

THE DEVELOPMENT OF PROFESSIONAL
COMPETENCES USING THE INTERDISCIPLINARY
PROJECT APPROACH WITH UNIVERSITY STUDENTS

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Abstract

This work describes an experience conducted by a group of professors from different departments at the University of Girona (Catalonia, Spain) which arose from the need for interdisciplinary work in university classrooms in order to promote competences relevant to the professional sector. As part of this experience, students from different degree programs were challenged to work collaboratively and in an interdisciplinary manner on a project related to the management of a school cafeteria designed for a real educational center. The work promoted the development of competences that are otherwise difficult to attain through activities that lack an interdisciplinary approach, which are key in today's professional world, such as multi-professional teamwork. Based on this experience, the feasibility of students from different areas of study carrying out a final degree project (FDP) that meets real, contextualized needs and requires the contribution of knowledge from different disciplines is considered.

Keywords – Higher education, Project-based learning, Interdisciplinarity, Competences.

1. Introduction: Justification for an interdisciplinary project

A few years after implementing a system in which competences constitute the focal point of the teaching-learning systems at the university, we are able to confirm that much greater progress has been made in the integration of knowledge and skills than in the integration or a complementary approach to the different disciplines within a given curriculum. The trend that has traditionally characterized university instruction has been to compartmentalize courses in a way that isolates them from one another. This is one of the most important reasons why integration has so rarely occurred in the past. Boden, Borrego and Newswander (2011) attribute this phenomenon to the existence of the culture of the discipline, thanks to which students are socialized in a system of higher education that is organized according to disciplines, which tend to maintain a hierarchical relationship amongst themselves (Long, 2001).

The aforementioned lack of integration has important consequences over the medium and long term. In this sense, it is generally agreed that the socialization in a particular discipline subtly models the students' ways of thinking and orientation towards learning, which often ultimately leads to a mutual lack of understanding among specialists in different fields when they attempt to collaborate with one another (Woods, 2007). This lack of integration also complicates what some authors refer to as interdisciplinary thought or comprehension (Spelt, Biemans, Tobi, Luning & Mulder, 2009). This refers to the development of skills that are increasingly required by today's professionals, which have to do with the possibility of changing perspectives, synthesizing knowledge from different disciplines and addressing complexity.

According to Posada (2004), competence-based training necessarily implies the integration of disciplines, knowledge, skills, practices and values, and this integration is necessary for the training of good professionals. The aforementioned author starts with the distinction made by Piaget (1979, cited in Posada, 2004) among the different levels of disciplinary integration: multidisciplinary, interdisciplinarity and transdisciplinarity.

Multidisciplinary represents the lowest level of integration and occurs when information from several disciplines is sought in response to a question, case or situation, without this interaction modifying or enriching these disciplines. This level is considered as the first phase in the creation of an interdisciplinary work. In spite of the fact that the current curricula have required greater coordination among instructors, which has facilitated a certain increase in the integration of different fields of knowledge within the same discipline (for example, in terms of the practical

activities and final degree/Master's projects), the actions that are being carried out cannot even be considered to be multidisciplinary.

Interdisciplinarity constitutes the second level of disciplinary integration. It takes place when the cooperation among the disciplines consists of real interactions and thus results in mutual enrichment, and even the actual transformation of the research and learning concepts and methodologies. Learning based on interdisciplinarity provides important advantages, among which Woods (2007) highlights: the development of a critical capacity in the discipline itself, which comes from seeing its limitations from another perspective; greater preparation for today's employment context, in which multi-professional work teams are increasingly common; and a better approach to current problems that require a much more comprehensive vision. Along these same lines, Holley (2009) emphasizes that students not only increase their fluency in the ideas and language of the different disciplines, they also expand their capacities in terms of the behaviors that are expected by each in a professional context.

Finally, in transdisciplinarity, theoretical systems are constructed without any clear boundaries between the disciplines. This is the most advanced stage of disciplinary integration. The experience described in this article takes place at the second level of integration, i.e., interdisciplinarity. It may serve as the basis for future activities, such as final degree projects, of a transdisciplinary nature.

Nikitina (2006), in turn, proposes a classification of interdisciplinary instruction in terms of three possible strategies to follow: contextualization, conceptualization and a problem-centered focus. Contextualization refers to the consideration of the disciplinary material according to time, culture and personal experience. Conceptualization means identifying the main concepts of the different disciplines and establishing a rigorous, quantifiable connection among them. The problem-centered strategy has been used in the experience described here. It represents the identification of the different ways of thinking in the various disciplines in order to approach real-life problems.

Methodologically speaking, project-based learning (PBL) was the framework chosen to implement the experience, due to its potential connection with the aforementioned problem-centered strategy. This can be considered as the learning which occurs as the result of the effort made by the students to develop a project, which constitutes a specific case of problem-based learning (Valero, 2007). A project is a complex task based on questions or problems that pose a challenge, involving the student in the design, problem solving, decision making and search for

information. It also offers students the possibility to work relatively autonomously over a more or less extended period of time. Their efforts culminate in a realistic product or presentation (Jones, Rasmussen and Moffitt, 1997; Thomas, Mergendoller and Michaelson, 1999; cited in Thomas, 2000), which represents proof of their learning. According to Markham (2003), PBL consists of proposing a project to the students that is perceived as ambitious, but feasible, which they must complete in small groups. In the context of this methodology, the teaching-learning process is organized according to the learning needs of the teams.

In spite of the important advantages that PBL has in terms of developing competences, among which are the capacity for analysis and reflection on the action itself and the increased autonomy when it comes to managing one's learning, it has a limited capacity to promote teamwork or problem solving and to stimulate the integration of knowledge from different disciplines if applied with students from the same group or class. Based on these limitations of this methodology as it is usually applied, this experience has been created based on the framework of promoting interdisciplinarity.

2. Project objective

The experience was carried out within the framework of the Interdisciplinary Project Network (IP) associated with the Institute of Education Sciences at the University of Girona. The objective of the experience, conducted with students outside the normal classroom and in an area that did not belong to any particular college, was to promote the development of competences closely associated with the professional world, such as teamwork and problem solving (Vaatstra & Vries, 2007), based on a contextualized project that required interdisciplinary work. The activity was construed and enriched by contributions from each of the knowledge areas of the professors on the network.

The aim of the activity carried out was to develop, in a collaborative and interdisciplinary manner, a project to manage a school cafeteria, designed for a real educational center located in Vall d'Aro (province of Girona, Catalonia), according to Project-Based Learning (PBL) methodology, with the requirement that it added an innovative aspect to the services already offered. This approach is intended to promote teamwork and problem solving among the students to a degree that would be difficult to obtain if the project were carried out by students from the same group or class.

3. Work methodology

During two academic years, a group of professors belonging to different departments and colleges at the University of Girona met regularly to design an activity that involved interdisciplinary work on an educational project based on PBL methodology. For the project to be successful, it was considered necessary for the topic (work proposal) to be capable of being analyzed and diagnosed from different perspectives, for there to be different alternatives for its resolution, and for it to have a level of complexity that was such that it required the participation of different types of professionals.

3.1 Discursive logic of the project

The project is structured based on the discursive logic of WHAT, HOW and WHY. With regard to WHAT and drawing from the assignment (the title of the project), the different groups of students were required to define their specific objectives and the strategies that they considered necessary for the design and construction of the project. In terms of HOW to do it, the groups decided on and justified the key elements the proposal needed to contain. Finally, the WHY question was considered to be a necessary element to address in order to experiment and obtain the maximum performance from the individual and teamwork, in the form of the completion and defense of the project design, and to profit from the work performed.

The project assigned to the students was specified on different levels. The first level of specificity required the students to draft a school cafeteria management model that involved a change in the food management model and in the complementary activities offered in a school cafeteria, and if possible, a change in the financial management. The next level of specificity was defined as the MESSI project of Vall d'Aro (the acronym in Catalan stands for Sustainable, Charitable and Innovative Eco-friendly Cafeterias). This last definition also specified the place: each group of students was to choose a school located in this valley made up by the municipalities of Santa Cristina d'Aro, Castell d'Aro-Platja d'Aro and Sant Feliu de Guíxols.

3.2 Project timing

The project was carried out over two months (in April and May 2014) and was concluded after four joint work sessions between students and professors. Each session lasted two hours, and except for in the first session, a presentation of the results was given by each group before the entire group. These four sessions consisted of:

- An initial meeting to present the project, the methodology to be used and the structure of the work. In addition, the four groups were formed, the schools to choose from were presented and the groups were organized.
- Based on a presentation about the structure of the different school cafeterias and how they worked by the student groups, the preparation of the proposal was considered. To do this, a specification task was completed, aimed at meeting the MESSI requirements. The aspects that would later be evaluated were also explained.
- After the presentation, discussion and assessment of the objectives and strategies proposed by each group for their school cafeteria, the next step was the preparation of the final presentation, where the students were informed about the different sections that needed to be included so that the projects could be compared among the groups.
- A Final presentation of each of the projects was given orally, at which time the corresponding written documents were also handed in (final project report and a hard copy of the presentation).

3.3 Project participants

A total of 22 students participated in the project, all of whom were registered in the courses taught by the professors involved at the time. Five students were from the agri-food program, four from industrial engineering, four from medicine and nine from psychology. The 22 students were divided into four work groups in a way that minimized matching up students from the same program as much as possible. Each group was assigned one of the schools participating in the experience, as shown in Table 1.

Number of students per group-school, according to university studies					
University program	Schools studied				TOTAL
	A	B	C	D	
Agri-food Engineering and Technology	2	1	1	1	5
Psychology	2	2	2	3	9
Industrial Engineering	1	1	1	1	4
Medicine	1	1	1	1	4
Total	6	5	5	6	22

A, B, C, D= Schools located in Vall d' Aro, Girona

Table 1. Student assignment to each school, according to university degree program

3.4 Development of the project

The work groups, considering the characteristics of their assigned schools (number of students who use the cafeteria, socioeconomic class of their families, educational environment, etc.), were required to address each of the key concepts that formed part of the MESSI project. Their proposals needed to specifically address topics such as the menu (0-km products, responsible consumption, Mediterranean diet, product quality control and carbon footprint), the expense (cost control and affordable cost according to the social structure of the families) and the arrangement of space and organization of the center (preventive medicine, healthy habits, social climate).

The students needed to learn and make an effort to work as a team throughout the process, completing tasks related to their area of study and integrating them into the group work, re-evaluating them and ultimately creating an interdisciplinary project. This meant knowing how to transmit their knowledge, acquire new knowledge, take responsibility for the tasks to be performed, present their points of view and defend the agreements made as a group.

The project was evaluated by the professors and two professionals associated with the topic of the proposed project (the town council member in charge of Tourism in Platja d'Aro and the manager of the school cafeterias in the local Consell Comarcal (Local body, made up by a group of municipalities). Each used the same rubric that had previously been presented to the students. The rubric considered a set of items that referred to the key points of the project, the quality of the documents written (final report and copy of the presentation) and the oral defense itself. The rubric used an evaluation scale, which expressed agreement-disagreement numerically from 1 to 5. Eight aspects were specifically evaluated, as described below:

- (1) How well the proposed activities match the objectives of the MESSI project.
- (2) The diagnosis and contextualization of the current conditions at the school.

- (3) The substantial change that the proposals represented in the activities.
- (4) Coverage of all the indicated aspects (menu, expenses, resistance to change, etc.)
- (5) The existence and clear definition of the evaluation indicators.
- (6) Substantiation based on experiences in other contexts.
- (7) Corroboration with persons involved at the schools.
- (8) Defense of the project by the different team members.

4. Project results

The results of the evaluation according to the indicators included on the rubric are shown below (Table 2):

Rub. quest.	Score on a scale of 1 to 5, measuring agreement-disagreement																Avg. score.
	School A				School B				School C				School D				
	E1	E2	E3	TE	E1	E2	E3	TE	E1	E2	E3	TE	E1	E2	E3	TE	
1	4	5	5	4.7	4	4	5	4.3	2	4	4	3.3	4	4	4	4.0	4.1
2	2	4	4	3.3	5	4	5	4.7	2	3		2.5	5	4	4	4.3	3.7
3	3	4	4	3.7	3	3		3.0	3	2		2.5	3	3	4	3.3	3.1
4	4	3	5	4.0	3	3		3.0	2	2	4	2.7	5	2	4	3.7	3.3
5	5	4	5	4.7	3	4		3.5	3	2		2.5	5	4	4	4.3	3.7
6	5	5	4	4.7	4	4	5	4.3	2	2		2.0	2	4	4	3.3	3.6
7	4	5	4	4.3	2	4		3.0	2	2	3	2.3	2	4	5	3.7	3.3
8	5	5	5	5.0	5	5	5	5.0	3	4	4	3.7	5	4	4	4.3	4.5
Avg. score	4	4.3	4.5		3.6	3.8	5		2.4	2.6	3.7		3.9	3.6	4.1		
TS	4.29				4.00				2.75				3.87				

Rub. quest.= rubric questions. E1, E2, E3= evaluators 1, 2, 3. TE=mean score (of three evaluators) for that question. TS= total score or total mean score for the project proposed for that school

Table 2. Results of the evaluation by the professors associated with the project and outside evaluators, according to the indicators included on the rubric

The results observed in items 1 and 8, with the highest scores, indicate that the members of the different groups were involved in the development and execution of the project, confirming that the What, How and Why dynamic was useful and attractive to them. With regard to the lowest scores, corresponding to questions 4 and 7, this may have been due to not having sufficient time to develop the project and the lack of collaboration on the part of the educational institutions,

respectively. With regard to the scores observed for item 3, our understanding is that the format of the experience failed to stimulate innovation as much as we had hoped. Once again, the time factor may have been decisive. In addition, it should be noted that all the evaluators agreed that project A was the one that best fulfilled the evaluation criteria, while project C was the worst in this regard, which indicates the consistency of the evaluation process itself.

The experience was also evaluated by the students individually, using an anonymous online questionnaire that included both open and closed-ended questions. The aim of the questionnaire was to gather the students' opinions and reflections on the MESSI project. To begin with, they were asked a series of specific questions that required them to indicate the extent to which they agreed with each item. Next, they were asked to provide more elaborate answers to a series of questions related to the project. It was explained to the students that these responses had two objectives: one, to increase awareness about their role in this project, which could contribute to improving their performance on similar activities in the future; and two, to be considered when making improvements to the design of this activity. Table 3 shows the quantitative results.

Question number	Survey questions	Score ⁽¹⁾
1	The interdisciplinary nature of the project helped me better meet the challenge.	4.53
2	The awarding of credits had an influence on participation in the project.	3.00
3	The final result of the project exceeded my initial expectations.	4.00
4	This type of projects contributes to greater commitment by group members.	3.76
5	This type of projects motivates students.	3.82
6	This type of projects promotes problem solving.	4.12
7	The proposed topic (management of a school cafeteria) was appropriate for this type of project.	3.35
8	The Institute of Education Sciences environment was appropriate for conducting the project sessions.	4.53
9	The faculty members were good communicators and encouraged us during the project.	4.29
10	The contributions made by the faculty members during the partial presentation sessions of the project were appropriate.	3.82

(1) The scoring consisted of the mean of the responses by the 22 students, based on a numeric scale of 1 to 5 that measured agreement-disagreement, where 1=disagreement and 5=complete agreement with each of the items

Table 3. Mean values obtained for the different items included on the survey administered to the students participating in the MESSI project

As seen in Table 3, questions 1, 6, 8 and 9 received the highest scores. The responses to questions 1 and 6 indicate that we have attained our objective: the interdisciplinary nature of the proposal improves the way in which the challenge was met. Answers 8 and 9 show the high degree of motivation by the professors involved and the desirability of conducting the experience

in a neutral environment that does not belong to any of the educational centers at the university. Conversely, the responses to questions 2 and 7 show lower mean scores. Question 2 stresses the motivating nature of the experience, as the students were not seeking to earn credits, while question 7 indicates that this was not dependent on the challenge, since the motivation remained the same in spite of the fact that the MESSI challenge did not please everyone. There were no differences in the opinions of the students according to their program of origin.

The qualitative results from the open-ended questions reveal that the interdisciplinary nature was essential to the resolution of the proposed case, and that this type of projects contributes to increasing student motivation and the commitment of all group members. However, the participants stated that they did not have enough time to get to know one another, due to the short duration of the project. This prevented them from overcoming certain conflicts that arose among the group members.

The students also claimed that the different scheduling structures for the courses in the different university colleges prevented them from finding enough time for group work and discussion. On certain occasions, this difficulty resulted in a violation of the spirit of the project, and the tasks were distributed among the group members according to specialty.

With regard to the specific project they worked on, the students reported the lack of involvement of some of the administrations at the schools analyzed. In terms of the professors, they stated that while the project was very well thought out and structured, the faculty needed to be more directly involved in the group work, providing more direct guidance.

5. Discussion

The activity carried out shows that it is feasible to conduct innovative, contextualized, real-life projects that are in turn implemented from the perspective of the different disciplines and knowledge of the students according to their studies. The completely interdisciplinary nature of the proposal contributed to a great extent to its enrichment, which coincides with the approaches of Kruch and Teer (2009), according to which a safe classroom environment can contribute to the learning by the work group. To cite one example, the sensitivity of food technology students to aspects related to the quality of raw materials or that of medical students to dietary and health issues was complemented by energy aspects of the building that concerned the engineering

students and the complementary activities that the children using the cafeteria could engage in, which were of interest to the psychology students.

One of the most important components in creating what Vaatstra and Vries (2007) refer to as an activating learning environment is the opportunity to apply theoretical knowledge to real-life problems or authentic cases (in this case, the management of a school cafeteria at an existing school). An environment of this type is characterized by the active manner in which the students structure and organize their knowledge through problem solving and the application of this to specific cases. This results in greater retention and comprehension of the contents studied and greater ability to apply this knowledge in practice. In other words, this type of environments contributes to helping students understand why, how and when they can apply their knowledge (Vaatstra & Vries, 2007). Consequently, it would be important to increase the offer of activities of this type and to monitor the participants to find out what incidence these projects have had on their subsequent entrance into the labor force, given the many benefits that teamwork has for labor contexts, contributing to increased productivity and satisfaction of work team members, among other aspects (Kruch & Teer, 2009).

In order to carry out this type of projects, it is essential to obtain the commitment of the different agents involved, both professors and students, since it requires an effort over and beyond the tasks that both groups have already been assigned. The success of this type of projects also requires a predisposition towards interdisciplinarity and a global vision on the part of the university, manifested by facilitating things as simple as adequate work spaces and coordinating schedules among the different colleges. These same aspects have been stressed by Boden et al. (2011) as barriers to interdisciplinary work, along with the strongly hierarchical structure that characterizes universities.

In addition, Öberg (2009) suggest that interdisciplinary work requires the creation of a common starting point, which necessitates the discussion of matters such as quality and credibility from the perspective of the different disciplines. With regard to the activity described here, the professors involved in the project required numerous meetings to agree upon the details of a project in which all the disciplines represented were equally reflected.

Likewise, the experience poses a series of questions, such as how this type of proposal fits in the different curricula, the appropriateness of the participation of external bodies in the evaluation of the projects and the desirability of maintaining a certain degree of flexibility in the evaluation rubric, giving the professors the option of adding or changing the indicators according to the

work synergies that emerge. In spite of these doubts, we believe that the experience conducted can be an interesting starting point to propose the completion of final degree projects (FDP) based on real-life proposals and of a strongly interdisciplinary nature.

With regard to limitations, it must be stressed that the students' lack of experience in carrying out projects based on real-life proposals and that require interdisciplinary work leads us to believe that it would be recommendable for it to have a longer duration. It is important to enable the students to obtain real knowledge of the location being studied, to become acquainted with the other team members and for the suggested proposals to have the time to mature. In this respect, Klein (1990, cited in Woods, 2007) conceives interdisciplinary learning as a communicative action and believes that the very skills that are required for interdisciplinary problem solving constitute a form of knowledge. The development of these skills and knowledge has a lot to do with the negotiation capacity of the team members; this capacity is acquired progressively through interaction.

Furthermore, the short time allowed for the project prevented any observations to be made about whether there was an evolution in the different aspects that Amey and Brown (2005) consider to be key for their model of interdisciplinary collaboration in the different student teams. Specifically, these are a discipline-focused orientation (which would transition from an initial mastery phase to a third integrative phase), a commitment to knowledge (progressing from expert to collaborative), a work-centered orientation (transitioning from individual to team) and leadership (shifting from “top-down” to “at the service of”). It would be interesting for future studies to closely monitor the different student teams in order to discover the factors that promote or limit the progress in each of these aspects within the university context.

6. Conclusion

As a general conclusion regarding the experience conducted and summarized in this article, it should be pointed out that the interdisciplinary nature of the project was essential for providing a solution to the proposed case. It can be concluded that this type of projects contributes to increasing student motivation and the commitment of each team member. This type of interdisciplinary projects involving real-life educational management builds relevant competences for the professional world and fulfils the chief characteristic of competence-based training, which

is to integrate disciplines, knowledge, skills, practices and values in order to train good professionals.

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