NEW TENDENCIES IN THE TEACHING AND THE LEARNING IN STATISTIC

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ABSTRACT

If they are used suitably, the technologies of information and communication (TIC), can contribute substantially to improve the quality of the education and the formation, and to adapt them to the requirements of a society based on the knowledge. In this work we try to explain the methodology used in the teaching of Statistic under a virtual environment. Therefore, the objective is to share the experience about the changes in the way of teaching that we are having in a present future and the changes about learning into new technological platforms of information, since in those learning atmospheres, enriched by means of the use of the TIC, are that can really transform the quality of the education. With this structure and organization of subject are described the results that are expected to be obtained and that have also been obtained during the current course are showed.

RESUMEN

Si se utilizan adecuadamente, las tecnologías de la información y comunicación (TIC), puede contribuir substancialmente para mejorar la calidad de la educación y la formación, y adaptarlos a los requisitos de una sociedad basada en el conocimiento. En este trabajo nosotros intentamos explicar la metodología usada en la enseñanza de Estadística bajo un entorno virtual. Por consiguiente, el objetivo es compartir la experiencia sobre los cambios en la manera de enseñar que estamos teniendo en un futuro ya presente y los cambios sobre la forma de aprender en las nuevas plataformas tecnológicas de información, desde que en estas de atmósferas de aprendizaje, enriquecidas por medio del uso de TIC, realmente pueden transformar la calidad de la educación. Con esta estructura y organización de la asignatura descrita se muestran los resultados que se esperan obtener y también que se ha obtenido durante el curso actual.

KEY WORDS: TIC, *e*learning, statistical knowledge, virtual.

MSC: 97U60; 97U70

1. JUSTIFICATION

This work deals with the use of the (TIC) which are all around us, within our reach. A use of the new technologies in order to involve students in a statistical teaching, which matches with the future that is approaching, and with the adaptation to The European Space for Higher Education (ESHE) [5]. One of the main objectives that is sought to reach is facilitating the mobility, not only the students but also the professors, investigators and others. Talking about the student´ situation, it is fundamental the adoption of a system of easily comprehensible and comparable studies among the European states which authorizes everyone to be introduced in the European labour market, no matter the nation in which one has obtained the studies.

To homogenize the different studies, one of the first steps was the establishment of the new system of credits, well-known as European Credit Transfer System (ECTS), as a common measure unit to the different states [4]. The current teaching-process is based almost exclusively on the professor's teaching, whereas starting from now a days, this should become a *process* in which the student becomes the true main character. To grant the student with a bigger protagonism in the *teaching-learning process*, and to get the student to acquire the wanted generic and specific competitions, part of the traditional lessons are

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substituted by non presential lessons. This new methodology takes harnessed a change in the evaluation system, because all the activities carried out by the students should be kept in mind in the final qualification.

In the non presential sessions we want to potenciate the tutorships´ support and the orientation seminars to do the directed works in small groups. This distinction implies a bigger responsibility, the student's autonomy, and a change in the professor's methodological positions. In the theoretical credits the subject is developed according to what the student has previously read and meditated. During the practical credits the professor acts mainly as a guider, and students assume a main and autonomous role [1].

Diverse technologies, instructors, teaching methods and technical of collaboration participate in this new teaching-process, elevating the teaching process to levels which are unreachable with the traditional methods. But, the virtual teaching reaches its acme if the technology is developed to the point that allows to the student:

- It is the most flexible method to teach because it doesn't impose schedules, being able to adapt the study to each personal schedule.
- It stimulates the communication among the students by celebrating debates, by the assignment of group tasks and by the personalized contact with the professor by using email, forums or chat.
- It pushes the students to take the reins of their education and be more responsible.
- The student can carry out their participations on a meditated way because they have the possibility of working off-line.
- It offers the student the possibility of controlling the learning process by means of continuous evaluation systems, by self-evaluation and by correct activities to the matters that are taught.
- The educational activities take place without the students converging into one place. Thanks to the new technological advances it becomes more feasible the possibility of learning with tools such as multimedia topics based on web, videoconferences, and electronic slates.
- It exists information Feed-back, so that, the professor knows if the student responds to the method and if he reaches the objectives which were fixed initially.
- It allows an upgrade of contents and activities in a permanent way, a fact that textbooks don't possess.
- They benefit of the advantages of the different teaching methods and of the benefices of the traditional didactic means, avoiding the inconveniences of them.

But the virtual installation of education systems still possesses a series of limitations which are linked:

- To the necessary technical means to be carried out, as an appropriate installation of the virtual teaching requires a wide investment in software, hardware, communications, nets, etc. which are not within reach of any people.
- To the conceptual change that implies to pass from the traditional pedagogical methods to the new teleformation systems.

Also, an *e-learning* good system implies a continuous upgrade which carries some costs, not only economical ones but also a professor´s waste and tiringness as they have to adapt themselves to these changes.

On the other hand, the student needs to have the appropriate work post to be able to consent to this formation. That leads to a social barrier caused by the inequality in the access to the TIC, and, therefore, to the formation which is offered through them. The lack of a sufficiently equipped computer or the slowness of Internet connection can put an end to the student's patience, causing the abandonment of the formative activity.

Because of all what has been analysed, it can be said that the TIC shares with the convergence process to the ESHE a couple of common aspects that are essential to understand separately and which comes from the conjunction of both of them. The first one is that both scenarios require a change; in the case of the

ESHE it is a change imposed by European institutions that force to the states and to their institutions to change structures, organizations and politics to adapt them to that common space. While in the case of the TIC the change is clear, as it lacks the sense of using the TIC to make the same things that were already made without them. Taking as starting point this ideas, the TIC are associated to the opportunity of a change, to the opportunity of making the things in a different better way. When we associate both scenarios, ESHE and TIC, they offer us the opportunity to think the way in which the university students carry out their more genuine functions.

A second aspect is that the required change talking about the reformation of the ESHE and talking about the TIC, has common elements: to facilitate the construction of the knowledge, to take the responsibility of the own learning, to have a bigger control on the contents and on the activities and to have the possibility of collaborative works not only for the students but also for the professors.

With all what has been dealt, we want to give our vision and our experience about all what is approaching, showing some of the tools and carried out activities, because up to now a days, not many studies about who the professor sees the convergence process and the incorporation from the TIC have existed.

2. DESCRIPTION OF THE USED MEANS

The development of computers and of the application of computer science to the education has been marked from their beginnings by their specific developments in the science teaching environment and particularly in the mathematics one. Therefore, we are going to give all the details about the tools used in our work and we are going to adapt it to this new teaching methodology.

To carry out our project the tool used for the creation of the courses is ***WebCT*** of the University British Columbia. WebCT is a Learning Content Management System (LMS) that allows to build interactive courses and to impart formation "on line", carrying out the students´ tutoring and the pursuit [2], [9]. WebCT has a huge number of communication tools, contents, evaluations and studies. It is, in the same way, a flexible educational environment where the students can, besides learning, share experiences and knowledge with virtual communities composed by users of the system.

By means of the tele-formation tool, WebCT interactive courses can be built in an intuitive and easy way. These courses can have tools and utilities like Chat, the shared Slate, Forums, email, contents and related tools: the program of the subject, a glossary, a searcher, a calendar, an index, etc., or also evaluation tools: exams, surveys, tasks, auto-tests, etc. At the same time, it offers to the professors the possibility of having a detailed information of the students´ progress and of the students´ knowledge assimilation. The system also allows making an exhaustive statistical analysis of the results of the exercises or of the exams. It can be done individually, or for a certain group of students.

Macromedia Dream weaver is a publishing HTML which allows to design, to code and to develop places, Web pages and applications. Dream weaver provides us useful tools not only if we want to control the code manually but also if we prefer to work in an environment of visual edition. This work allows us controlling the whole process of creation of a web place: creation of the place, to structure the link tree, to design the pages and the ascent of our work to our servant web. It includes tools for the code edition (such as colored of code and automatic termination of labels) and reference material on HTML, leaves of styles in cascade (CSS), JavaScript, ColdFusion Markup Language (CFML), Microsoft Activates Server Pages (ASP) and JavaServer Pages (JSP).

Another application that has been used is the well-known as ***Hot Potatoes***. It is a group of six tools developed by the University of Victoria (Canada), which allows elaborating different types of interactive test based on Web pages. The interactivity of the exercises is obtained by means of JavaScript. Any member of an educational institution can get Hot Potatoes for free, for Windows and for Macintosh in the following address: ***http://web.uvic.ca/hrd/halfbaked***. The different test types that can be elaborated are given by the following programs: ***JBC*** (Test of five answers where one should choose one), ***JQuiz*** (Questions that are answered in a text square), ***JMix*** (Exercises in which one should order the sentences), ***JCros*** (With it crosswords can be carried out), ***JMatch*** (Association exercises can be carried out), ***JCloze*** (It allows creating texts with gap fillings).

With her, we have been carried out a series of auto-test exercises that will allow the students to apply what they have gone learning and understand better the contents. These exercises are guided to help the

students in the attainment of their last objective that is the learning having a bigger grade of knowledge about their progress.

It is also sought to endow the student of presentations in *PowerPoints*, where the most important thing of each topics is summarized, as well as videos, and another series of utilities that can be used for a bigger help and a bigger understanding of the contents. To sum up, to improve the process of the student's teaching-learning as much as possible.

3. WHAT IS EXPECTED TO BE OBTAINED?

New technologies of the communication open us new representation windows and a transmission of the mathematical-statistical knowledge. Foregonly, the advances in the technology of the calculation and in the communication, will suppose, they are already supposing, the possibility of creation of new virtual spaces of symbolic representation that without any doubts open numerous perspective of didactic utility. And for this essential reason, the importance of the systems of external representation of the mathematical knowledge facilitates, understanding these essentially as products, its manipulation and its transmission because they connect, up to now not obtained by any support of information, with basic components in the nature of the mathematical thought.

The professors in the virtual environment stop being the direct instructor and they become facilitators, offering to the student tools and hints that help them to develop their own learning process, and that at the same time that assist their doubts and necessities [6]. The tutor will be the person in charge of having a direct contact with the student, predisposing him and advising him in the pursuit of the studied subjects, and therefore, he is the figure that must avoid the demotivation and the student's abandonment in his auto-formative process.

Now, the tutor should establish a series of parameters like *ratio tutor/student, time* or *type of the tutor's answe*r, where the tutor will try to give the more personalized as possible answer, whenever the content of the outlined question and the possible ones interested in oneself answer don't require that this answer becomes public by means of the plank of announcements of the tool of the tele-formation.

Therefore, summarizing, after the initial moments of contact with the virtual environment, the larger or smaller grade of the student's participation won't depend so much on the technological aspects as on the methodological ones, the student's initial interest for the matter of the virtual course is supposed.

Starting from this moment, the tutor's work is of maximum importance and his attitude should be presided over by the enthusiasm, the perseverance and the attention to his students and by the multiple interactions that take place in an environment in which the communication channels are privileged.

Without any spirit of offering a closed list of advice for the tutor, we dare to make the following suggestions, because at least, they will probably help to carry out their complex activity in the virtual classroom:

- It is necessary to cause the group´s interest from the very beginning of the course and to maintain it in each one of the formative sessions. Without any interest, the participation is almost impossible.
- It is suitable to give a sense to the daily work, relating it with the one that was made the previous day and with the coming one. It is necessary that the student knows why and for what reason he is working to avoid the demotivation and to channel the interest through the participation.
- We should recognize the student's previous knowledge in the matter and, starting from these, to sustain the development of the formative session that concerns.
- When we face an explanation in a synchronous session you should look for the interaction with the student to check if this follows this explanation.
- We can request to a student that summarizes the information that the tutor has just facilitated or to some of his partners, which allows us to evaluate if the students understand without the difficulty of the matter.

- We can also propose to the group, after the exhibition of the matter, to carry out an activity in which the information that he/she has just received has to be applied. In the envirement of the theoretical knowledge to the practice some doubts that will stimulate the students´ participation will arise.
- The activities in group are one of the best ways to achieve the students´ interest, to harness their participation and to avoid the isolation sensation, which are virtual teaching characteristics.

4. USE EVALUATION OF THE TIC IN STATISTIC SUBJECTS STUDIED BY THE STUDENTS

In last course, and within the *Plan de Virtualización de Asignaturas para el curso Académico* 2006/2007 of the Virtual Training Center of the University of Granada (CEVUG) - Secretaryship of Technologies for Support to Teaching (STAD), a subject of Statistic[4] in way *b-learning*[5] was taught with a pursued task, to improve the teaching quality by means of an semi-presential sessions in which another ways of teaching are distributed in the classroom, according to the traditional model, whereas another is based on denominated education online, virtual teaching or tele-formation, in which the student carries out a process of the auto-learning under professor's supervision.

With this project we are persecuting to generate didactic materials to help the students like complementary and/or alternative tools to the environment web already created for these students, thus continuing in this way to reinforce present teaching and to foment the active and autonomous learning of the students. The contents[6] that have been elaborated have been divided in the following big blocks:

- Traditional educational material: subjects of theory, problem relations and scripts of practices. All of them can be found by the students in web pages and pdf file, that can be lowered and be worked like and when they want. The theory notes have been published in manuals that are used and demanded by the students, without any costs for them.
- Material directed to the auto-learning: tutorial videos on practices of computer and problems type made in Power Point.
- Material directed to the auto-evaluation: auto-evaluation question classified by topics and/or level of difficulty.

We understand that the first phase of the developed project concluded in May, end of the past academic course, the evaluation and valuation of the tool corresponds the present to the students in course, although some of them participated in an initial evaluation which we will comment next, but, in general, we believe it had a good welcome.

Anyway, the professors implied in this educational experience fixed the following main objectives with the purpose of evaluating the degree of advantage or use of the same one:

- To value the degree of improvement in the derived learning from the existence and use of the materials of created support to teaching.
- To evaluate the perception that the students have about their didactic utility, as well as of the different curricular materials including.
- To estimate the degree of satisfaction of the students to improve and elaborate new materials.
- To increase the number of registered students.

The degree of attainment of these objectives will be valued from the results of a poll between the student-users, which reflects on these issues, wonders what utility and view them deserves and they put on in evidence the deficiencies observed for possible improvements in the future.

[4] We teach the subject about Virtual Statistics and Tourism.
[5] Blending Learning, educational modality in which combines the present formation and the on-line formation.
[6] The students can find all elaborated material for Statistic subject in *http://cevug.ugr.es/asignaturas_online.php* or the web of the investigation group, *http://www.ugr.es/local/eues/webgrupo/index.html*, where necessary information for the student can be found, like dates of examinations, schedules of tutorship, etc. This web page has been created with the objective to continue including more professors and therefore more subjects, more materials to improve the process of teaching-learning of the students and where it can act in an autonomous way acquiring bigger work initiative.

Likewise, we try to objectively assess the influence of the innovative teaching methodology introduced this academic year in the obtained results, considering the total number of approved, the average rating of the groups, the relative dispersion of qualifications, etc. These measures will allow us, among others, comparing results between groups of students from previous academic courses involved or not in this type of educational experience and to compare results to extract the opportune conclusions.

The valuation can be considered good, so the results are always higher than five point two on six, but we have also collected a number of issues that the students have proposed and, of course, we believe that an improvement is needed. We still have a lot of work to do, we are in an early stage, but we believe that the results and reception has been good, although we consider that we must continue and improve the undertaken work line.

5. CONCLUSIONS

The vertiginous and ascending movement of the new technologies as well as the quick entrance in the ESHE, together with the improvement of the pedagogical procedures do that most of the professors and/or tutors face an important change in the way of giving and elaborating the lessons nowadays.

The new technologies of communication open new windows of representation and a transmission of the mathematician-statistical knowledge, where the professors in the virtual environment are no longer direct instructors and they become facilitators, offering the student tools and tips to students to help to develop their own process of learning, and they also start being the people who take care of their doubts and necessities [7]. The tutor becomes the person in charge of having a direct contact with the student, predisposing and advising in following up the studied materials, and therefore, it is the figure who has to avoid the student´s demotivation and the abandonment in their self-formative process [3].

It is important to emphasize, from our point of view, the student not only learned statistical knowledge, but they also, as we think have had a tool which has served as guide in the way of the learning, enriching the process through the use of the technologies, fomenting a renovated process and renovating the teaching-learning process, where competitions that will allow to form individuals for a learning throughout all the lifetime have been developed.

Our present objective must be to update us in this methodology which uses the available resources to foment the self learning of the students, establishing simultaneously a continued guide that covers the needs of those ones who cannot habitually attend the class (because for work reasons, for time of coincidence or any other eventuality).

In the online education, after the initial moments of contact with the virtual environment, the larger or smaller degree of student´s participation is not going to depend as much on the technological aspects as on the methodological ones, supposed the initial student´s interest by the subject of the virtual course [8]. This one will be the main departure point for a new centered educative methodology based on the student, opposite to the traditional model of skillful lessons in which the center of the education process is the professor.

Therefore, we conclude that the incorporation of TIC in university teaching is one of the strategic priorities in the methodological environment according to the Proposals for the Renovation of the Educational Methodologies in the Spanish University published recently by the Ministry of Education [5].

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REFERENCES

[1] BATANERO, C. and DÍAZ, C. (2007): Training future statisticians to teach Statistics. In: M. Ivette Gomes, D. Pestana, P. Siva, (Eds.), **Proceedings in ISI 2007,** Lisbon, Portugal.

[2] CRAMER, E., CRAMER, K. and KAMPS, U. (2002): e-stat: A web-based learning environment in applied statistics. In: W. Hurdle, B. Runs (Eds.) **COMPSTAT 2002 Proceedings in Computational Statistics,** Physica, Heidelberg 309-314.

[3] DAVIES, N., MARRIOTT, J., and GIBSON, L. (2007): Solving the problem of teaching statistics? In: M. Ivette Gomes, D. Pestana, P. Silva, (Eds.), **Proceedings in ISI 2007**, Lisbon, Portugal.

[4] LÓPEZ, A. J. (2004): El papel del e-Learning en el Espacio Europeo de Educación Superior, In: **Congreso Online Educa**, Madrid.

[5] MECD (2006**). Propuestas para la Renovación de las Metodologías Educativas en la Universidad**. SGT,. Madrid.

[6] MONTERO, M. A. (2007): Enseñanza de Estadística en un entorno virtual. **Revista de Informática Educativa y Medios Audiovisuales**, 4, 1-6.

[7] MONTERO, M. A. and QUESADA, I. (2007): Enseñar Estadística bajo un entorno Virtual. In **XXX National Congress of Statistic and Operational Research,** Valladolid, Spain, 2007.

[8] SYMANZIK, J., VEKANUSOVIC, N. (2002): Teaching Statistics with electronic textbooks. In: W. Hurdle, B. Runs (Eds.) **COMPSTAT 2002 Proceedings in Computational Statistics**, Physica, Heidelberg, 79-90.

[9] SYMANZIK, J., and VEKANUSOVIC, N. (2006): Teaching an introductory Statistics course with Cyber Stats, an electronic textbook. **Journal of Statistics Education**, 14, www.amstat.org/publications/jse/v14n1/symanzik.html