ARTIFICIAL INTELLIGENCE (AI) TO STRENGTHEN THE CRITICAL THINKING COMPETENCE IN AGRICULTURAL ENGINEERING HIGHER EDUCATION

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Abstract

Artificial Intelligence (AI) is the ability of a machine to exhibit the same capabilities as humans, such reasoning, learning, creativity and the ability to plan. Its future applications are expected to imply great changes, but AI is already present in our lives, despite the possible risks that its inappropriate use may entail. Therefore, the United Nations Educational, Scientific and Cultural Organization, UNESCO, states that we should focus our efforts on a) learning with AI, b) learning about AI and c) preparing for AI. They also point out its great potential for developing innovative teaching and learning practices. For all these reasons and taking into account the opportunities that AI presents for teaching innovation, we believed that it should be introduced in classrooms bringing students closer to this new technology, and it could be a good tool for critical thinking. The objective of this project was to strengthen the critical thinking competence (G15) of Agricultural Engineering students through AI, using primary-secondary sources of information that will allow them to refute/approve the solution provided by AI to solve a given problem. A linear methodology was used and in doing so, we proposed a real problem to our students. Then the students using AI sources of information searched for solutions to the given problem. Then they received instructions to solve the problem. Finally, they should refused or approved the solution provided by AI, using critical thinking. The flipped classroom was used as a methodology to search with AI a solution to a given engineering problem. By checking, validating and confirming the results, they contrasted the results provided by AI, strengthening the G15 critical thinking competence. An e-rubric was used to evaluate the objectives, aligning the evaluation with the competences to be acquired by the student. The results showed students different familiarity with AI technology. Master students showed higher knowledge of AI than Degree students. Moreover, we teach and even present for the first time, students and teachers to AI technology. The students were fascinated with AI and expressed the huge opportunities that this technology could bring to many of the activities that they face while learning. Two advantage students, not the majority of them, even started to give instructions to AI and exploited its results. Some teachers also had first contact with this technology and expressed many doubts and concerns in the future of the teaching and learning process considering AI and how to evaluate academic activities that can be solved quickly with AI such bibliographic review, redaction, etc. We concluded that this technology will move the teaching-learning process to a new context and teachers have to adapt their evaluations to this new area.

Keywords: Teaching innovation project, Technology, teaching-learning process, flipped learning, e-rubrics.

1 INTRODUCTION

The European Higher Education Area (EHEA) promotes competency-based learning [4]. In this sense, in Agricultural Engineering at the University of Valladolid, the Degree Evaluation Commission of the Agency for the Quality of the University System ANECA recommend to insist on competency-based learning and evaluation. In this line, in previous projects we have developed rubrics that allowed align the evaluation with the competences that students must acquire [2]. We designed subjects' practices that allowed students to contact with companies in the labour market and strengthen the G15 competence of critical thinking, because we observed that it was the competence that the students needed most to develop [3]. In this context, we believed that the emergence of Artificial Intelligence (AI) could serve to challenge the critical thinking of our students. AI is the ability of a machine to present the same capabilities as human beings, such as reasoning, learning, creativity and the ability to plan [6]. Its future applications are expected to involve big changes, but AI is already present in our lives. Nevertheless, there are possible risks that its inappropriate use may entail, such as the negative impact on our behaviour, artificial stupidity, bias and lack of neutrality of machines, unintended consequences or the impact on employment [1]. Therefore, the challenge we face is to allow students/teachers to take

advantage of this ongoing technological revolution and access to its benefits, fundamentally in terms of innovation and knowledge. In this sense, AI plays a central role in the digital transformation of society and has become an EU priority [5]. In the field of education, UNESCO [6] points out that AI has the capacity to address some of great challenges, such as developing innovative teaching and learning practices. For this reason, UNESCO [6] establishes that it should focus on three areas: learning with AI (for example, using AI tools in classrooms), learning about AI (AI technologies and techniques) and preparing for AI (for example, enable all citizens to understand the potential impact of AI on human life). For all these reasons, taking into account the opportunities that this new technology presents for teaching innovation, we introduced AI into subject practices as a good instrument for critical thinking. In doing so, the flipped classroom methodology was used and students searched with AI solutions to a given engineering problem. Then, they received tools to solve the problem by themselves. By checking, validating and confirming the results provided by AI, they contrasted the result, strengthening critical thinking competence (G15). Finally, to evaluate the project, an e-rubric was used, aligning the evaluation with the competencies that the student must acquire.

2 METHODOLOGY

In order to introduce the artificial intelligence (AI) into subject practices as a good instrument for critical thinking (G15 competence) the flipped classroom methodology was used.

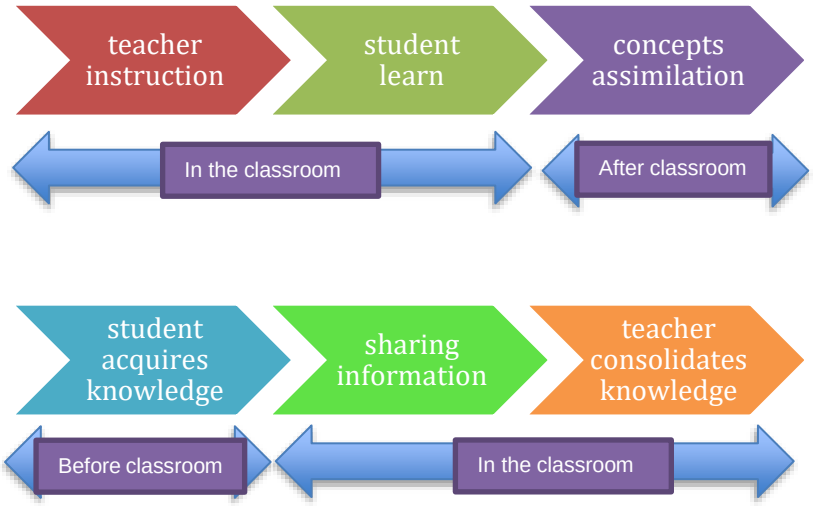

Figure 1. Comparison among traditional teaching-learning model (up) and flipped learning model (down).

Firstly, the students searched with AI solutions to a given engineering problem. Then, they received tools to solve the problem by themselves. By checking, validating and confirming the results provided by AI, they contrasted the result, strengthening critical thinking competence (G15). Finally, to evaluate the project, an e-rubric was used, aligning the evaluation with the competencies that the student must acquire.

The Agricultural Engineering students at the University of Valladolid presented in table 1 participated in this teaching learning project from 4 Degrees and Masters studies in the first and second semester of 2023-2024 promotion.

In the quantitative analysis of the rubric results, three competences the students must acquire was compared,

i) G15: the critical thinking,
ii) G3: the capacity of summarize and
iii) G5: the ability of communicate in technical and non-technical forums.

The case of the competence of critical thinking G15, two items were used, i) one traditional item such the economic analysis of the engineering result and ii) one innovator item such the AI result analysis.

Moreover, a qualitative analysis of the teachers and students experience with AI was conducted.

Table 1. Students, subjects, semester and level of participants in the teaching and learning project "AI to strengthen the critical thinking competence in agricultural engineering higher education"

Subject	Degree/Master	Semester	Level	Students
Commercialization	Degree in agricultural and rural engineering	1	4	15
Marketing	Master in food quality and development	1	1	13
Commercialization	Degree in engineering of agricultural and agri-food industries	2	2	10
Marketing	Master in Agronomic Engineering	2	1	19

3 RESULTS

The qualitative analysis of the teachers and students experience with AI revealed students different familiarity with AI technology. Master students showed higher knowledge of AI than Degrees students. Moreover, we teach and even present for the first time, students and teachers to AI technology. The students were fascinated with AI and expressed the huge opportunities that this technology could bring to many of the activities that they face while learning. Advantaged students, not the majority of them, even started to give instructions to AI and exploited its results. Some teachers also had first contact with this technology and expressed many doubts and concerns in the future of the teaching and learning process considering AI and how to evaluate academic activities that can be solved quickly with AI such bibliographic review, redaction, etc. We concluded that this technology will move the teaching-learning process to a new context and teachers have to adapt their evaluations to this new area.

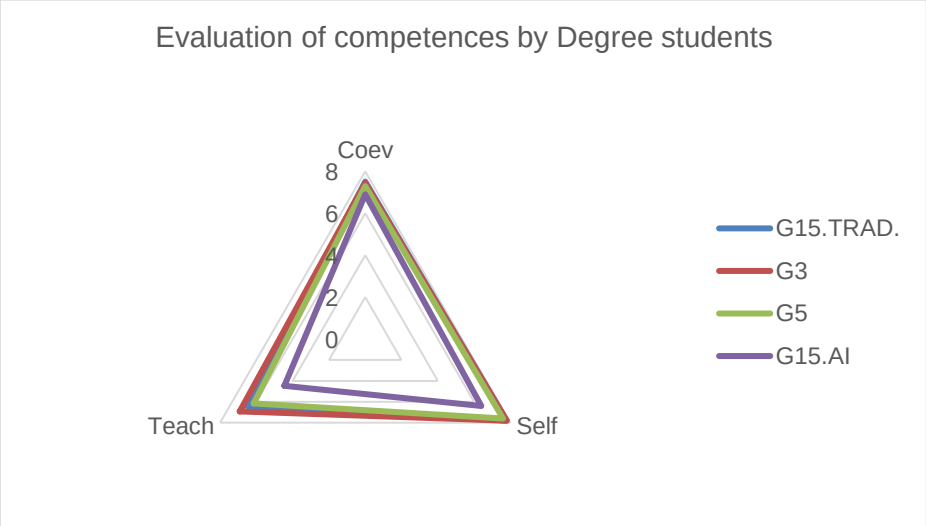

Figure 1. Comparison of marks given by Degree students and teacher by competences: G15: the critical thinking, G3: the capacity of summarize and G5: the ability of communicate in technical and non-technical forums.

The quantitative analysis of the rubric results by Degree students shows teachers' lower marks than the students' marks.

The higher marks, both students and teachers, were given to traditional assessment of critical thinking, for instance an economical critical analysis, than AI solution critical analysis. This result corroborates the lack of familiarity of the students and teachers with AI and lack of experience to evaluate such practices.

Even, the students showed very low marks to their activity on AI.

In this level, the students expressed believe on many of the AI arguments and think as right most of AI affirmations.

Table 2. Rubric marks given by Degree students and teacher by competences: G15: the critical thinking, G3: the capacity of summarize and G5: the ability of communicate in technical and non-technical forums.

	Co-evaluation	***Self-evaluation***	***Teacher evaluation***
G15.Traditional	7.52	7.80	6.46
G3	7.45	7.80	6.92
G5	7.30	7.60	6.15
G15.AI	6.90	6.40	4.46

The Master students gave higher marks than the Degree students. This result can be explain due to the maturity of Master students and confidence in give marks.

Table 3. Rubric marks given by Master students and teacher by competences: G15: the critical thinking, G3: the capacity of summarize and G5: the ability of communicate in technical and non-technical forums.

	Co-evaluation	***Self-evaluation***	***Teacher evaluation***
G15.Traditional	7.46	7.50	7.70
G3	7.40	7.25	7.85
G5	7.50	7.50	6.15
G15.AI	7.25	7.75	6.46

The results show similarity in the self-evaluation and co-evaluation, which also means maturity to judge their classroom students similarly than themselves. The Master students gave instructions to AI and advanced in the use of AI by their own initiative, they, also felt more confident in give marks to the practice with AI with higher marks.

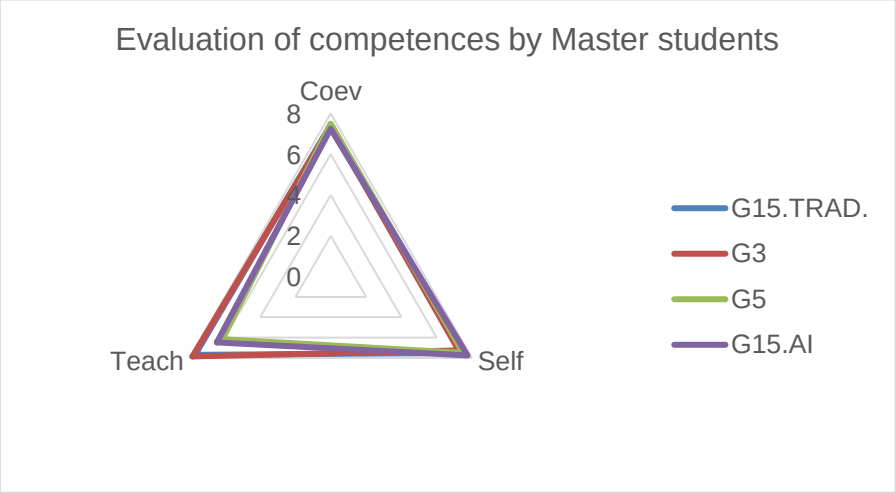

Figure 2. Comparison of marks given by Master students and teacher by competences: G15: the critical thinking, G3: the capacity of summarize and G5: the ability of communicate in technical and non-technical forums.

4 CONCLUSIONS

We concluded that this technology will move the teaching-learning process to a new context and teachers have to adapt their evaluations to this new area. The students were fascinated with AI and expressed the huge opportunities that this technology could bring to many of the activities that they face while learning. Master students showed higher knowledge of AI than Degrees students. Some teachers also had first contact with this technology and expressed many doubts and concerns in the future of the teaching and learning process. Undergratuate students expressed believe on many of the AI arguments and think as right most of AI affirmations respect Master students. The Master students gave instructions to AI and advanced in the use of AI by their own initiative, they, also felt more confident in give marks to the practice with AI with higher marks.

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