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Research Article

Evaluation of the Degree of Interdisciplinary Knowledge and Interest in Participating in Multidisciplinary Groups of the Degree in Industrial Engineering and Chemical Engineering Project Students and the Advanced GIS Students of the Degree in Geomatics Engineering and Surveying

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Abstract

The current socio-economic and professional context poses the challenge of training students in skills that will help them work cooperatively in multidisciplinary teams in the future. The chances of finding solutions to problems increase when team members know the potential that each can contribute. In this work, the student's perception of interdisciplinarity and their degree of interest has been evaluated to know the basis on which to apply teaching innovations that improve this perception between the degrees of Industrial Engineering and Chemical Engineering and the degree in Geomatic Engineering and Topography from the UPV. After designing and conducting a survey of students, it is concluded that there is a lack of knowledge about the possibilities and potential of interdisciplinary collaboration. However, students are interested in working in multidisciplinary teams, so they should try to incorporate this multidisciplinary. in teaching for the benefit of future graduates.

Key words: Multidisciplinary; Teaching; Survey; Collaboration

Introduction

In today's post-industrial society, knowledge is one of the primary sources of competitive advantage in companies (Fong 2003). In an increasingly interdependent work context, those competences related to teamwork that allow working cooperatively with professionals from different disciplines are of particular importance [1].

As organizations seek new business strategies to compete in the global marketplace, they often find that multidisciplinary teams are

needed to develop innovative products and services and respond to customers interested in a wide range of products and services [1].

On the other hand, multidisciplinary teams provide a structure for bringing together employees with the diverse technical backgrounds needed for these tasks, and the growing popularity of team-based organizational structures reflects the widely shared belief that teamwork offers the potential to achieve results that individuals working in isolation could not achieve [2]. This requires that project team members with diverse skills, knowledge, and experience work together to solve problems that arise in a project and to make this possible. All members of a team must be aware of the potential expertise that each team member possesses to be able to design and implement new solutions or even improve the efficiency of existing processes.

For this reason, those competencies related to teamwork that enable future graduates to work cooperatively with professionals from different disciplines are particularly important. The current European Higher Education Area (EHEA) takes up this challenge and establishes the need to train professionals with the new profiles demanded by the socio-occupational context [1].

According to the MEC [3], the current objective of university teachers is to approach the didactic approaches that underlie the EHEA, giving the student a more significant role in their training, encouraging collaborative work, organizing teaching according to the competences that future graduates must acquire and promoting the acquisition of tools for autonomous and lifelong learning. Given that knowledge is not located in unconnected parcels, creating spaces that allow content to be connected is necessary. To achieve this transfer of knowledge, Pozuelos, Rodríguez and Travé [4] urge teachers to step outside the narrow confines of their subjects and consider new dimensions of the object of study.

Multidisciplinary requires strategies based on participation, cooperation, and joint activity that address the construction of learning from real situations, where students from different disciplines share the leading role in developing a final product for which they all feel responsible [1].

To this end, interdisciplinary education exposes students to research in multiple disciplines, trains them in collaborative methods through team-based research, and promotes new communication and collaboration across disciplines [5].

Likewise, interdisciplinary knowledge strengthens the connections between disciplines and, in the process, weakens the division of labor within disciplines, exposes gaps, stimulates cross-fertilization, and creates a new field of focus for knowledge research [6]. Nissani [7] lists ten benefits produced by interdisciplinary work, including that creativity often requires interdisciplinary knowledge, that immigrants often make relevant contributions to their new field, that many intellectual, social, and practical problems require interdisciplinary approaches, and finally, that interdisciplinarity can help bridge communication gaps in the modern academy, thus helping to mobilize its enormous intellectual resources in the cause of greater social rationality and justice.

On the other hand, the OECD points out as empirical reasons observed for applying interdisciplinarity from the student's point of view, that it makes it possible for students to change their field of specialization without losing time, that it helps students adapt to the inevitable fluctuations in the labor market, that practicing interdisciplinarity creates career possibilities in new fields and makes it possible for students to remain interested and curious about their work. They are more motivated because they feel that the subjects, they are studying are relevant to reality and that practicing interdisciplinarity creates possibilities for careers in new fields and makes it possible for students to remain interested and curious about their work. They are more motivated because they feel that the subjects, they are studying are relevant to reality, and there is the opportunity for more enriching personal contact. On the other hand, practicing interdisciplinarity educates graduates to be more inventive minded while emphasizing concepts and methods rather than subject content, and thus makes it possible for students to learn to handle tools and be more creative.

Reasons related to the needs of teachers are that interdisciplinarity in these cases was seen as a way of "breaking down barriers and obstacles to communication in the university from the inside and breaking down the sharp dividing line between knowledge and reality between the university and society from the outside", while reasons related to scientific interests are that interdisciplinarity makes it possible to broaden the field of knowledge, enabling multiple and convergent approaches and emphasizing the unity between phenomena. At the same time, the motives related to scientific interests are that interdisciplinarity makes it possible to broaden the field of knowledge, enabling multiple and convergent approaches and emphasizing the unity between phenomena.

De Zure [8] points out that most teaching approaches associated with interdisciplinarity are based on active learning strategies and promote higher-order critical thinking skills. The integration of the two subjects in a multidisciplinary context result in a synergy that enhances the new learning context to its maximum effectiveness [1].

With the aim of getting students to adopt an interdisciplinary approach that prepares them for their professional future, the ACDC-IT Teaching Innovation project (exp. 1882), which brings together three schools of the Universitat Politècnica de València (UPV) (School of Industrial Engineering, School of Civil Engineering and the School of Geodesic, Cartographic and Topographic Engineering) and the Polytechnic School of Alcoy, with the participation of nine teachers of four subjects in the fourth year of the degree. In this PIME, through the development of a collaborative project that focuses on the application of information technologies, the aim is for students from different degrees to learn about the skills and tools they have in other degrees and that this will help them to learn first-hand about the potential offered by interdisciplinary collaboration in their future professional environment.

In order to establish a baseline, in this first year of development of the PIME, the aim is to assess the perception of the need for

interdisciplinarity in problem solving and the degree of interest in interdisciplinary collaboration, specifically in the use of information technologies applied to projects. For this purpose, a survey measuring this degree of interest as an indicator of the students' interest in interdisciplinary collaboration was proposed as an indicator. Guide for the drafting of the full texts of the papers.

Objectives

The aim of this work is to evaluate the degree of interdisciplinary knowledge existing, as well as the degree of interest in participating in multidisciplinary groups during the internships of the subjects among the Project students of the Degree in Industrial Engineering and Chemical Engineering and the advanced GIS students of the Degree in Geomatics Engineering and Topography.

The specific objectives are to:

- Assess the degree of knowledge about the needs and potentials for interdisciplinary collaboration.
- Assessing the perceived degree of applicability of the acquired knowledge to other fields
- To assess the perception of the degree of preparation acquired in the degree to work in multidisciplinary teams.
- Assess the degree of interest in working in multidisciplinary teams.
- Assess the degree of willingness to participate as a pilot group in the proposed teaching innovation.

Development

Target group selection

The target group for the survey was the final year undergraduate students during the 2022-2023 academic year in the subjects of Advanced GIS in the Degree in Geomatics and Topography Engineering (IGT), Chemical Engineering Projects in the Degree in Chemical Engineering (IQ) and Projects in the Degree in Industrial Technologies Engineering (GITI) in which the teaching innovation of the PIME ACDC-IT is to be implemented during the next 2023-2024 academic year.

In total, this is a target group of 364 students consisting of 212 GITI Project students, 67 IQ Project students, 31 IQ Project (EPSA) students, and 55 Advanced GIS students.

Design of the assessment survey

Under the criteria of simplicity and focus, a short multiple-choice questionnaire has been designed, consisting of seven questions, each with three response options in Likert format [9] (agree, disagree, and undecided).

A total of 10 questions were elaborated, with four and three particularized questions for the Project students (IQ and GITI) and for the Advanced GIS students, respectively, since in the case of the Project students, we wanted to assess the degree of knowledge about the potential of interdisciplinary collaboration and in the case of the GIS students we wanted to assess the degree of perception of the need for this collaboration as they are the ones who will provide the ICT tools for practical applications provided by the needs of the industrialists.

In order to guarantee the ethics of this research and following the recommendations of the Ethics Committee regarding the use of personal data and the Institute of Education Sciences of the UPV, a question was asked prior to the questionnaire regarding consent for the processing of data and information was provided on the purpose of the survey and the use that would be made of the responses received, as well as the anonymity of the survey (Table 1). The questions are shown in table 1.

Table 1: Questions included in the survey.

ID	Question	Addressees
1	Do you think that during your degree, you are given enough training to work in multidisciplinary teams in the future?	IQ, GITI, IGT
2	Would you like to introduce an interdisciplinary practice in Advanced Projects/GIS with GIS students of the Geomatics/Projects Degree of the ETSII to learn how a plant location would be done in a more realistic way?	IQ, GITI, IGT
3	Do you think that geographic information tools could be useful to study the location factors of an industrial plant and the concrete choice of plots?	IQ, GITI, IGT
4	Would you voluntarily participate in a teaching innovation project to create multidisciplinary working teams from different degrees in some subjects?	IQ, GITI, IGT
5	Do you know what a geographic information system (GIS) is?	IQ, GITI
6	Would you like to see more IT/software used during the degree course in those subjects where this is possible?	IQ, GITI
7	Would you voluntarily participate in a teaching innovation project to introduce more information technologies (ICTs) in the bachelor's degree?	IQ, GITI
8	Do you know the location needs of industrial plants?	IGT
9	Would you like to see more case study applications used during the degree, where possible?	IGT

Survey pass: A voluntary survey was conducted in the project practice and advanced GIS sessions

The survey was composed as a test in Poliforma-T, the UPV teaching platform, and was designed to be available during the months of October to December 2022 so that teachers, during the laboratory practice sessions of the subject, on the day that was most convenient for them, could open it and students could fill it in on a voluntary basis, establishing a maximum duration of 5 minutes.

Analysis of results

A comparative analysis has been carried out in relative value between the answers given by each grade to the same questions and a descriptive statistic between them (mean and standard deviation).

Results

The results section is subdivided into questions that are common to all four subjects, questions that are common to all three Project subjects but not present in the GIS subject, and questions that are unique to the GIS subject.

The number of responses to each of the three options (agree, disagree, and undecided) to all questions in all subjects has been calculated as a relative value in percentage (%) of the total number of responses made in order to be able to compare results between subjects with different numbers of responses.

The total number of responses per subject is 123 responses for Industrial Engineering Degree Projects, 12 responses for Chemical Engineering Projects at the UPV (IQ UPV), 27 responses for Chemical Engineering Projects (EPSA) (IQ EPSA) and 11 responses from advanced GIS students of the Geomatics and Topography Engineering Degree (GIS). In total, out of a total of 364 students, 173 responded, which represents 47%.

Questions common to the four subjects of the three degrees (IQ, GITI, IGT)

The questions common to all four subjects are described in Table 2.

Table 2: Questions were asked to the four subjects described.

Question 1	Do you think that during your degree, you are given enough training to work in multidisciplinary teams in the future?
Question 2	Would you like to introduce an interdisciplinary practice in Advanced Projects/GIS with GIS students of the Geomatics/Projects Degree of the ETSII to learn how to make the location of a plant more realistic?
Question 3	Do you think that geographic information tools could be useful to study the location factors of an industrial plant and the concrete choice of plots?
Question 4	Would you voluntarily participate in a teaching innovation project to create multidisciplinary working teams from different degrees in some subjects?

The results in relative value with respect to the total number of answers per subject and per question (described in table 2) can be seen in Figure 1. In this figure, with respect to question 1, it can be seen that less than half of the students in all subjects consider that they have sufficient training to work in multidisciplinary teams in the future. In addition, a high degree of indecision (around 40%) is observed for this question in all four degrees. Table 3 shows that, on average, 34% would agree that there is sufficient training, and 37% are undecided. The authors of this study consider that this may be due to a lack of knowledge of how a multidisciplinary team works (Figure 1) (Table 3).

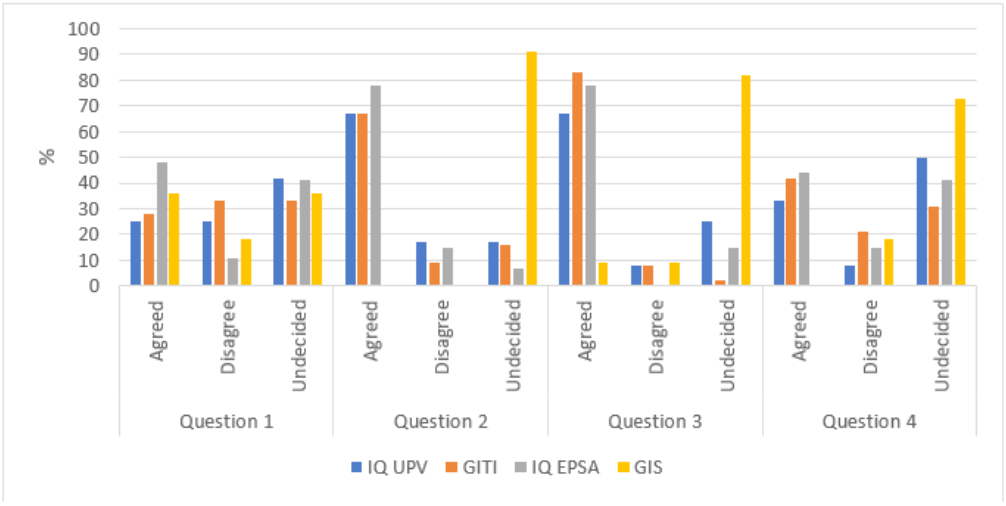

Figure 1: Percentage of responses per question and subject. Questions 1 to 4.**1:**

Table 3: Mean and Standard Deviation values by question-and-answer type. Questions 1 to 4.

		$\bar{X}$ (%)	σ
Question 1	Agreed	34,3	10,3
	Disagree	21,8	9,4
	Undecided	37,9	4,1
Question 2	Agreed	53,0	35,7
	Disagree	10,3	7,6
	Undecided	32,8	39,1
Question 3	Agreed	35,8	28,1
	Disagree	6,3	4,2
	Undecided	31,0	35,3
Question 4	Agreed	29,8	20,4
	Disagree	15,5	5,6
	Undecided	48,8	17,9

On the other hand, with regard to question 2, more than 60% of the students surveyed in all project subjects consider it interesting to introduce an interdisciplinary internship with students of the subject they do not currently teach in order to learn how the location of an industrial plant could be done more realistically. However, 90% of the surveyed GIS students are undecided on this second question. The authors of this paper believe that this is because, for project students, GIS tools provide a wide range of possible applications within their professional performance, whereas GIS students consider knowledge about how to more realistically locate a plant to be a very specific application within their professional development that they may never use.

Similarly, when asked question 3, more than 60% of the students surveyed in the three project subjects considered that geographic information tools could be useful to study location factors of an industrial plant and the concrete choice of plots of land, but 80% of the respondents in the GIS subject were "undecided" on this question.

Finally, less than 50% of the students surveyed in the four subjects, responding to question 4, would voluntarily participate in a teaching innovation project to create multidisciplinary work teams from different degrees in some subjects. In the specific case of the students of the GIS subject, none of the respondents to this question "agreed". Furthermore, it is worth noting that, when asked this question, between 40 and 50% of the total number of respondents in the project subjects and 70% in the GIS subject were undecided. Again, the authors believe that this high degree of indecision may be due to a lack of knowledge of what collaboration in a multidisciplinary project involves and implies.

Questions common to the three Project subjects (IQ, GITI)

The questions common to the three Project subjects are described in table 4.

Table 4: Questions were asked about the three project subjects described.

Question 5	Do you know what a geographic information system (GIS) is?
Question 6	Would you like to see more IT/software used during the degree course in those subjects where this is possible?
Question 7	Would you voluntarily participate in a teaching innovation project to introduce more information technologies (ICTs) in the bachelor's degree?

Figure 2 shows the results in relative value with respect to the total number of answers per subject and per question described in table 4. It shows that between 70 and 90% of the students surveyed in the three project subjects do not know what a geographic information system (GIS) is (question 5).

In addition, more than 50% of the surveyed students in the three subjects would like to see more IT/software used in the subjects where possible during the degree course.

Finally, with regard to question 7, "Would you voluntarily participate in a teaching innovation project to introduce more information technologies (ICTs) in the Degree?" differences are observed in the three subjects surveyed. Students of the IQ UPV subject are mostly undecided on this question (around 60% of respondents), while GITI students agree in 44% and undecided in 32%. And almost 60% of IQ EPSA students would agree (Figure 2) (Table 5).

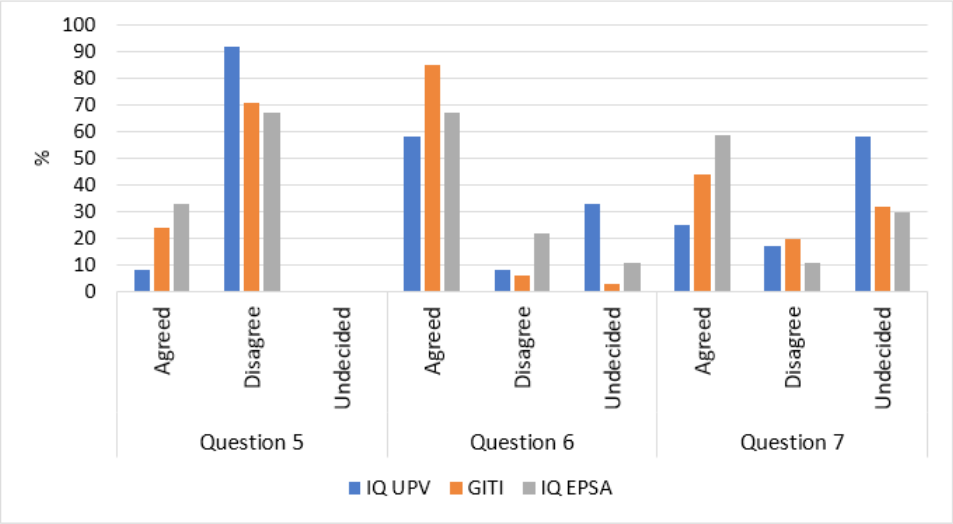

Figure 2: Percentage of responses per question and subject. Questions 5 to 7.

Table 5: Mean and Standard Deviation values by question and type of response. Questions 5 to 7.

		$\bar{X}$ (%)	σ
Question 5	Agreed	21,7	12,7
	Disagree	76,7	13,4
	Undecided	0,0	0,0
Question 6	Agreed	70,0	13,7
	Disagree	12,0	8,7
	Undecided	15,7	15,5
Question 7	Agreed	42,7	17,0
	Disagree	16,0	4,6
	Undecided	40,0	15,6

Questions unique to the Advanced GIS course (IGT)

Table 6 shows the exclusive questions asked to the students of the Advanced GIS course.

Figure 3 shows the results in relative value with respect to the total number of responses to the questions described in table 6. It shows a clear polarization of the answers. While more than 60% of the respondents to the question on awareness of localization needs state that they are aware of this need, 27% are undecided, while all the students surveyed doubt whether they would like more case study applications to be used during the degree course in the subjects where this is possible (Figure 3).

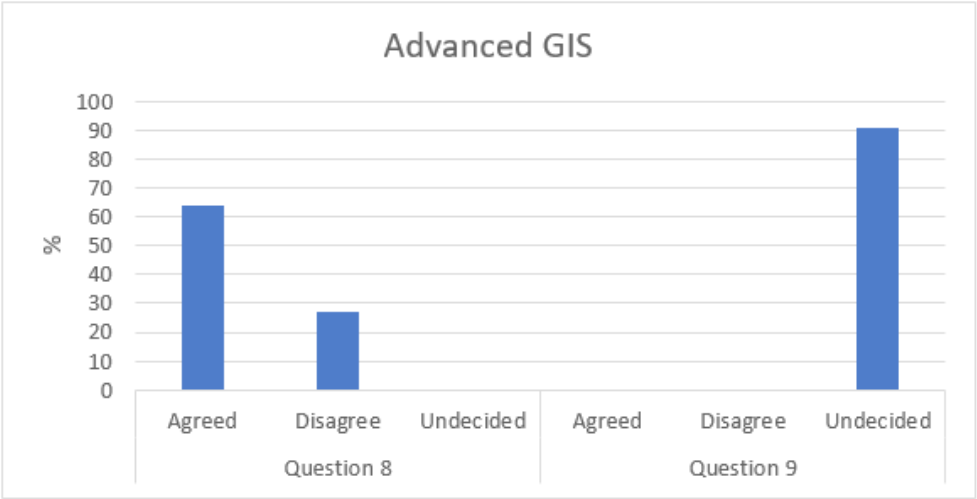

Figure 3: Percentage of answers per question in the advanced GIS subject. Questions 8 and 9.

Table 6: Questions were asked about the three project subjects described.

Question 8	Do you know the location needs of industrial plants?
Question 9	Would you like to see more case study applications used during the degree, where possible?

Conclusions

In this study, the degree of existing interdisciplinary knowledge and the degree of interest in participating in multidisciplinary groups to define the starting point of a teaching innovation (PIME ACDC-IT project exp. 1882) was evaluated by means of a survey carried out among the Project students of the Degree in Industrial Engineering and Chemical Engineering and the advanced GIS students of the Degree in Geomatics Engineering and Topography of the UPV during the first four-month period of the academic year 2022-2023.

The degree of knowledge about the needs and potential of interdisciplinary collaboration is relatively low in the Project subjects (IQ and GITI) as only about one fifth of the students know what a GIS is, and the advanced GIS students think they know about the needs for the location of an industrial plant (two thirds of the total number of respondents).

On the other hand, the perception of the degree of applicability of the knowledge acquired to other fields is strikingly low, especially among advanced GIS students, since only one tenth sees the tools, they have mastered as useful for the location of an industrial plant, while, on the contrary, more than one third of Project students do perceive this usefulness.

Likewise, with regard to the degree of preparation acquired in the degree to work in multidisciplinary teams, around a third of all students in all subjects consider themselves prepared, but almost 40% consider themselves undecided, which shows that in general terms, students do not perceive the specific preparation in the degrees as sufficient to work in multidisciplinary teams in the future.

It is worth highlighting the high degree of interest in working in multidisciplinary teams, as more than half of all students would like to encourage this multidisciplinary that would allow them to learn more tools/applications in their future work. In line with this interest, around a third of project students would be interested in participating as volunteers in a pilot group for the application of the proposed teaching innovation, while the vast majority of GIS students are clearly undecided and even reluctant to participate.

In general terms, it can be seen that the answers given by the students of the Project subjects, even with differences between grades, follow the same trend, while the answers given by the GIS students follow a different pattern, and they declare themselves to be very undecided on certain questions.

In conclusion, there is a lack of knowledge about the possibilities and potential of interdisciplinary collaboration between degrees, which may be due to the lack of specific training or promotion of multidisciplinary in the teaching programs of the different degrees and their subjects. However, students are interested in this multidisciplinary training and collaboration, and this opens up a great opportunity and predisposes the success of future teaching innovations applied in this field for the benefit of graduates.

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Conflict of Interest

No conflict of interest.

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