GENERATING WITH ARTIFICIAL INTELLIGENCE (AI) IN AGRICULTURAL ENGINEERING HIGHER EDUCATION

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Abstract

United Nations Educational, Scientific and Cultural Organization highlights the great potential of artificial intelligence (AI) to develop innovative teaching and learning processes. In this line, it is suggested to focus on learning with the AI, learning about the AI and prepare students for AI. In doing so, in a previous project, our agricultural engineering students solved a problem and compared the solution with the solution gave by AI, strengthening the critical thinking competence (G15). In this project, we aimed to also contribute to AI with this critical thinking. To do this, the flipped classroom methodology was developed and students asked a generative AI to solve a problem. The students then received tools to solve the problem through testing and reasoning. The students then compared the results with the results of AI and generated a paragraph to feed AI with a supposedly improvement in the solution of the problem. Additionally, an e-rubric was used to align the evaluation with the competences that students need to acquire. This project presents a teaching-learning innovation in three aspects: a) the flipped classroom methodology, b) the use of AI technological innovation to develop the G15 critical thinking competence and c) the use of an evaluation with an e-rubric in line with the EHEA. However, the results show that students, instead of competing with AI, they use AI believing without a doubt what AI says and avoid critical thinking. It is concluded that despite the benefits of AI, it is necessary to clearly define its use in the teaching-learning process, designing appropriate tools for the development of students' critical thinking. Moreover, the teachers learned with this project to identify students that used AI to avoid critical thinking.

Keywords: Competences, evaluation, critical thinking, e-rubrics, technology, education.

1 INTRODUCTION

The United Nations highlights the great potential of Artificial Intelligence (AI) to develop innovative teaching and learning processes [1]. AI is already present in our lives and is expected to bring great challenges to all of our activities in the near future. However, the misuse of AI has potential risks that need to be considered, such as the negative impact on our behaviour, artificial stupidity, bias and lack of machine neutrality, unintended consequences and the impact on employment [2]. Research is therefore needed to take advantage of this technological revolution and reap its benefits in terms of innovation and knowledge [3]. To achieve this in the development of innovative teaching-learning processes, the United Nations [1] establishes that we should focus on three areas: learning with AI (e.g. using AI tools in the classroom), learning about AI (its technologies and techniques), and preparing for AI (e.g. enabling all citizens to understand the potential impact of AI).

In this sense, and in order to complete the recommendation of a varied assessment based on the competences [4], in previous teaching innovation projects, we developed rubrics to align the assessment with the competences that the student must acquire [5]. In addition, we designed practices for students to contact companies for their future job insertion in the agri-food sector. Finally, we proposed students to contrast the solution provided by an AI to an agricultural engineering problem [6], thus strengthening the critical thinking competence G15, since we found that this was the competence that we needed to work most with our students [7].

At this point, and encouraged by the positive acceptance by students and teachers of our previous practices using AI in the classroom, we felt we should go a step further and contribute to this new technology with our insights and critical thinking using generative AI.

The aim of this teaching innovation project is to contribute to and improve AI with a contrasted and tested result for a given agricultural engineering problem, based on students' critical thinking.

This project presents a teaching-learning innovation in three aspects: a) the flipped classroom methodology, b) the use of AI technological innovation to develop the G15 critical thinking competence and c) the use of an evaluation with an e-rubric in line with the EHEA.

2 METHODOLOGY

2.1 Method

The flipped classroom method was used to achieve the aim of the project. First, the students received an agricultural engineering problem to solve. Then, students asked the AI to solve the problem.

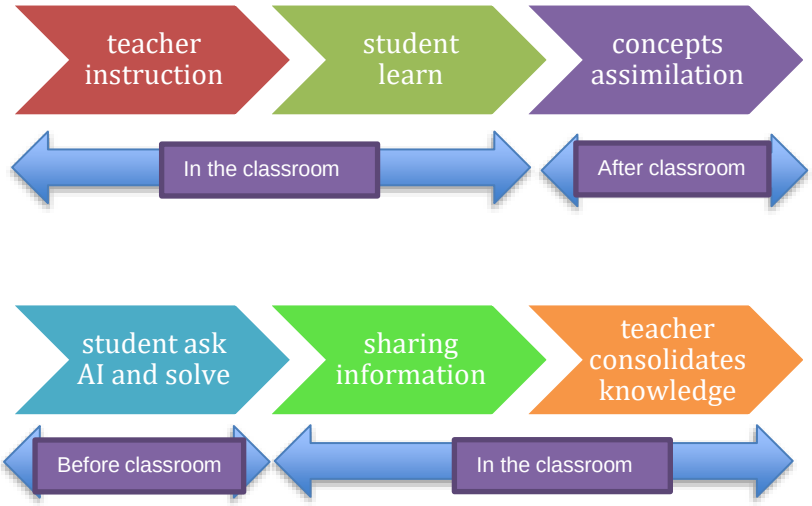

Figure 1. Comparison among traditional teaching-learning model (up) and flipped learning model (down).

Students were given tools to solve the problem using valid databases, consulting primary sources, interviewing farmers and companies, developing field works, calculating, testing and reasoning. The students prepared their solutions to the problem and presented them in the classroom.

The students then checked, validated and confirmed the results provided by the AI and contrasted them with their results, thereby strengthening critical thinking skills (G15).

The students then compared their results with those of the AI and wrote a paragraph to feed the AI with an improvement, supposedly, in solving the problem.

In addition, students used a rubric to assess their work, self-assessment, the work of other students, co-assessment, and to align the assessment with the competences they need to acquire. Teachers also used the rubric to assess students.

2.2 Participants

This innovative teaching and learning project involved 66 students of Agricultural Engineering at the University of Valladolid.

The participants were students from three degree courses, Degree in Agricultural and Rural Engineering, Degree in Oenology and Degree in Engineering of Agricultural and Agri-food Industries, and two Masters, Master in Agricultural Engineering and Master in Food Quality and Development.

The teaching innovation project was developed during the winter and spring semesters of the 2024-2025 academic year.

The profile of the participants is shown in Table 1.

Table 1. Students, subjects, semester and level of participants in the teaching and learning project 'Generating with Artificial Intelligence (AI) in Agricultural Engineering Higher Education '.

Subject	*Degree/Master*	*Semester*	*Level*	*Students*
Commercialization	Degree in Agricultural and Rural Engineering	1	4	24
Marketing	Master in Food Quality and Development	1	1	16
Marketing	Degree in Oenology	1	4	4
Commercialization	Degree in Engineering of Agricultural and Agri-food Industries	2	2	5
Marketing	Master in Agricultural Engineering	2	1	17

2.3 Data analysis

In order to analyze the results, a quantitative and qualitative analysis was carried out.

On the one hand, the rubric contained marks given by students and teachers, for the students' self-evaluation of their work and for the co-evaluation of the other students' work.

In the quantitative analysis of the results of the rubric, three competences that the students have to acquire were marked,

i) G15: critical thinking

ii) G3: the ability to summarize, and

iii) G5: the ability to communicate in technical and non-technical forums.

In the case of critical thinking G15, two items were used, i) a traditional item such as the economic analysis of the engineering result and ii) an innovator item such as the AI result analysis.

On the other hand, the rubric included a space where students and teachers could write a paragraph after the marks to explain their evaluation and experience. Then, a qualitative analysis of the teachers and students' experiences with AI was carried out, together with their comments on the evaluation of the competences to be acquired and their opinion on the evaluation of the teaching innovation project.

3 RESULTS

3.1 Rubrics quantitative analysis

The quantitative analysis of the rubrics shows that undergraduate students rated themselves highly, they rated themselves with the highest scores. They scored themselves higher than Masters students. The Masters students only scored themselves highest for Communication and Use of AI competences.

In addition, undergraduates rated other students with the highest score for technical competence. On the other hand, Masters students did not rate any of the competences of other students with the highest point.

It can be concluded that Masters students are more critical.

Undergraduate students gave higher scores to the use of AI by other students than Masters students.

This result can be explained by the fact that the younger students, were more familiar with the technologies and believed in their use as a digital generation.

Nevertheless, the students did not give higher marks to this competence. The students gave the higher marks to the technical competence for the diploma students and to the communication competence for the master students.

This result can be explained by the underestimation of transversal, digital or personal competences by students in the context of their university studies.

It can be concluded that students underestimate digital competences compared to technical competences.

As usual, the students' score is, in all cases higher than the teachers' score [5].

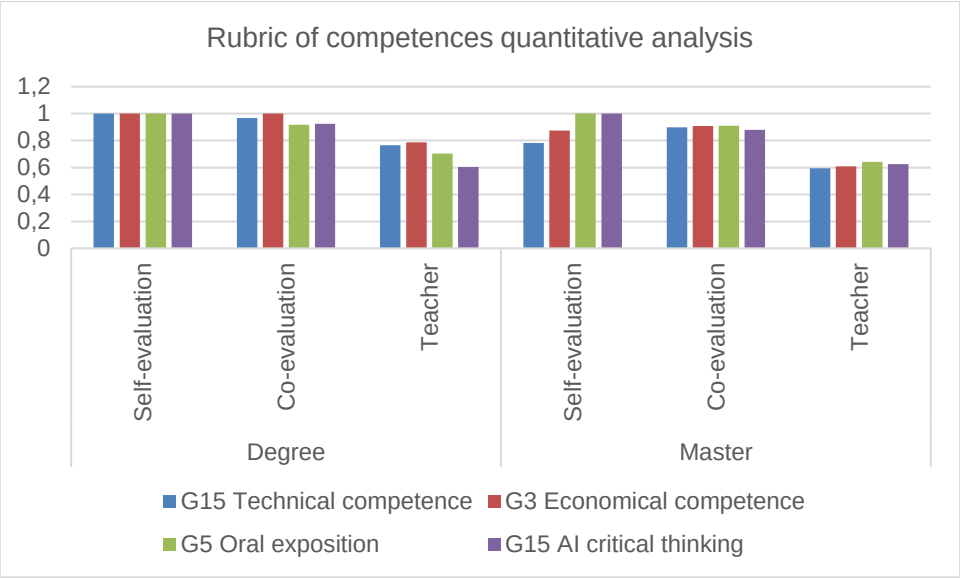

Figure 2. Mean scores given by teachers and students, self-evaluation and co-evaluation, for competences to be acquired by students.

3.2 Rubrics qualitative analysis

The qualitative analysis shows the students' comments mainly on technical competence. It can be concluded that students attach the greatest importance to this competence. This result was confirmed with the students in which they manifested that they do not see any sense in evaluating the competences G5 and G15. The students attach the greatest importance to the technical competences.

Moreover, the students marked themselves with an expert use of AI, while their peers consider the need of their colleagues to improve the use of AI.

The results show that students, instead of competing with AI, use AI believing without doubt what AI says and avoid critical thinking. It is concluded that despite the benefits of AI, it is necessary to clearly define its use in the teaching-learning process and to design appropriate tools for developing students' critical thinking.

Furthermore, this project taught teachers how to identify students who use AI to avoid critical thinking.

Teachers showed great interest in the teaching innovation project and confirmed that they had learned to identify how students use AI and when AI is used instead of critical thinking.

Table 2. Competence ratings by students and teachers.

		G15 Technical competence	***G3 Economical competence***	***G5 Oral expression***	***G15 AI critical thinking***
Degree	Self-evaluation	1	1	1	1
	Co-evaluation	0.9667	1	0.9167	0.9243
	Teacher	0.7652	0.78695	0.7043	0.6046
Master	Self-evaluation	0.7813	0.8750	1	1
	Co-evaluation	0.8988	0.9091	0.9108	0.8791
	Teacher	0.5938	0.6094	0.6406	0.6250

4 CONCLUSIONS

It can be concluded that students attach the greatest importance to technical competence.

It can be concluded that students underestimate digital competence compared to technical competence.

It can be concluded that Master students are more critical.

It can be concluded that despite the benefits of AI, it is necessary to clearly define its use in the teaching-learning process and to design appropriate tools for the development of students' critical thinking.

Furthermore, this project has taught teachers to identify students who use AI to avoid critical thinking.

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