QUALITY ASSESSMENT AND IMPROVEMENT FOR THE BILINGUAL BACHELOR'S DEGREE AND BLENDED LEARNING MASTER'S DEGREE IN COMPUTER SCIENCE ENGINEERING

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Abstract

The concept of quality has, over the last few several decades, become both central to the field of higher education and an increasingly important issue, although it is recognized that it is a difficult concept to define, given its multidimensional nature. UNESCO defines quality in higher education as a multi-dimensional, multi-level, and dynamic concept relating to the contextual settings of an educational model, to the institutional mission and objectives, and to specific standards within a given system, institution, program, or discipline.

The Bachelor's degree in Computer Engineering at the University of Castilla-La Mancha (UCLM) has emerged as a new challenge as regards adapting Computer studies to the European Higher Education Area (EHEA), thus leading to the definition, maintenance and establishment of new curricula in order to adapt to the European Credit Transfer System (ECTS).

One of the strategies adopted by the UCLM for the future short and medium term is to improve the internationalization of its studies through its full commitment to bilingual Bachelor's degrees. Another strategy towards which the UCLM is committed is online training and/or blended learning in order to provide students with flexible mechanisms, versatility, personalization and accessibility, thus maximizing the potential of new technologies.

The Ciudad Real School of Computer Sciences, which is no stranger to the University of Castilla la Mancha's commitments has, in its strategic plan, decided to implement the short-term bilingual Bachelor's degree in Computer Science in parallel with the Computer Science degree currently taught in Spanish, and the implementation of a blended learning format in the official Master's degree currently offered on campus. These two clear commitments are aligned with the UCLM's strategic plan, and require an in-depth and efficient quality process if this implementation is to be achieved with the quality guarantees imposed by society as regards the institution of and guidelines proposed by the Bologna Declaration.

In order to implement these two new commitments, it is desirable to achieve high quality and continuously improved bilingual learning and blended learning. The intention of this research is therefore to act as a guide to ensure that the implementation of both the bilingual Bachelor's degree and the blended learning Master's degree is carried out correctly in a coherent and coordinated manner, and meets the highest standards of quality. It is therefore necessary to define a quality assurance methodology with which to ensure and guide the definition of both activities, along with more appropriate evaluation criteria for the particulars of these new disciplines, such as the monitoring and strict control of the most important aspects that must be achieved and the current state in terms of the quality present during the implementation of both the Bachelor's degree and the blended learning Master's degree.

In order to monitor quality and ensure improvement it is necessary to develop a balanced scorecard in which a specific set of indicators and metrics representing important aspects that must be measured for each discipline, are represented and visualized in order to know the level of quality, factors to improve, aspects to consider and changes to adopt at any time, with the objective of improving the quality of Bachelor's and Master's degrees.

Keywords: Quality assessment, bilingual grade, semi-presential master, Computer Science Engineering.

1 INTRODUCTION

Teaching is an essential function of university activity, but it is by no means the only one; it must therefore meet some requirements that guarantee its quality, all the more so in a period of change like the present time. “Working within the new model of university demands greater engagement on the part of the teaching staff” [1]. At the same time, the University also needs to get to grips with the directives coming from the Bologne Declaration; that means putting into operation a whole plan of action whose goal is to structure a new relationship between teachers and students, one that is based on the central idea of learning. The University must also ensure the availability of the material resources needed to carry out these changes with some guarantee of quality [1].

In its report “Standards and Guidelines for Quality Assurance in the European Higher Education Area“ [2],the European Association for Quality Assurance in Higher Education (ENQA) states that the role of teachers is crucial in the achieving of a quality EHEA. This makes specific reference to the need for the teaching faculty to be satisfied with, and involved in, their students’ learning process; it also affirms that this process should be subject to external assessment, so that skills can be duly recognized and certified. According to the ENQA, there are a few considerations to be taken into account as regards the quality of teaching. These include the following: opportunities should be given for teachers and lecturers to develop and enlarge their teaching skills; they need to be encouraged to make the most of their ability [3].

For some decades now, the concept of quality has clearly been occupying a central place in the field of higher education, becoming an increasingly important issue; this is in spite of the fact that it is recognised as being a difficult topic to define, given its multidimensional nature. The UNESCO [4].defines quality in higher education as a multidimensional, multi-level, dynamic concept; it is related to the contextual elements in an educational model, as well as to its mission and institutional goals and the specific standards within a given system, institution, programme or discipline.

Society as a whole is calling for the functions of universities to be linked to increasingly-demanding criteria of efficacy, efficiency and excellence. That means that quality is right at the hub of the design of university policy [5]. This innovation project therefore proposes to offer a methodology that assures and improves quality, in a quest to reinforce and/or increase this aspect in the teaching that takes place in the two new initiatives that are to come into being in the next academic year (the bilingual bachelor’s degree and the blended learning master’s degree). By *teaching quality* we refer to all those activities whose goal is to improve the knowledge, competence and skills of the university teaching faculty: these activities will have a direct impact in the classroom and lecture theatre, where educational innovation has an essential role [3].

Quality is no easy concept to tie down in a simple definition; as we have already said, it is multidimensional and any attempt to define it will only be successful if the concept of quality assurance is employed. This means that all policies, systems and processes should be directed at assuring the maintenance and enhancement of the quality of education offered in a given institution [6] A quality assurance system demonstrates that an establishment is confirming to itself and others that the appropriate conditions are there for students to achieve the standards set by that institution [7].

Quality assurance is also a complex concept in its own right; in practice it adopts many different dimensions and forms which may in turn change and/or be combined, depending on the specific needs of each system [8]. In general, there is a consensus that when we talk about quality assurance, we mean an “all-embracing term, referring to an ongoing, continuous process of evaluating the quality of a higher education system, institutions, or programmes. Evaluation in this case refers to the monitoring, guaranteeing, maintaining and improving of these levels” [4].

The Degree in Computer Engineering at the University of Castilla-La Mancha came into existence to respond to the challenge brought by the need to conform to the Computer Science studies established by the EHEA [9]. This led to the definition, updating and establishing of new curricula, in an effort to comply with the European Credit Transfer System (ECTS) [10]. This accreditation will be fully effective in the academic year of 2013-2014, with the appearance of the final year of the Computer Science degree. The degree is therefore a complete four years of study, with all its subjects and capacities correctly adapted to the European standards. In addition, the Escuela Superior de Informática (ESI) - The Faculty of Advanced Computer Science- in Ciudad Real has for some years now been offering a full-time master’s degree in Computer Engineering. The degree has a very well-defined curriculum, objectives, skills and practical assignments for its students; professionally speaking, its appeal comes from the excellent employment prospects enjoyed by those graduates who take this master’s course.

In its strategy for the present and the future, the ESI in Ciudad Real has staked a great deal on the bachelor's degree and the master's course. On the one hand, the idea is to internationalise the degree, and on the other, to put the blended learning of the master's into operation. These two ventures are completely in step with the strategic plan of the UCLM; they demand an in-depth, efficient quality process so that deployment of these degrees may be carried out with the guarantee of quality sought by society and the institution itself, as well as by the directives set out by the Bologna Declaration. All of this will be assured by the international accreditation of both the bachelor's degree and the master's degree.

There is an obvious and important need, then, to have a methodology available for the assurance and improvement of quality in the implementation of the bilingual bachelor's degree and the blended learning master's course. There has to be some guarantee about subjects and teaching practice; these must conform to the principles and quality guidelines that ensure that the objectives set are actually reached. They also need to comply with the criteria and recommendations established by the *European Quality Assurance Network for Informatics Education* (EQANIE). All this allows us to meet certain levels of quality, whilst at the same time adjusting the curricula so that they fit in to the European framework and hence subsequently receive European certification of the Computer Science syllabus.

Our paper is structured as follows: Section 2 sets out the objectives we wish to reach in this work. Section 3 presents the set of activities established in the attempt to reach those goals. In Section 4 we describe the work method used to ensure that the research part is in tune with the activities that were to be undertaken. Section 5 gives a description of the tasks we defined for each one of the activities presented in this paper as we set out to achieve a series of results that would enable us to meet the objectives proposed initially. The final section presents our conclusions, where there is an explanation of the results that are expected to be achieved in our research.

2 THE OBJECTIVES SOUGHT

The objective of this project for teaching innovation is to assure and improve the quality of the bilingual bachelor's degree and the blended learning master's degree. The aim is to achieve all this by designing and developing a methodology for assuring and improving quality which would at the same time guarantee that these new courses would be rolled out properly and consistently. That would mean following a series of criteria, metrics and indicators which will be used in a balanced scorecard to monitor and evaluate the quality of the different subjects that form part of the bilingual bachelor's degree and the official master's degree course.

To ensure and improve the quality, the methodology proposed should be followed. This sets out the guidelines for the correct implementation of the subjects in the bilingual degree and the master's blended learning degree course It also contains a set of factors, criteria and quality standards which should be met and complied with, defining a series of metrics and indicators which will assure a good level of quality in the implementation.

For the bilingual bachelor's course, as well as for the official master's degree, a direct relationship should be established between the quality criteria and the acquisition of the skills and abilities formulated for the bachelor's degree and the master's degree in Computer Engineering. These skills and abilities will therefore be the key point in assuring, measuring, controlling and defining the quality criteria for these two qualifications in Computer Science.

The creation of an balanced scorecard will be another goal; this will display the level of quality of the bachelor's degree and the blended learning master's course at any given time, shown by the values taken by the indicators and metrics of quality. The indicators will point to the level of compliance, or the degree to which the different activities of the subjects achieve the skills established for those subjects. They will also keep track of the participation of the students, the quality of the material used and its accessibility; they will also register how suitable the activities are for the particular features of a given subject. The indicators will in addition show the opinions and assessments of students and teaching staff, diplaying enrolment figures for each year, the rates of pass marks and numbers of drop-outs; they will also show what tools were used, etc.

Lastly, the aim is to produce an action plan to achieve the accreditation of the bachelor's degree and the bilingual degree in Computer Engineering, as well as of the official master's degree in its different modalities. This accreditation would be at a European level, granted by the EQANIE, the European Quality Assurance Network for Informatics Education through the Euro-Inf Project, the main purpose

of which is to develop a reference network for accreditation of qualifications in Computer Science within the EHEA.

3 THE ACTIVITIES PLANNED

To reach the objectives that have been set, we are going to divide the project into 5 quite distinct activities which are needed if it is to be accomplished. They are the following:

3.1 Analysis of the state of the art

A study should be carried out to analyse the different proposals and standards for assuring quality in higher education. An in-depth study should also be performed to discover how to develop a balanced scorecard which analyses the whole range of proposals and technology for the development of quality. The criteria provided by the EURO-INF on topics to do with quality in higher education will also be analysed and studied so that they can be implemented when European accreditation is requested.

3.2 Analysis of the bilingual bachelor's degree and the blended learning master's degree

An in-depth analysis needs to be conducted of all the aspects that make up these two qualifications; the objectives of the degree as a whole, as well as the skills, the teaching practice, the assessment criteria, the different activities, the possible coordination, the content, student participation, the number of students with pass marksand the enrolment figures, etc. The tools used should be analysed too, along with the scheduling and the resources for each subject.

3.3 Defining the quality assurance methodology

A methodology which assures the quality of the subjects needs to be built-one which helps us to obtain a series of guidelines and recommendations. These would show how to define certain activities that would enable specific skills to be acquired, indicating what the most appropriate assessment criteria are and identifying the key points, as well as how the subjects and contents are in tune with the skills. This methodology will enable us to define a series of metrics and indicators that would allow us to assess, measure and monitor the quality factors that are defined for the set of subjects making up the bilingual bachelor's degree and the blended learning master's degree.

3.4 Developing a balanced scorecard

This balanced scorecard enables us to have an overall view of the level of quality at any given time; it visualises the values of the indicators that have been defined, along with the metrics and the criteria that have to be taken into account in controlling, monitoring and measuring the quality level in both the bilingual bachelor's degree and the blended learning master's degree. The balanced scorecard will display the values obtained from the indicators and metrics that have been defined in earlier activities. This will make it possible to keep track of each of the aspects that play an important part in assuring a good level of quality in both the bilingual bachelor's degree and the master's degree. The balanced scorecard will allow us to see which aspects comply with the quality criteria and which ones should be improved when they do not conform to or reach the minimum levels of quality required for the bilingual bachelor's degree and the blended learning master's degree.

3.5 Defining an action plan for European accreditation

A detailed plan will be created; this will indicate the steps to be followed, together with the norms and criteria to be borne in mind to make it possible for the degree in Computer Engineering to receive European accreditation by EQANIE, (the European Quality Assurance Network for Informatics Education) within the EURO-INF reference framework for qualifications in Computer Science.

4 METHODOLOGY AND TASKS

In tackling this project of teaching innovation, we are going to use an approach to, and adaptation of, the “action-research” method, which is a qualitative research method that offers iterative cycles of application and refinement of theories that have been built in real environments, allowing us to obtain interesting information that would enable the proposals to be improved. Padak and Padak identify the following steps that should be followed in the research that uses this method [11].

4.1 Planning

This is the identification of the relevant questions that will guide the project. These should be directly related to the object under investigation and it should be possible to find answers to them. The study of the state of the art is carried out in this activity; the subjects that make up the bilingual bachelor’s degree and the blended learning master’s degree course are considered and analysed.

4.2 Action

What happens here is a controlled, careful and deliberate variation of the practice. A simulation or test of the situation is carried out; the participant intervenes and and acts on the real situation. This is where we have to build the quality assurance methodology and work out the criteria, metrics and indicators of quality which will be included in the balanced scorecard that should also be produced in this step.

4.3 Observation

This step is for gathering information, collecting data, documenting what is happening. It is also known as “assessment”. At this stage we should have a look at the balanced scorecard and check that it is working according to plan. That means ensuring that the indicators and metrics have been incorporated properly, that they show consistent, error-free results and that the methodology is the right one, identifying possible faults or mistakes, etc.

4.4 Reflection

At this stage the results are shared with the rest of stake-holders, inviting the proposal of new relevant questions. The aim is to improve the quality assurance methodology, identifying new aspects that were not considered originally but which have come to light during the course of the application of the methodology. Possible errors will be corrected, thereby improving the balanced scorecard and updating the set of quality indicators and so on.

With these characteristics, the process that we have used as an adapted approach to Action-Research is iterative. It thus advances with increasingly-more-refined solutions by completing cycles. In each of these cycles new indicators and quality metrics are inserted, then put into practice and checked in the following cycle, as shown in Fig 1.

This cycle is a feature of Action-Research; it is a reflexive process of learning and of seeking solutions. This cyclic character is in fact a re-evaluation or a re-think of the action that should be taken, or the paths that need to be followed, weighing up the diagnosis in careful critical thought.

For this innovation project to be completely successful, it is a really useful idea to employ the action-research method. By carrying out surveys and interviews in the certifying agencies and with the teachers who give the qualifications we will obtain a constant feedback of information which will allow us to determine if the content of the subjects and the description of the skills related to security and audit are attuned to the real needs of companies.

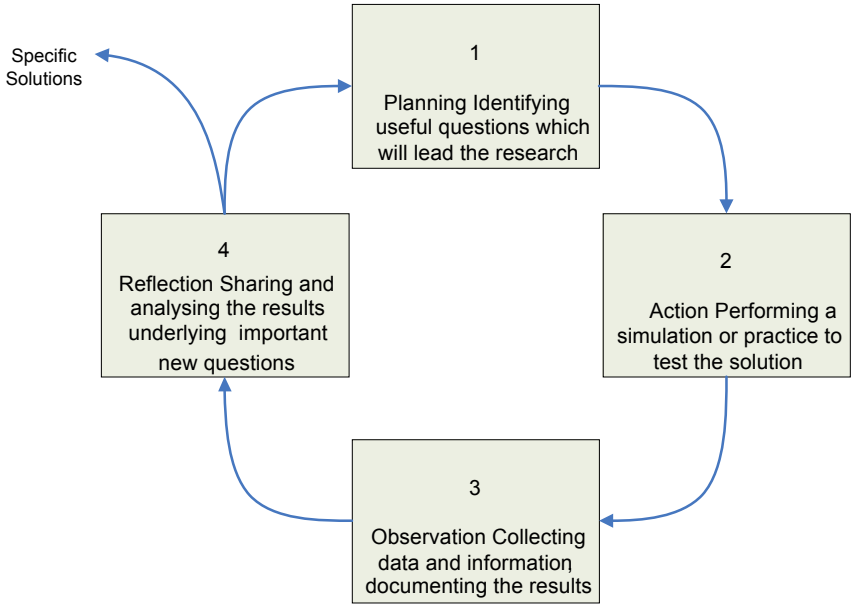

Fig. 1. Action-Research Process

5 WORK TASKS

The tasks for each of the activities into which we have divided the project are described below. We have 5 activities, described in section 3; for each one of these we can see the tasks that need to be done so that the particular activity can be carried out successfully to achieve the results that are expected and desired. The expected results are set out in detail in the section which provides our conclusions.

5.1 Activity 1 - Analysis of the present situation of the bachelor and master's degree

5.1.1 Tasks

- Analyse the present situation of the bilingual bachelor's degree, identifying the key aspects, the subjects involved, the teachers, etc.
- Analyse the present situation of the blended learning master's degree, identifying the key aspects, the subjects involved, the teachers, the tools used, the planning, etc.
- Analyse the situation of the bilingual bachelor's degree within the degree in Spanish, seeing the factors of failure or success.
- Analyse the situation of the blended learning master's degree within the full-time master's degree, seeing the factors of failure or success.

5.1.2 Expected Results

- A report of the present situation of the bilingual degree and the blended learning master's degree within the bachelor's degree and full-time master's respectively.

5.2 Activity 2 - Analysis of the state of the art

5.2.1 Tasks

- Analyse the different proposals and standards which are related to quality assurance and that address university learning.
- Analyse the existing initiatives and proposals in the development of balanced scorecards and the particular technology used in that development.
- Identify those proposals that are most suitable for use or application in the project.

5.2.2 Expected Results

- Informe del estado del arte incluyendo las iniciativas de métodos para el aseguramiento de la calidad y propuestas de desarrollo de cuadros de mando.
- Report on the state of the art, including the initiatives on methods for quality assurance, as well as proposals for the development of balanced scorecards.

5.3 Activity 3 - Definition of the quality assurance methodology

5.3.1 Tasks

- Identify the tasks and activities of the methodology using the proposals and standards analysed previously as a basis.
- Define the methodology with the stages, steps and general tasks, as well as the inputs and outputs for each one of them and the results achieved in each of the tasks or steps.
- Define the tasks and specific steps to assure the quality of the bilingual bachelor's degree, taking due account of the special features of receiving instruction in English.
- Define the tasks and specific steps to assure the quality of the blended learning master's degree course, taking due account of the special features of blended learning.

5.3.2 Expected Results

- Methodology for the assurance of overall quality.
- Methodology for the assurance of the quality of the bilingual bachelor's degree.
- Methodology for the assurance of the quality of the blended learning master's degree.

5.4 Activity 4 - Development of a balanced scorecard

5.4.1 Tasks

- Analyse the functional and non-functional requirements of the balanced scorecard, along with the technological needs.
- Design the architecture of the balanced scorecard, incorporating all the indicators defined in the previous activities, fulfilling all the requirements identified in the previous task for the bilingual bachelor's degree.
- Design the architecture of the balanced scorecard, incorporating all the indicators defined in the previous activities, and fulfilling all the requirements identified in the previous task for the blended learning master's degree.
- Develop the balanced scorecard, integrating both of the above architectures.
- Automate the balanced scorecard in such a way as to enable the information to be generated, monitored and managed automatically, or semi-automatically.

5.4.2 Expected Results

- Balanced Scorecard

5.5 Activity 5 - Tests for validation and refining

5.5.1 Tasks

- Carry out the tests and checks needed to check the applicability, traceability, correctness and consistency of the methodology and of the results generated with specific cases of subjects for the bilingual bachelor's degree.
- Carry out the tests and checks needed to check the applicability, traceability, correctness and consistency of the methodology and of the results generated with specific cases of subjects for the blended learning master's degree course.

- Carry out the validation tests for the balanced scorecard, aiming to check the functionality, usability, ease of use and consistency with the values shown.
- Identify and analyse the possible errors and faults found in the validation tests, to propose improvements, changes and updates, both for the methodology and the balanced scorecard.

5.5.2 Expected Results

- Report on the tests carried out for the methodology, informing of errors found.
- Report on the tests carried out for the balanced scorecard, informing of errors found.
- List oferrors and changes, along with possible solutions to be integrated for the correction of errors and the improvement of the proposals.

5.6 Activity 6 - Planning for european accreditation

5.6.1 Tasks

- Analysis of the present syllabus of the bachelor's degree in Computer Science, as well as of the official master's degree.
- Study of the crirteria and directives to be followed in order to achieve European accreditation.
- Planning and defining of the proposal for the accreditation of the bachelor's degree and the master's degree in Computer Science.
- Execution of the action plan and the dossier of specifications for the bachelor's degree, including the standard degree and the bilingual one, the full-time master's and the blended learning master's, a plan and dossier of specifications that are attuned to the criteria and guidelines defined and analysed previously.

5.6.2 Expected Results

- Action plan for European accreditation of the bachelor's degree and the master's in Computer Engineering.

6 CONCLUSIONS

The expected results for this project coincide with the expected results in each activity. We therefore have:

- A follow-up report which tells us how the project is developing and if the deliverables are being defined correctly, as well as whether the participants are performing their tasks appropriately, etc.
- A report of the present situation both of the bilingual bachelor's degree and of the blended learning master's, identifying the activities, the planning, tools students, teachers, assessments, etc. This gives an idea of how the bilingual bachelor's degree and the blended learning master's course are being implemented and also provides information about participation and the students who are on the degree courses.
- A report on the state of the art that includes the study conducted to discover the different initiatives of methodologies and processes that exist for the assurance of quality, as well as the study performed to investigate the processes of development of balanced scorecards for different sectors.
- The methodology for quality assurance that includes the main nucleus and which may be re-used in the evaluation of quality of other areas, together with the specific branches for which the methodology was created; for the branch of the bilingual bachelor's degree and for the blended learning master's degree.
- The balanced scorecard which displays all the values that have been regarded as essential and which represent the teaching quality both of the bilingual bachelor's degree and of the blended learning master's degree.This visualisation will be done in multiple formats (text, bar graphs, diagrams, etc.), making it easier to understand the real situation. In addition, this

should be as automatic as possible so that if we have known initial values we may automatically manage the whole balanced scorecard, with no need for any user intervention.

- Reports of the validation tests, which will identify the possible errors, faults, changes or problems when the relevant tests are performed, both for the methodology of quality assurance and the balanced scorecard. Those errors or changes highlighted will also be scrutinised and solutions will be given, or guidelines provided; this will allow us to improve and correct tne methodology and the balanced scorecard.
- Lastlly, an action plan will be drawn up, in order to make the request for European accreditation by the *European Quality Assurance Network for Informatics Education* (EQANIE), creating up the documents, specifications and guides and following the criteria and recommendations given by EQANIE, for the bachelor's degree and the master's degree in Computer Science (the standard bachelor's degree, the bilingual bachelor's degree, the full-time master's and the blended learning master's).

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