without a doubt, their initial training is key.

However, although the importance of this competence is recognized, on the one hand, education students do not always acquire an adequate level during their training period and on the other hand, there are no adequate instruments to assess the acquisition of this competence or teachers that have developed the same which becomes a contradiction to solve.

Thus, the purpose of the aforementioned author is to explore the development of the digital competence of the future teacher and for this purpose a new instrument for the evaluation of its execution or performance has been designed and developed, making use of the potential of 3D virtual environments.

In this way, it can be affirmed that 3D virtual environments allow a wide variety of evidence and evaluation strategies to be made to make rich and precise observations about students' digital competence and, based on these results, a series of design principles are proposed and of measures to improve said competence in these future teachers.

Authors such as García, et al (2007) report that the true potential of a new technology usually takes a whole generation to develop. In the case of digital natives (those individuals who have grown up immersed in digital technology) they are still going through this period of transition / adaptation that leads them to a change in habits and thinking caused by the thrust of this generation.

According to certain calculations, within 20 years, that group could constitute 70% of the world population, but the contradiction is that the training processes could become a brake for the development of the potential of these individuals if the teachers who guide said processes do not promote the realization of training activities that promote the initiatives and creativity of students.

In the educational field, today's students no longer correspond to those for whose teaching traditional education systems were created, hence the imperative need to explore what direction educational innovation should take to adapt to the characteristics of this digital age and in particular of 3D technology.

In this regard, in the field of 3D computer graphics, the augmented reality edge stands out. Authors such as De la Torre, et al. (2013), analyze the adoption of digital alternatives to physical models, using

augmented reality technologies and multitouch tablets, with the purpose of offering a ubiquitous learning environment (u-learning), to stimulate the understanding of three-dimensional space.

The above indicates some of the multiple possibilities that the different edges of the use of 3D computer graphics can offer in the educational field, but it is not enough to know the different applications but what is really about is to raise the technological culture of teachers and changing their role so that they incorporate these modern technologies with a meaning and sense of transformation in their teaching work

An insufficient technological culture of teachers in terms of what 3D computer graphics can offer to improve the teaching-learning process limits them to develop a creative teaching-learning process in accordance with the current times that a renewing teaching demands so that the latter do not fall behind in relation to their students, which becomes a contradiction to be resolved.

III. USE OF 3D COMPUTER GRAPHICS IN TEACHING-LEARNING PROCESSES IN CAREERS OF THE UNIVERSIDAD DE ORIENTE

The incorporation of 3D computer graphics in the teaching-learning processes in careers of the Universidad de Oriente, has had a spontaneous and no systematic character, at the initiative of professors from different careers, which has been verified by this researcher in based on diagnoses made as part of the doctoral research that is being carried out.

In this regard, there are isolated examples of careers, such as Architecture in which computer programs are used that favor the development of 3D computer graphics. However, they are used in certain subjects of the career, not in the generality of these, which contradicts the infinite possibilities that these graphics have to facilitate motivation and understanding of content, especially those that are complex and abstract for students, taking into account the type of content of this career.

The same situation has been perceived in Engineering careers, which, like Architecture, belong to the branch of Technical Sciences, in which the potential that 3D computer graphics can offer as important last generation teaching aids is not used, for the delivery of content that is motivating, attractive and understandable for students.

It has also demonstrated the interest of students to learn the contents from this particular type of graphics, but this contradicts the limited technological preparation of teachers to be able to develop didactic means of this type, also showing a meager educational management by these in the search for 3D models, of existing collections, available on the Internet, for use in the teaching - learning process of the subjects they teach.

It has also been possible to verify in the theoretical order, the lack of models and didactic strategies, tending to the incorporation of 3D computer graphics in the teaching-learning processes of the different university careers, so that they contribute to improving the latter to base on the recognition of these graphics as innovative teaching aids provided by 3D digital technology and their systematic use in said processes.

Hence the need to improve the dynamics of the teaching-learning process of professional contents, based on the development of three-dimensional digital models, which takes into account the existing dialectical relationship between the complex that presupposes the interpretation of objects or phenomena of the profession and the concrete of the 3D representation of them, which would contribute to achieve better levels of assimilation of professional content.

On the other hand, the technological culture of teachers in terms of 3D computer graphics should be increased, so that they develop initiatives with them incorporating them in the teaching-learning process of the contents of their subjects, with the purpose that said process is in tune with the current challenges and demands of the current digital era.

This requires teachers to play more active roles and raise their creativity in the search for motivational training environments, based on didactic experiences based on 3D digital technology, due to the many advantages it offers.

For their part, students have to change their passive role as mere recipients of information, for active roles in the search, with high levels of autonomy, of everything they need to appropriate content.

Hence, the doctoral research that this researcher is developing, aims to provide a didactic model of the dynamics of the teaching process of professional content learning, mediated by 3D digital technology, which serves as a theoretical support for a didactic strategy as an important methodological instrument for perfect in practice this process.

IV. CONCLUSIONS

In this work we have analyzed the social contradictions in the educational field of 3D computer graphics, which can be incorporated into the teaching-learning processes as important last-generation didactic means tending to achieve better levels of motivation and understanding of the contents by students, especially those that are complex and abstract.

The insufficiencies evidenced in the use of 3D computer graphics in the teaching-learning processes of different careers of the Universidad de Oriente indicated the relevance and feasibility of improving the dynamics of these processes tending to achieve better results in these.

In accordance with the above, the author of this paper, as part of the doctoral research in Education Sciences that is being carried out at the Center of Studies "Manuel F. Gran", intends to provide a didactic model of the dynamics of the process of Teaching - learning of professional content, mediated by three-dimensional digital models and a strategy of the same nature, based on the model, which aims to perfect that process.

REFERENCES

Journal Papers:

[1]. R D. Morelli, Aplicaciones didácticas de modelado de sólidos y vistas automáticas con AutoCAD, *Graphica, http://www.exatas.ufpr.br/portal/docs_degraf/artigos_graphica/aplicaciones.pdf*, 2007.

[2]. S. Castro, C. Delrieux and A. Silvetti, Computación Gráfica en la Universidad Nacional del Sur. *Repositorio Institucional de la Universidad Nacional de la Plata, http://sedici.unlp.edu.ar/handle/10915/23559*, 2001.

[3]. E. Mesa Múnera, J F. Ramírez Salazar and J W. Branch Bedoya, Construcción de un modelo digital 3D de piezas precolombinas utilizando escaneo láser, *Avances en Sistemas e Informática, Vol.7 Nº.1, march 2010. ISSN 1657-7663, https://revistas.unal.edu.co/index.php/avances/article/view/20611/21637*, 2010.

[4]. J L. Saorín, J. Torre-Cantero, C. Meier, D. Melián Díaz, C. Ruiz Castillo and A. Bonnet de León, Creación, visualización e impresión 3D de colecciones online de modelos educativos tridimensionales con tecnologías de bajo costo. Caso práctico del patrimonio fósil marino de Canarias, *Education in the Knowledge Society, vol. 17, Nº. 3, 2016, pp. 89-108, e-ISSN 2444-8729, http://www.redalyc.org/articulo.oa?id=535554763006*, 2016.

[5]. A. De Antonio Jiménez, M. Villalobos Abarca and E. Luna Ramírez, Cuándo y Cómo usar la Realidad Virtual en la Enseñanza, *Revista Iberoamericana de Informática Educativa, ISSN-e 1699-4574, Nº. 16, https://dialnet.unirioja.es/servlet/articulo?codigo=4794517*, 2000.

[6]. J S. Ávila Forero, Diseño de material didáctico para la enseñanza de anatomía. *Editorial Universitat Politècnica de València, Creative Commons License CC BY-NC-ND 4.0, http://ocs.editorial.upv.es/index.php/IFDP/IFDP/paper/viewFile/2955/2154 DOI: http://dx.doi.org/10.4995/IFDP.2016.2955*, 2016.

[7]. F M. Esteve Mon, J. Adell Segura and M. Gisbert Cervera, Diseño de un entorno 3D para el desarrollo de la competencia digital docente en estudiantes universitarios: usabilidad, adecuación y percepción de utilidad, *RELATEC - Revista Latinoamericana de Tecnología Educativa, Vol. 13 (2) (2014) 35-47, ISSN 1695-288X, https://relatec.unex.es/article/view/1443 DOI: https://doi.org/10.17398/1695-288X.13.2.35*, 2014.

[8]. E. Vizconde Veraszto, J T. Franco de Camargo, J. Barros Filho, F. García García, S. Ferreira do Amaral and J A. Bortoloti, Estrategias para el desarrollo de contenido educativo 3d. Producción de animaciones modeladas por ordenador utilizando software libre, *Icono 14, Revista de Comunicación y Nuevas Tecnologías, Year 10 Vol. 1, pp. 198-212. ISSN 1697-8293. Madrid (Spain), https://icono14.net/ojs/index.php/icono14/article/view/26 DOI: https://doi.org/10.7195/ri14.v10i1.26 , 2012.*

Theses:

[9]. F M. Esteve Mon, La competencia digital docente. Análisis de la autopercepción y evaluación del desempeño de los estudiantes universitarios de educación por medio de un Entorno 3d, *Universidad Rovira y Virgili. Pedagogy Department, 2015.*