VALIDATION OF RUBRICS TO ASSESS COMPETENCES IN AGRICULTURAL ENGINEERING HIGHER EDUCATION

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Abstract

The European Higher Education Area (EHEA) learning process, proposed by the Bologna Declaration, is based on a competences model. Therefore, the teaching process, including the evaluation, must be designed and developed according to the competences that the students need to acquire. This paper presents a teaching innovation project which is the continuation of a previous experience in the use of rubrics to assess competences in Higher Education. In the previous project, we noticed some weaknesses. The students did not consider the rubric until the assessment moment and rubrics were limited used by students to self-monitoring their learning process contributing to their teaching responsibility and to self-evaluate their work quality and possible improvement. The teachers lacked experience and skills to create and develop rubrics to assess competences limiting the alignment of the evaluation with the teaching-learning process. Finally, it was observed a limited participation of all the involved in the evaluation process. In order to overcome these issues the present project aims to develop a validated use of rubrics to assess competences in Higher Education. In doing so, the following methodology in four steps was developed. In the first step, the teachers collected criteria and indicators for the assessment of competences in Higher Education, in our case for Agricultural Engineering degrees and Masters. In the second step, the students scored the criteria at the beginning of the semester in order to consider the rubric from the first moment of the teaching process. In the third step, the teachers discussed the indicators and criteria and create the rubric. In the fourth step the rubrics were implemented by teachers during the evaluation process and the students scored their level of acquisition of competences. Finally, the teachers discussed and compared data giving feedback to the rubrics for the assessment of competences. The results of the innovation learning experience showed an improvement in i) the alignment of the evaluation with the teaching-learning process, ii) the participation of all the involved the evaluation process, iii) the students´ self-monitoring of their learning process contributing to their teaching responsibility, iv) the students self-evaluation measuring their work quality and possible improvement.

Keywords: Innovation, rubrics, innovation teaching project, validation, assessment

1 INTRODUCTION

The learning process proposed by the Bologna Declaration is a competences-based model in which all the teaching process, including the evaluation, must be designed and developed according to the competences that the students need to acquire [1]. In this line, there is unanimity in the scientific community on the need to improve the quality of the assessment, revising and revamping the evaluation [2], [3]. In doing so, the rubrics are recognized tools to evaluate the learning process [4] aligned with the competences-based learning model [5], [3]. Nevertheless, it has been marked the need to insight into the use of rubrics [6]. In doing so, Reddy and Andrade [7] suggested the need of four research lines for rubrics, i) enhance rigorous methodologies to analyze the reliability and validity of the rubrics [8], ii) implement more research on the reliability and validity of the rubrics [9], iii) extent the geographical and cultural analysis of the use of rubrics, because most of the studies are carried out in the United States and iv) diversify the use of the rubrics not only for the evaluation but also for learning and self-assessment purposes.

Authors proposed different methodologies to use the rubrics in the evaluation. Alsina [4] suggested three steps for the use of rubrics, i) the definition of the competences to assess, ii) the establishment of the levels of achievement and iii) the elaboration of the assessment plan to be implemented, in order to normalize the teaching-learning process. Alsina [4] proposed a teachers´ committee working together to establish the criteria and levels of achievement for the students. On the other hand, Fernandez March [1] suggested that the methodology must included the students´ resources to be mobilized, the type of assessment classified, the levels of achievement of competences characterized,

the teaching-learning methodology summarized, the learning process scheduled fixing the students and teachers activities and the models of the learning monitoring established. For Fernandez March [1], the teacher solely will be responsible of all the process. To the best of our knowledge, methodology lacks of the consideration of the students in the design of the assessment [10], [11].

In the previous project using rubrics to assess competences, we noticed some weaknesses. The students did not consider the rubric until the assessment moment and rubrics were limited used by students to self-monitoring their learning process contributing to their teaching responsibility and to self-evaluate their work quality and possible improvement [12]. The teachers lacked experience and skills to create and develop rubrics to assess competences limiting the alignment of the evaluation with the teaching-learning process [13]. Finally, it was observed a limited participation of all the involved in the evaluation process.

The aim of this innovation teaching project is to develop a validated use of rubrics to assess competences in Higher Education and its implementation to Agricultural Engineering Degrees and Masters.

2   METHODOLOGY

A linear methodology in four steps was developed. In the first step, the teachers collected criteria and indicators for the assessment of competences in Higher Education, in our case for Agricultural Engineering degrees and Masters. In the second step, the students scored the criteria at the beginning of the semester in order to consider the rubric from the first moment of the teaching process. In the third step, the teachers discussed the indicators and criteria and created the rubric. In the fourth step the rubrics were implemented by teachers during the evaluation process and the students scored their level of acquisition of competences. Finally, the teachers discussed and compared data giving feedback to the rubrics for the assessment of competences (Figure 1).
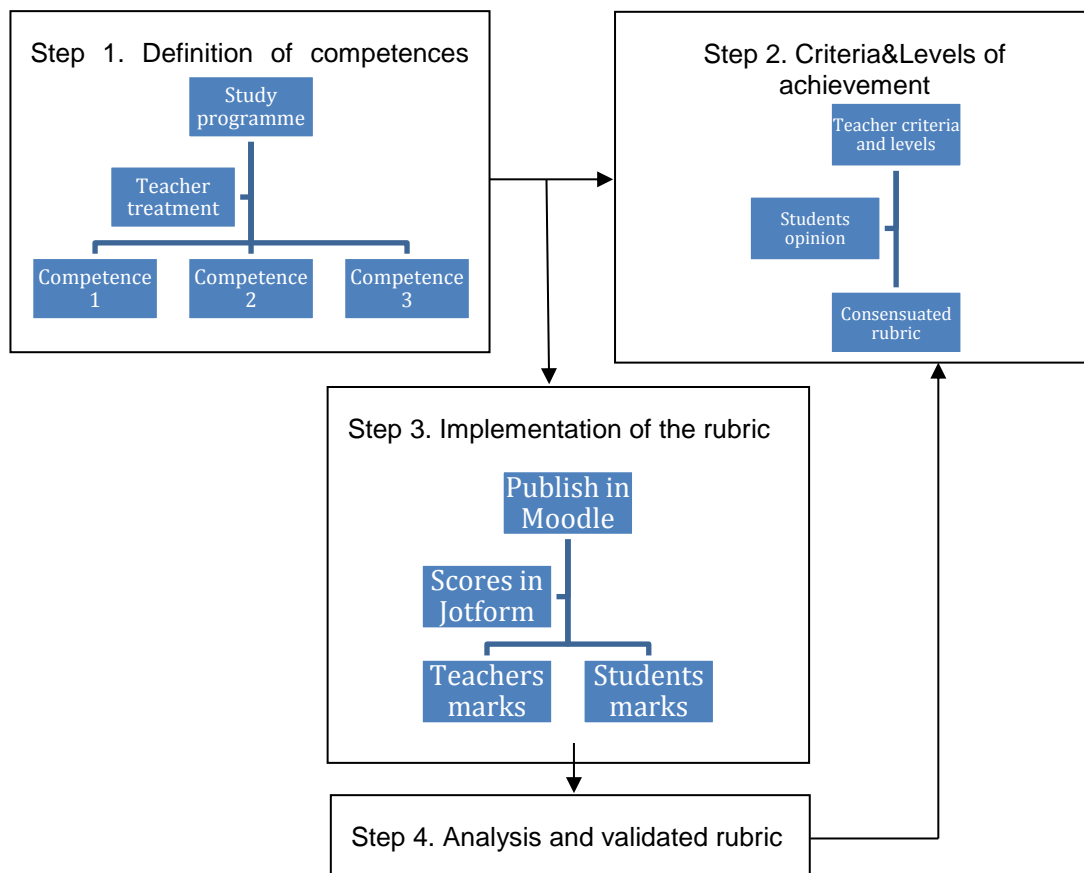

Figure 1. Methodology for the validation of rubrics to assess competences in Agricultural Engineering Higher Education.

During the implementation of the innovation teaching project, the competences were collected from the study programmes provided by the Degrees and Masters Higher Education National Ministry. Three competences were considered, i) Capacity to analyse and summarise (C1), ii) Ability to communicate both in technical and non-expert forums (C2) and iii) Critical thinking (C3) according to the study programme. For the implementation of the rubric, four subjects of Degree and Master were considered (Table 1). The sampling of participant students totalled 42 by January 2019, with an average age 23.67 (the youngest aged 21 and the oldest 31). The sample counted 37.84% men and 62.16% women.

Table 1. Sampling of studies, subjects and students involved in the innovation teaching project assessing competences by rubrics.

Degree/Master	Subject	N students	University
Degree Enology	Marketing	5	Valladolid
Degree Agricultural Engineering	Commercialization	11	Valladolid
Master in Agroforestry Tech.	Rural development	2	Valladolid
Master in Food Quality and Dev.	Marketing	24	Valladolid

3   RESULTS

The results show, on the one hand the participation of the students ranking the criteria and levels of achievement, participating in the assessment design. On the other hand the implementation of the rubric in Agricultural Engineering validating its use for the evaluation in Higher Education.

3.1   Criteria and Level of Achievement Ranking

Teacher proposed to students the rubric at the beginning of the semester. Rubric contained three essential features: criteria students are to attend to in completing the assessment, markers of quality (level 1, level 2 and level 3), and punctuating (Likert scale anchored extremes 1-very low achievement to 5-complete achievement). Criteria were used in determining the level at which student work meets expectations. Markers of achievement give students a clear idea about what must be done to demonstrate a certain level of mastery, understanding and proficiency. A rubric matrix of three competences for three stages and three levels of achievement (9x3) presented. For this initial rubric the students were invited to order from one to three the importance of each criteria and level. They were also invited to propose for each competence another criteria and levels of evaluation.

Students showed for the competence C1 Capacity to analyse and summarise the same level of criteria than teacher in solving the problems while gave higher importance than the teacher to the adaptation to the market and to cover objectives. The formal aspects were less important for the students than teacher. They commented that found more important the content than the formal aspects (Table 2).

Table 2. Rubric used to assess the competence C1 Capacity to analyse and summarise. Average score of importance.

Competence	Category	Level 1	Level 2	Level 3
C1	Formal aspects	Accomplish guide 1.9	Cover objectives 2.7	Include flow chart 1.6
	Solving problems	Address a real case 1.8	Solve problems 2.2	Deal with market 2.2
	Adaptation	Adapt to market 2.2	Adapt signature 1.9	Eco. & Techn. 2.0

In the assessment of the C2 Ability to communicate both in technical and non-expert forums, the students again gave higher importance to the content than the formal aspects. The distribution of the presentation time, to address the subject and raise interest in the public were the most important criteria in this competence for the students. Nevertheless, the teacher found important, especially nowadays, to use a good support for the presentation, moreover to express fluently and respond properly to the questions of the public (Table 3). The criteria express fluently and respond properly have the lowest marks in the students. It may be concluded that the students are conscious of their weakness and they preferred to give a lower importance than other criteria in the assessment.

Table 3. Rubric used to assess the competence C2 Ability to communicate both in technical and non-expert forums. Average score of importance.

Competence	Category	Level 1	Level 2	Level 3
C2	Presentation	In time and form 2.0	Time distribution 2.4	Proper support 1.6
	Expression	Proper vocabulary 1.8	Address subject 2.6	Express fluently 1.8
	Audience interest	Audience attention 2.0	Create interest 2.7	Answer questions 2.0

For the C3 Critical thinking, the students gave importance in the conclusions of their projects to deal the premises, derive of the objectives and once again to be adapted to the market. Nevertheless, the criteria strongly linked to a critical thinking were less important for the students. They gave less importance to provide in their project their own recommendations and futures lines of action which can really demonstrate their significant critical thinking in their projects (Table 4). They spent a lot of time and efforts in the previous phases of the project, background, solve problems and results. It seems that lack of time and importance to the real important of conclusions and future actions.

Table 4. Rubric used to assess the competence C3 Critical thinking. Average score of importance.

Competence	Category	Level 1	Level 2	Level 3
C3	Formal conclusions	SWOT or similar 1.8	Deal premises 2.6	Own recommend. 1.6
	Address objectives	Address objectives 1.9	Derive objective 2.5	Novel conclusion 1.8
	Practical implications	Future lines 1.5	Feasible 1.9	Adapt to market 2.6

3.2 Implementation of the Rubric

The teachers and the students completed a digital survey and scored their perception of the achievement of competences, at the end of the semester. The survey was carried out using the Jotform digital tool. A focus group compared the punctuations given by students and teachers (Table 5). It was found differences between students and teachers marks at all levels and criteria. On the one hand, some methodological and formal aspects were not fully achieved by the students. For instance, accomplishing the project guide proposed by the teachers or including a SWOT analysis in their project and a flow chart to summarize the presentation. These mistakes showed a low attention paid to the rubric by some of the students during the teaching process. On the other hand, it was found differences in criteria related to a deep analysis and critical thinking. For instance, criteria related to the students recommendations, the future lines of action and the feasibility of the projects. These

differences are a logical part of the evaluation process. Nevertheless, it is interesting to confirm that the students in the score of the criteria at the beginning of the semester already marked the less importance given to these criteria of critical thinking.

Table 5. Average and means difference between punctuations given by students and teacher to the achievement of the criteria describing in the learning competences assessed.

		M Student	M Teacher	MS-MT
Level 1	Accomplish guide	4.75	3.88	0.87
	Address a real case	4.57	4.26	0.31
	Adapt to market	4.57	4.02	0.55
	In time and form	4.54	3.83	0.71
	Proper vocabulary	4.11	3.76	0.35
	Audience attentive	4.61	4.32	0.29
	SWOT or similar	3.57	2.19	1.38
	Address objectives	4.43	3.62	0.81
	Future lines	4.43	3.3	1.13
Level 2	Cover objectives	4.65	3.93	0.72
	Solve problems	4.62	4.00	0.62
	Adapt signature	4.46	4.00	0.46
	Time distribution	4.05	3.76	0.29
	Address subject	4.54	3.69	0.85
	Create interest	4.31	4.29	0.02
	Deal premises	4.47	3.50	0.97
	Derive objective	4.49	3.55	0.94
	Feasible	4.49	3.31	1.18
Level 3	Include flow chart	3.86	2.52	1.34
	Deal with market	4.42	4.02	0.40
	Eco. & Techn.	4.38	4.12	0.26
	Proper support	4.70	3.60	1.10
	Express fluently	3.92	3.85	0.07
	Answer questions	4.26	2.85	1.41
	Own recommend.	3.84	3.43	0.41
	Novel conclusion	4.60	3.5	1.10
	Adapt to market	4.60	3.33	1.30

The perception of the teacher of competences achieved was lower than the students´ perceptions.

The analysis of the aggregated criteria shows similar values between students and teachers on solving problems, adaptation to the market and expression criteria and larger variations in the critical thinking and some formal aspects of the capacity of analysis and sum (Figure 1).
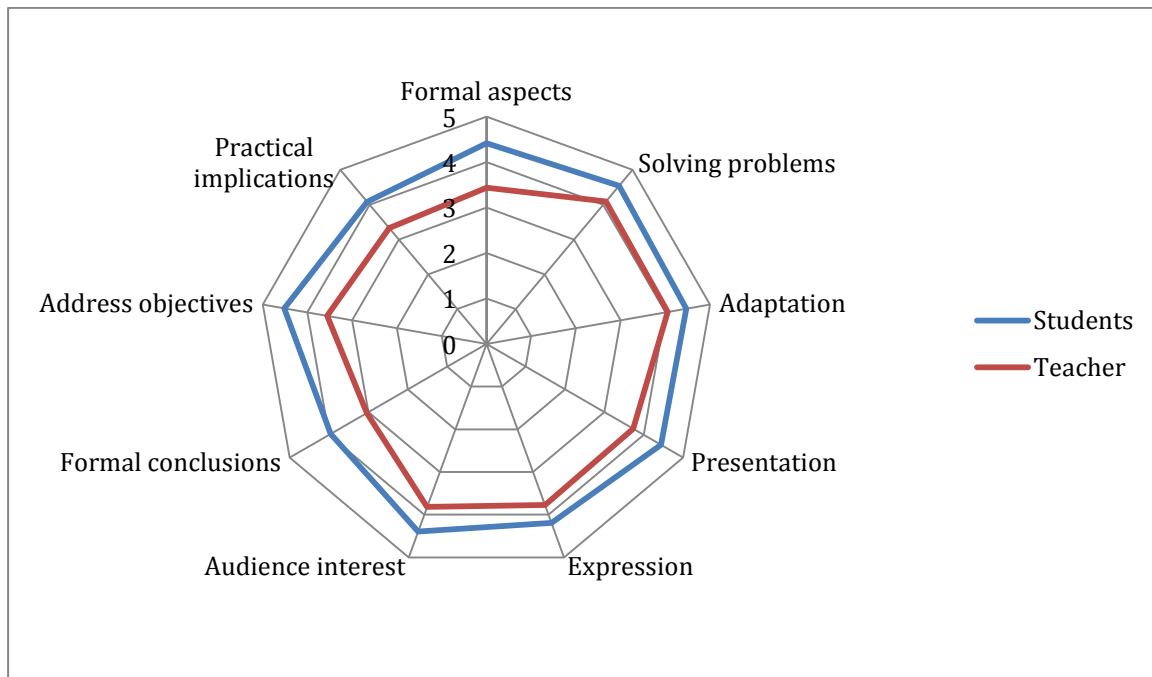

Figure 1. Average punctuation to competences criteria by teachers and students.

The competences evaluation (Table 6) showed teachers lower perception of the achievement of competences than students, positive difference between students and teachers punctuation. The competence less achieved both students and teachers was students´ critical thinking. The competence higher achieved by students and teachers was the capacity to analyse and summarise. Teachers agreed students´ capacity to analyse and summarise caused by the social media and information and communication technologies used by younger students that promotes to analyse and summarise.

Table 6. Means punctuations given by students and teacher to the achievement of the aggregate criteria of competences to assess.

Competence	Category	M Students	M Teacher	MS-MT
C1	Formal aspects	4.42	3.44	0.98
	Solving problems	4.54	4.09	0.45
	Adaptation	4.47	4.05	0.42
C2	Presentation	4.44	3.73	0.71
	Expression	4.19	3.77	0.42
	Audience interest	4.39	3.82	0.57
C3	Formal conclusions	3.96	3.04	0.92
	Address objectives	4.52	3.56	0.96
	Practical implications	4.08	3.33	0.75

The larger variation appeared in critical thinking competence and concludes a different acquisition by students (Table 7). Teachers´ focus group attributed this variation to the students´ different baseline knowledge to face the studies and pointed out the need to revise the admission process.

The competence less achievement both students and teachers was students´ critical thinking. The competence higher achievement by students and teachers was the capacity to analyse and summarise.

Table 7. Means punctuations given by students and teacher to the achievement of learning competences to assess.

Competence	M Students	M Teacher	MS-MT
C1: Capacity to analyse and summarise	4.47	3.86	0.61
C2: Ability to communicate both in technical and non-expert forums	4.34	3.77	0.57
C3: Critical thinking	4.19	3.31	0.88

The innovation teaching project showed that teachers realize the competences that the students need to acquire. In this sense, teachers concluded the ability of the rubric to align the evaluation with the Bologna teaching-learning process. The teachers expressed that rubric is capable to measure the progress, evolution and acquisition of competences by the students according to the European Higher Education Area (EHEA) learning process.

The teachers notice the students´ lacked of self-evaluation measuring their work quality and possible improvement. Students to assume their teaching responsibility is a challenge using rubrics.

It was concluded students presented higher importance in practical solutions to agricultural engineering market problems than formal aspects.

There is a need to improve the use of rubrics in order to students make decisions about their current level of learning to inform revision and improvement.

4   CONCLUSIONS

- The competence less achieved both students and teachers was students´ critical thinking. The competence higher achieved by students and teachers was the capacity to analyse and summarise.
- The students give less importance to provide in their project their own recommendations and futures lines of action which can really demonstrate their significant critical thinking in their projects.
- The less important criteria for students are the criteria with the lowest marks of achievement.
- The students presented higher importance in practical solutions to agricultural engineering market problems than formal aspects.
- The teachers expressed that rubric is capable to measure the progress, evolution and acquisition of competences by the students according to the European Higher Education Area (EHEA) learning process.
- The teachers notice the students´ lacked of self-evaluation measuring their work quality and possible improvement.

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