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Collaborative Learning Experiences for the Development of Higher-Order Thinking

Experiencias de Aprendizaje Colaborativo para el Desarrollo del Pensamiento de Orden Superior

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Contents

ABSTRACT:
The work presented in this article describe the conceptualization and methodological proposal for the development of two distinct pedagogical approaches. One, based on Inquiry Based Learning (IBL), is structured in phases, guiding the student through the learning process. The other is based on gamification, applied as an integrated teaching-learning strategy. It includes the definition of the formative assessment, student classification and learning experiences, which include traditional practical assignments and educational games. This study was conceptualized and applied in two curricular units of different areas, to identify the impact that these strategies have in the construction of higher-order skills, such as communication skills, critical thinking and collaboration. There are strong indicators that the intense and active role of students allows them to build strong connection to the issue in study and also to rely on team work for further in the knowledge building.
Keywords: Collaborative Learning Experiences, Higher-Order Thinking, Higher Education, Teaching-Learning Strategies, Gamification

RESUMEN:
El trabajo presentado en este trabajo describe la conceptualización y la propuesta metodológica para el desarrollo de dos enfoques pedagógicos distintos. Uno, basado en el aprendizaje basado en la investigación (ABI), se estructura en fases, guiando al alumno a través del proceso de aprendizaje. El otro se basa en la gamificación, aplicada como una estrategia integrada de enseñanza-aprendizaje. Incluye la definición de la evaluación formativa, la clasificación de los estudiantes y las experiencias de aprendizaje, que incluyen asignaciones prácticas tradicionales y juegos educativos. Este estudio fue conceptualizado y aplicado en dos unidades curriculares de diferentes áreas, para identificar el impacto que estas estrategias tienen en la construcción de habilidades de orden superior, como habilidades de comunicación, pensamiento crítico y colaboración. Existen fuertes indicadores de que el rol intenso y activo de los estudiantes les permite establecer una fuerte conexión con el tema en estudio y también confiar en el trabajo en equipo para avanzar en la construcción del conocimiento.
Palabras clave: Experiencias de Aprendizaje Colaborativo, Pensamiento de Orden Superior, Educación Superior, Estrategias de Enseñanza-Aprendizaje, Gamificación

1. Higher Education Trends and Challenges for the XXI century

Human knowledge is considered, in the XXI century, as a fundamental factor for the economic and social development of modern societies (Pijano, Scott, & Knight, 2014). One of the missions of Higher Education Institutions (HEI) is to produce knowledge that contributes to the development of the society. In fact, HEI are a crucial factor for the human capital development and innovation, assuming an important role for the success and sustainability if the knowledge economy. However, in the last forty years, higher education has been facing a set of challenges that have been shaping their management and operation model, the relevancy of the produced knowledge, the conditions in which it is produced, and the adequacy to the needs of the market economy.

The Feasibility Study Report (Trembley, Lalancette, & Roseveare, 2012) refer some of the main characteristics of the changes observed in higher education, such as the massive expansion of education systems, the existence of different types and profiles of institutions, the diversity of the offer of the programmes, the heterogeneity of the students' profiles, the rapid integration and constant technological development, the internationalization, and the management, operation, and quality assessment models.

Moreover, all levels of education, all over the world, have observed, during the seventies, a significant expansion. According to the UIS data (http://data.uis.unesco.org/), there was 32.5 million students in higher education programmes. In the year 2000, the number increased to 100 million, and, in 2010, there were 178 million students in higher education. This numbers show a 4.3% annual growth in until the year 2000 and a 5.9% growth until 2010. Some projections point to an even steeper increase, assuming an additional 100 million students in higher education in the year 2025 (Marope, Wells, Hazelkorn, & Unesco, 2013).

There are several reasons the explain this expansion. Some European countries established the goal of having 40% to 50% of the young adult population in higher education. Some emerging countries, such as China, Latin America and the Arab States greatly contributed to this dynamism, foreseeing 40% young adult population with higher education training in the year 2020. In addition, the democratization of education and the 12 years of mandatory education, in many countries, contribute to enlarging the number of students in higher education. Moreover, the increasing number of women and ethnical minorities as well as the creation of conditions to simplify the access for students that did not manage to complete the secondary school are other factors that stimulate the expansion of higher education (Mesquita, Lopes, Álvarez, & Del Río, 2014).

Internationalization also constitutes an important factor for the transformation of higher education. Students from different countries enroll in mobility programmes, for partial or total training. This reality also poses a challenge to HEI, in terms of professional profiles and programmes, and in terms of accountability. The Bologna declaration proposed the adoption, by the signatory countries, of a simple model for conversion and comparison of academic degrees based on a common structure. In this

context, several instruments were developed to translate the credits and qualification, as the European Credit Transfer and accumulation System (ECTS).

Considering this context, the democratization and massification of education has been contributing to the creation of new types of institutions that complement traditional universities. These institutions, designated as polytechnic or universities of applied sciences, are oriented towards more technological and professional areas, according to the market needs. One of the characteristics of this training is related to the more practical subjects and the integration of specific internship in the programmes. The diversity of HEI missions also lead to the development of different professional profiles and, at the same time, an adaptation of traditional universities that aspire to increase their total number of students.

All these issues represent challenges that HEI must face in the next decades, considering the changes that globalization and market economy have been stimulating. In this sense, several economic, political and socio-demographic trends rise, with reflection on the pedagogical and scientific organization of HEI.

The Organization for Economic Cooperation and Development (OECD) identified several key demographic trends for the period to 2030 (Centre for Educational Research and Innovation & Organisation for Economic Co-operation and Development, 2008). The student participation will continue to expand, along with higher education systems, with only a few countries contracting in student numbers. Women will become the majority in student populations in most developed countries and will substantially expand their participation. The mix of the student population will become more varied, with greater numbers of international students, older students, part-time students, and other types. The social base in higher education will continue to broaden, along with uncertainty about how this will affect inequalities of educational opportunities between social groups. Attitudes and policies relating to access as well as the consciousness among disadvantaged groups will change and become more central to national debates. The academic profession will become more internationally oriented but will still be structured in accordance with national circumstances. The activities and roles of the academic profession will be more diversified and specialized and subject to varied employment contracts. For many developing countries, the need for ever-expanding numbers of university teachers will mean that overall qualifications, now rather low, may not improve much, and current reliance on part-time staff in many countries may continue (Altbach, Reisberg, & Rumbley, 2009).

These trends suggest a reflexion on the pedagogical dynamics that should be developed in the course of these students' training and that cope with the training the constantly changing world needs, and where higher-order thinking skills have particular relevance (Mesquita, Lopes, & Bredis, 2016). The next sections describe the importance of the development of that kind of skills and the pedagogical trends that supports it in the context of higher education.

1.1. Higher-Order Thinking Subchapter

The changes in the professional world have repercussions in higher education. The globalization phenomenon, the rapid expansion of the use of technology, and the expansion and diversity of higher education students, demands redesigning and rethinking the pedagogical approaches for the development of personal and professional competences adequate to the socio-economical scenario. It is expected that, higher education graduates, in addition to the cognitive competences, also develop functional competences, social competences and lifelong development of professional competences. These set of competences are an essential part of the worker abilities for the demanding post-industrial society, and, because of that, they should be properly considered in the design of the higher education programmes (Van der Klink, Boon, & Schlusmans, 2007).

Studies by Bransford, Brown, and Cocking (2000) and Schwartz, Bransford, and Sears (2005) emphasize that the main teaching and learning objective is the development of adaptive expertise, meaning the ability to apply knowledge and skills, significantly obtained, in a flexible and creative way, in a broad set of situations. This goes beyond the acquisition of mastery and routine experience in a specific subject. On the contrary, it concentrates the disposition and the capacity of continuously changing the essential competences. It is, therefore, essential for the lifelong learning that society demand. Adaptive expertise is built through the development of Higher-Order Thinking Skills (HOTS).

There are several major concepts relevant to the higher order thinking processes. First, the levels of thinking cannot be separated from the levels of learning, because they involve interdependent, multiple components and levels. Second, in real life, students will learn content in both community and school experiences. The concepts and vocabulary they learn in the prior year will help them learn both higher order thinking skills and new content in the coming year. Third, higher order thinking involves a variety of thinking processes applied to complex situations and having multiple variables (King, Goodson, & Rohani, 2009).

According to Dumont, Istance and Benavides (2010), the HOTS are the most valued in the professional context and in the societal relations. They include the ability to generate and process information at a complex level, to think critically and systematically, to take decisions weighting different options, to create meaningful questions regarding different subjects, to be flexible and to adapt to new information and situations, to be creative, to be able to justify and solve real-world problems, to acquire a deep understanding of complex concepts, to have media literacy, to work in teams, to communicate and argue in persuasive manner.

This set of transversal skills are developed through specific teaching-learning strategies, the depart from the traditional model and appeals to the deep involvement of students on their own knowledge building process.

1.2. Pedagogical Approaches and Teaching-Learning Strategies

Scientific literature has been highlighting the importance of pedagogical change in higher education (Fry, Ketteridge, & Marshall, 2009). However, HEI have some resistance to this change, maintaining several barriers related with the rigid structure of the curriculum, the departmental organization, the insufficient knowledge and preparation to introduce changes, and the traditional academic perspective the majority of teachers have. However, empirical research about how people learn reveals the necessity to perform a deep reflection about what students are learning, the relevance of what they learn, the essence of the knowledge and the way it is accessed and assessed.

The social-constructivism approach is a pedagogical line that allows the student to be active in the construction of his knowledge, in the context of an enabling social and emotional environment, built through the interaction and negotiation with the others. This approach presumes the use of diverse teaching-learning strategies, which enable the development of HOTS in the context of the higher education, such as (Dumont et al., 2010):

- Guided learning: the teacher assumes the main decisions about the objectives, teaching-learning strategies and assessment, giving feedback, comments and rewards.
- Action learning: students assume an active role in the definition of the learning objectives. There is a strong presence of the student in self-organization and self-planning.
- Experiential learning: it is not controlled by the teacher and there are no predetermined objectives. What is learned is determined by the context, by the students, by the people they contact with (teachers, colleagues …), by their discoveries. It is a sub-product of the activities in which people are involved.

To support the progressive introduction of adaptive expertise development, there should be a balanced and integrated use of all three teaching-learning strategies. The balance should allow the teacher to define the structure and to supervise the process, as well as to allow him to create moments for the self-regulation and self-assessment of the knowledge construction. It is of particular importance the existence of an enabling environment, as well as the teacher action. Teachers should design, implement and monitor the learning experiences, select and create the pedagogical material, and define different action types and moments to create an emotional environment that fosters integration and stimulates the students' involvement.

For this, HOTS is further stimulated through the use of several methodologies:

- Collaborative learning: students work together, being responsible for their and for the others' learning. This methodology takes a long time to develop, because students are used to traditional teaching-learning strategies, which appeals to individual action, passive role and little receptive to the others' ideas.
- Learning with technology: the approaches that use technology as an element to foster learning support the students and implement meaningful teaching-learning experiences. Technology offers several tools essential for the development of enabling environments. They can be used to support the interaction between colleagues, the autonomous work, the assessment system and in inquiry-based learning strategies.
- Formative assessment: the formative and self-regulated assessment guides the students to achieve better results. For that, it is necessary a constant feedback, keeping students aware of their progress and giving them information regarding their needs and weaknesses.
- Inquiry-based approaches: have been considered as relevant in the development of HOTS. These methodologies imply the development of complex and meaningful studies or projects, requiring the involvement, collaboration, research, resource management and the development of communication and argumentation skills.

Recently, the literature has been revealing that Gamification is a strategy that obeys the above mentioned forms, able of fostering HOTS. It allows designing an up-to-date feedback mechanism through game thinking and mechanics, providing students with meaningful learning experiences that contribute to higher autonomy, implementing a formative assessment mechanism based on awards, points or badges, within a technological background, and providing collaboration between students in educational games (Lopes, 2014).

The teaching-learning strategies described in the following sections, and that are the centre of this work, were developed under the previous assumptions, considering that students can improve their HOTS when they are engaged in enabling environments that stimulates active and experiential learning, with the constant guidance of the teacher.

2. Inquiry-Based Learning and Gamification

The design of teaching-learning strategies is within the scientific and pedagogical autonomy that characterizes higher education teachers' activities. Higher education institutions have the responsibility of providing an adequate environment for their teachers' pedagogical development. It is also necessary that each one of them assumes the role of the researcher of the own practice (Zeichner, 1993), focused on the teacher but based on the cooperation with his colleagues (Garcia, 1999).

Several experiences have been confirming that some pedagogical strategies, such as the involvement of teachers with their own pedagogical training (Pinto, 2008), tutorial supervision, project based learning, contribute to the success and integration of students (Simão, Flores, Fernandes, & Figueira, 2008). According to Formosinho and Oliveira-Formosinho (2012), the professional development of teachers requires the construction of a set of theories and evidences about the methods, structure and approaches and also processes (highlighting the mechanisms that foster change) and their effects on the students and organizations.

The adoption of methods that help students to build meaning about the knowledge that is relevant to their training require an interrelation between the planning of the teaching-learning activities, the implementation of the action and the assessment processes. Understanding the planning, the learning and the assessment as related processes imply a pedagogical action that value the collaboration between the teacher and the student, as well as an ongoing reflection, research and reformulation (Fernandes, 2013).

Some of the research performed concerning pedagogical innovation in higher education showed several teaching-learning strategies that value student involvement in the process of knowledge building. Among these, two were chosen: Inquiry-Based Learning and Gamification.

2.1. IBL as Teaching-Learning Strategy

Inquiry Based Learning (IBL) has been receiving increasing attention as a teaching-learning methodology. It follows the scientific process, describing processes that teachers and students adopt to build significant knowledge (Keselman, 2003). This concept is based on the idea that learning through discovery and through associated meaning creates, in each student, a deeper and more permanent understanding (Bruner, 2008, 2015; Prestie & Smith, 2010).

IBL is considered as a problem solving approach, implying the use of several procedures inherent to this strategy. According to Dewey (2007) and Bruner (2008, 2015), this methodology emphasizes the participation of the student to discover new knowledge. In addition, it also highlights the need to organize, in a clear and sequential way, all the research process.

The research process in IBL is structured in phases with units of action logically related. These guide the students and focus their attention in the characteristics of the reflective and scientific thinking. Pedaste et al. (2015), in the analysis of 32 IBL related papers, revealed the existence of some variations on the research cycles. After an approximation of concepts, they identify five distinct phases: orientation, conceptualization, research, conclusion and discussion.

The orientation is focused on the stimulation of interest and curiosity towards a problem. During this phase, the research topic is introduced through a life situation, suggested by the teacher or defined according the interest of one or more students.

The conceptualization is the process that allows understanding the concepts associated to the problem previously defined. It is structure in two steps: questioning and hypothesizing. The former generates a research question or a set of open questions concerning a study area. The latter generates a testable hypothesis. Although both are based on a theoretical justification and both contain dependent and independent variables, there is a fundamental difference between them: the hypothetical direction associated to the relation between variables is not present in a research question. In general, hypothesizing results in a statement or a set of statements, although the questioning results in a research question.

The research phase is where curiosity is transformed in action, to answer the research questions or to assess the generated hypothesis. This is further divided in three sub phases: exploring, experimenting and interpreting data. Students explore, observe, plan and perform different experiments, changing variable values, making forecasts and interpreting results. Exploring is a systematic way to conduct a research with the intention of finding a relation between the involved variables. Data interpretation has the purpose of finding the meaning of the collected data, synthetizing new knowledge. The final result of the research phase is the interpretation of data (discovering the relation between variables) that allows answering the main problem.

The conclusion is the phase in which the study evidences are demonstrated. In this phase, students solve their research questions

of hypothesis and check if they are answered or supported by the research results.

The discussion contains the sub phases of communication and reflexion. The communication is the moment in which the students present the results and conclusions to the colleagues and get feedback and comments. The reflexion is the way students think about what happened in the research cycle and what they learned with it. The communication is an external process, a form of scrutiny by the group, while reflexion is an internal process of internalization and questioning about the experienced and learned.

2.2. Gamification as Teaching-Learning Strategy

Gamification describe the use of game-thinking and game mechanics in non-gaming contexts to solve problems and to engage audiences (Deterding, Sicart, Nacke, O'Hara, & Dixon, 2011). It may include challenges, rewards, points, levels and others, within the objectives of the scenario.

The application of gamification on educational contexts also allows using games as educational tools. This approach use games as learning experiences with the goal of increasing the student knowledge just by playing them, whether in context or not. In fact, the core components and patterns of game design intrinsically integrate some kind of learning with the game mechanics (Linehan, Kirman, Lawson, & Chan, 2011).

Usually, there are two approaches for using games in education. The first seeks the engagement that commercial and wide available games have to foster learning outside the school environment. Games such as Sid Meier's Civilization or World of Warcraft can provide a challenging and motivating world that require analysing, planning, communicating and others, contributing to improving the problem solving abilities of players. On the other hand, games can be specifically designed to convey traditional content in a different, untraditional, form.

Not everything can be learned through the first method, and not everything can be sufficiently motivating in the second method. It seems obvious that an educational game is simply not a collection of content organized in an untraditional way. Educational games should follow the same principles that makes entertainment games intrinsically motivating. Some of these principles include the existence of medium and long term goals organized as increasingly complex levels, requiring the player to make decisions and take actions, provide immediate feedback, include a reward system for achievements, gradually teach the player new skills necessary to overcome more challenging obstacles.

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3. Methodology

The assessment of the impact of the pedagogical experiences is performed with two main goals. On one hand, it allows the teachers and the institution to evaluate the success of the new strategies and, on the other hand, it provides a mean for students to become part of the process, including them in the design of the learning experiences.

The evaluation methodology is designed considering the involvement of students with the process and must reflect on the available pedagogical techniques and approaches. They must understand, from the beginning, what this paradigm shift represents and what is the role of each one of them. This is best achieved by stimulating them to think about the issue, posing questions, considering individual positions and reflecting on the overall learning process. In addition, it is also necessary to understand the levels of satisfaction and motivation of the students in several moments of the process. At the end, a final assessment is made to compare the initial perception of the students.

The impact of the pedagogical approaches is an action-research process, considering that all those involved can contribute both to the thinking that informs research and practice and to knowledge development. The main research concern is related to the self-initiative and autonomy of the students, as well as the pedagogical techniques.

The research methodology is structured in seven key steps (Table 1). In each step, data is gathered with different instruments, using specific interviews and observation of students in different learning activities.

Table 1
Key steps in the action-learning process.

Key steps	Descriptions
Step 1	Definition of the objectives and development of the supporting document. Creation of the learning experiences and the classification model. Monitoring process (reflections with the pedagogical supervisor).
Step 2	Clarification of the project with all authors (School director, Department, Programme Coordinator, Pedagogical Council).
Step 3	Initial assessment: analysis of the students' perceptions about the learning process in higher education and the expectations concerning the project (interview).
Step 4	Presentation and discussion of the learning process and classification methodologies (students). Informed consent.
Step 5	Pedagogical practice: design and implementation. Development of 21 learning experiences according to the learning outcomes and curricular unit structure.
Step 6	Collaborative work (students, teacher).
Step 7	Final assessment: questionnaires to the students; comparative analysis of the students' learning results; reflections and discussion with the pedagogical supervisor.

Source: Own elaboration

3.1. Design and Implementation of IBL

The IBL pedagogical experiment was developed with 75 students of the curricular unit Population Dynamics, of the Social Worker degree. Students were divided in two classes with 39 students in class A and 36 in class B. Each class had four contact hours, per

week, with the teacher. Each class was further divided in two, with four groups of four (or five) elements each (a total of 16 groups).

In the first classes, a research process was suggested, with a research methodology proposed by the teacher. The whole process was explained, considering the IBL phases. This process was initiated by deconstructing the terms "Population" and "Dynamics". In each class, students studied and reflected on words that they were associating with these terms. Next, the necessary concepts were clarified through the reading and discussion of texts. Each group was required to create a research topic, from the cross of these two words. Each group presented several possibilities. It was then suggested that each group select the problem, among all they found, they would like to research.

Considering the importance of including all the groups in the study of all the problems, the teacher found an organizational strategy to conduct the research. The group that generated the problem ({A, B, C, D}, in Figure 1) also created four partial research questions, that were delivered to the other groups ({E, F, G, H}, {I, J, K, L} e {M, N, O, P}}. Each group was then responsible for researching and collecting data that would allow answering the question, within the frame of the main research problem. The responsible group collected the information from the other groups and also summarized it in a PowerPoint presentation. The presentation was performed by a speaker (according to a round-robin scheme – elements E, M e I in Figure 1), that was also expected to discuss and explain the partial question.

The student assessment was also participative. All the students that presented the work performed a self-assessment, by answering and following a guideline. The teacher (P, in the figure), the responsible group ({A, B, C, D}) and the group were the presentation element belong, all assessed the performance of element E during the presentation. The same happened for all the elements in all the groups.

In addition, each group also assessed the work presented and its contribution to the main research question. They also assess the role of the responsible group; dynamizing and managing the collective work (Figure 2).

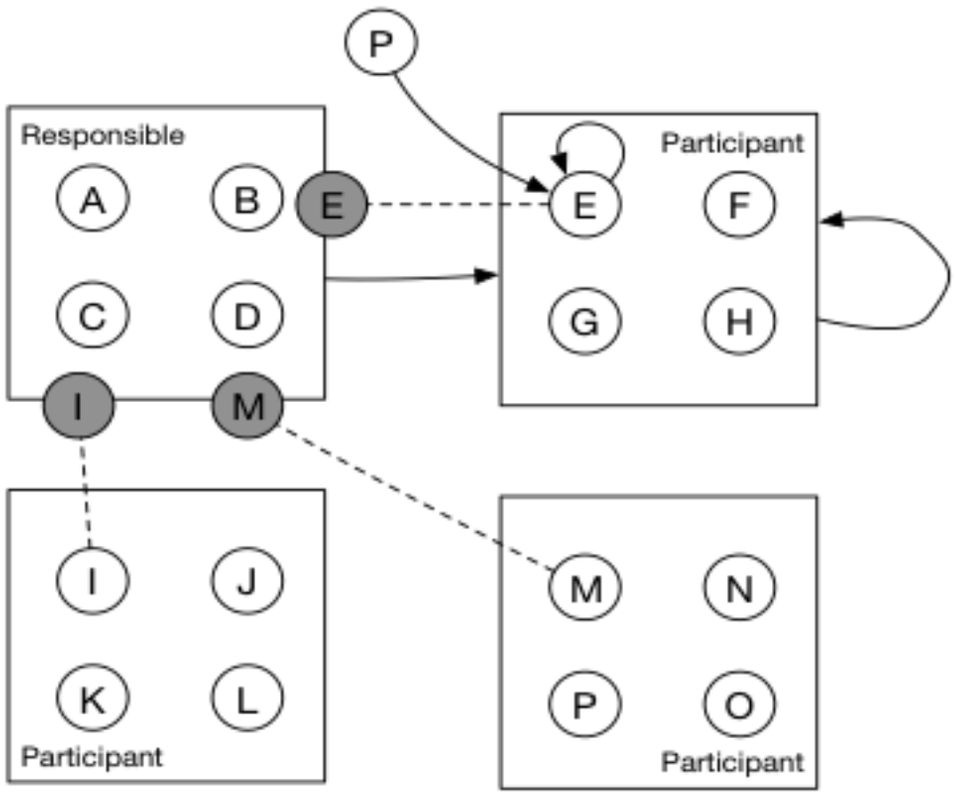


Figure 1. Assessment of the oral presentation.

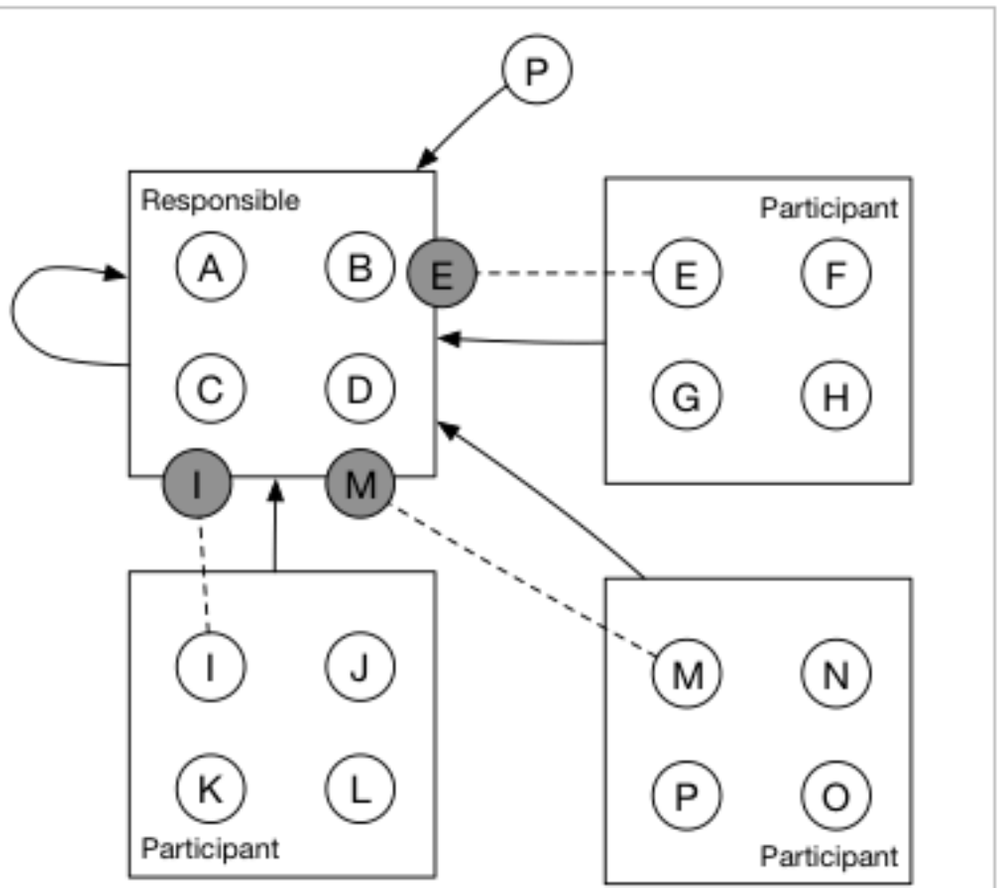
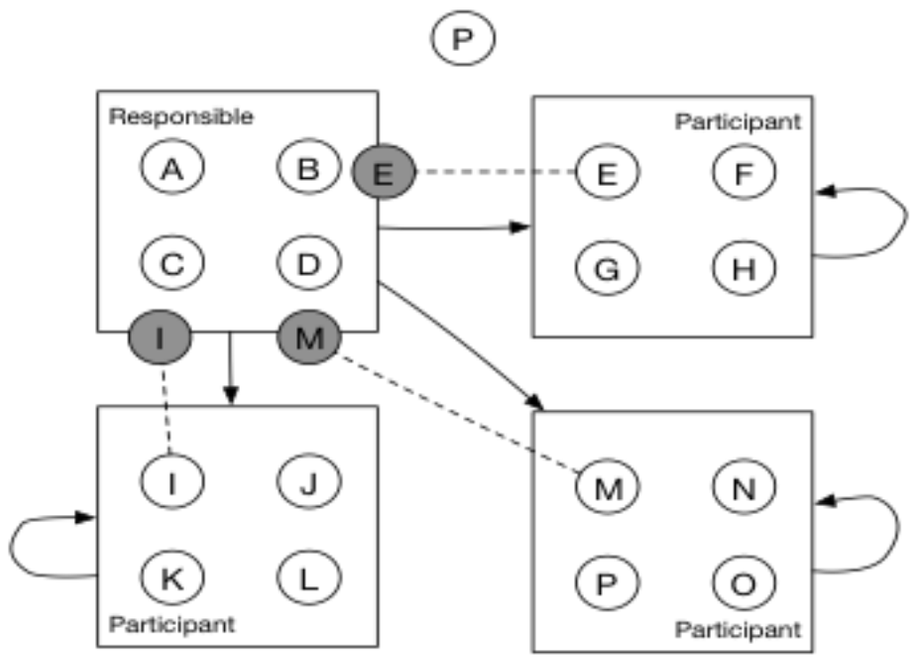


Figure 2. Assessment of the responsible group.

The responsible group assessed the contribution of all groups and also performed its self-assessment (Figure 3).

The teacher assessed the contribution of all the group elements in the development of the research study and also their performance in the written report. Students could choose two of the themes that were used to write a final reflection. All these assessment elements were collected and used to calculate a grade for each student.

Figure 3
Assessment of the participating groups.



3.2. Design and Implementation of Gamification

The curriculum of Network and System Management of the Informatics Engineering, in which gamification was applied, is structured in four sections or chapters. Each section has several topics that should be mastered before advancing to the next section. The final assessment and the associated grade depend on the success on each of the section as well as the creativity and the knowledge level demonstrated in every topic.

Students are graded from 0 to 20, which is translated to the ECTS scale, demonstrating how she performed relative to other students (the best 10% are awarded an A-grade, the next 25% a B grade, the following 30% a C-grade, the following 25% a D-grade and the final 10% an E-grade). Success is only considered if the student has a grade equal or above 10 (0-20).

The assessment and grading follows a reward structure design pattern. All the students have to fulfil the minimum requirements to

succeed, meaning that they have to overcome all the sections or "levels". Within each level, the increasing number of overcame obstacles (represented by stars, awarded according to the difficulty of the learning experience) will grant the student a higher grade. Whenever a learning experience is completed, Bit Points are awarded, that although not contributing to the final classification, can be used to "buy" extra tools or help from the teacher (Lopes, 2014).

The student can, at any time, see the evolution within the awards system using a standard web browser. This will present the completed levels, the levels still to come, the difficulty of the completed learning experiences and the total Bit Points. The level map also gives access to the item store, where the student can buy information or tools to be used in other tasks.

Each student is unique in the way he learns. The learning experiences should consider this diversity and should be adequate to motivate them and to provide the necessary challenges for learning to take place. In this context, the concept is understood as a reinforcement of the goal of an educational interaction over its location (school, classroom) or format (course, program). In the gamified subject, the learning experiences include not only traditional, transmissive, approaches and practical work assignments but also designing and playing games. The latter is regarded as an integral part of the students' knowledge building, with the objective of being instructional with the main focus on the cognitive side of instruction.

There are traditional practical assignments, which present to the student an exercise or problem that has to be understood and solved with network and system tools of their choice. Some are easier and others mode demanding, to allow students to choose according to the confidence and motivation they think they have. This also contributes to the student regulate the learning rhythm and, usually, after completing an easy learning experience, they return and try to finish a normal or even a hard, to pursue higher grade.

Among the traditional practical assignments, several games where also designed and built. The first game, available in the first level, layer easy, is a card game, called Virtualization Game. The objective of the game is to learn concepts related to operating system virtualization. The students have to design the cards according to a fixed set of rules. The cards, similar to memory cards, have a question and a consequence to follow, should they fail.

The second level, layer easy and normal, include a tabletop Role-Playing Game (Lopes, 2015). This game is played in person, around a table, where all the actions and consequences are communicated orally. The game is played by 4 or 5 students, where one performs the role of the Game Master and the remaining assume the role of Datuist monks, the heroes of the adventure. This educational content of this game is relative to the isolated systems, in particular recovery and survivability of data.

The third level allow students to play a board game, called Cabinet (Lopes, 2014). This is a strategy game, of the worker placement style, in which the players have to compete for resources to build and maintain an enterprise wide data-centre.

The results of all the learning experiences, either traditional as well as games, are recorded in a chart, providing immediate feedback to students. The chart is represented as a castle conquering mission, in which it is necessary to conquer all five castles. The record is translated into a classification scale, which results in the students' final grade.

3.3. Evaluation Methodology

The evaluation of both IBL and Gamification was composed of several instruments, including class observation, interviews and questionnaires, presented to students both in the beginning of the semester and in the end. In this work we refer, mainly, to the data obtained in the final questionnaire, allowing us to extract and analyse data related to the development of higher-order thinking skills.

We did not intend to compare both approaches, but to understand how they, although different, contribute to developing students' HOTS in five dimensions. Each of the pedagogical approaches (IBL and Gamification) used one questionnaire, both with the same structure, composed of 7 sections, as follows: 1) Student characterization and background; 2) Pedagogical and didactical organization; 3) Details concerning the teaching-learning strategy (IBL in one class and Gamification in the other); 4) Satisfaction and motivation with the teaching-learning strategy; 5) Difficulties with the teaching-learning strategy; 6) Advantages of the teaching-learning strategy; 7) Evaluation system. Although the structure is similar, the questionnaires differ in some specific issues, taking into account the differences between the two pedagogical strategies.

The academic success was also a factor, used as an indicator to understand if students were, in any way, prevented from succeeding in different pedagogical scenarios, in which they are not used to.

4. Analysis and Discussion

The implementation of active pedagogical methodologies, particularly in higher education, is considered, by the literature, of the utmost importance. However, because students are used to traditional methodologies and also because programmes are designed considering a traditional approach, it is important to evaluate the impact these methodologies have in the teaching-learning process as well as on the development of higher-order thinking skills.

Considering the academic success of the students, the majority managed to approve in both subjects. In the IBL class, 98% completed the subject and in the gamification, 93% had success. The students that did not succeed, are working-students, which had some difficulty attending to classes.

The data collected allowed analysing different dimensions of the teaching-learning process, which includes: the content relevancy, the acquisition of knowledge, the contribution towards motivation, the difficulties in adapting to the pedagogical strategy, and the assessment process (Table 2).

Table 2
Student opinion concerning the pedagogical strategy

	Gamification		**IBL**	
	mean	**sd**	**mean**	**sd**
The pedagogical content was relevant to my learning process	3.76	0.75	4.20	0.60
The work was relevant to the acquisition of new knowledge	4.06	0.66	4.30	0.66
The contribution to motivation and learning success	3.94	0.85	4.26	0.44
Understanding the process	3.29	0.92	2.76	0.84

Interpreting the information on the pedagogical material	3.00	0.87	2.70	0.84
Relation with the colleagues	2.59	1.06	2.64	1.12
Autonomy in researching	3.00	0.94	2.53	1.17
Group work	2.94	1.43	2.71	1.03
The evaluation system is adequate to this UC	4.00	0.71		
Management of the inter group work			2.67	1.03

Source: Own elaboration

Students find the contents, in both subjects, very relevant to the learning process (3.76 – Gamification and 4.20 – IBL). They consider that the strategies were very relevant to the acquisition of new knowledge (4.06 – Gamification and 4.30 – IBL). They also feel that the strategies contribute to higher motivation (3.94 – Gamification and 4.26 – IBL).

Students identify some difficulties related to the implementation of the pedagogical strategies. They had some difficulties in understanding the whole process (3.29 – Gamification and 2.76 – IBL) as well as interpreting the information provided by the teacher in the pedagogical material (3.00 – Gamification and 2.70 – IBL).

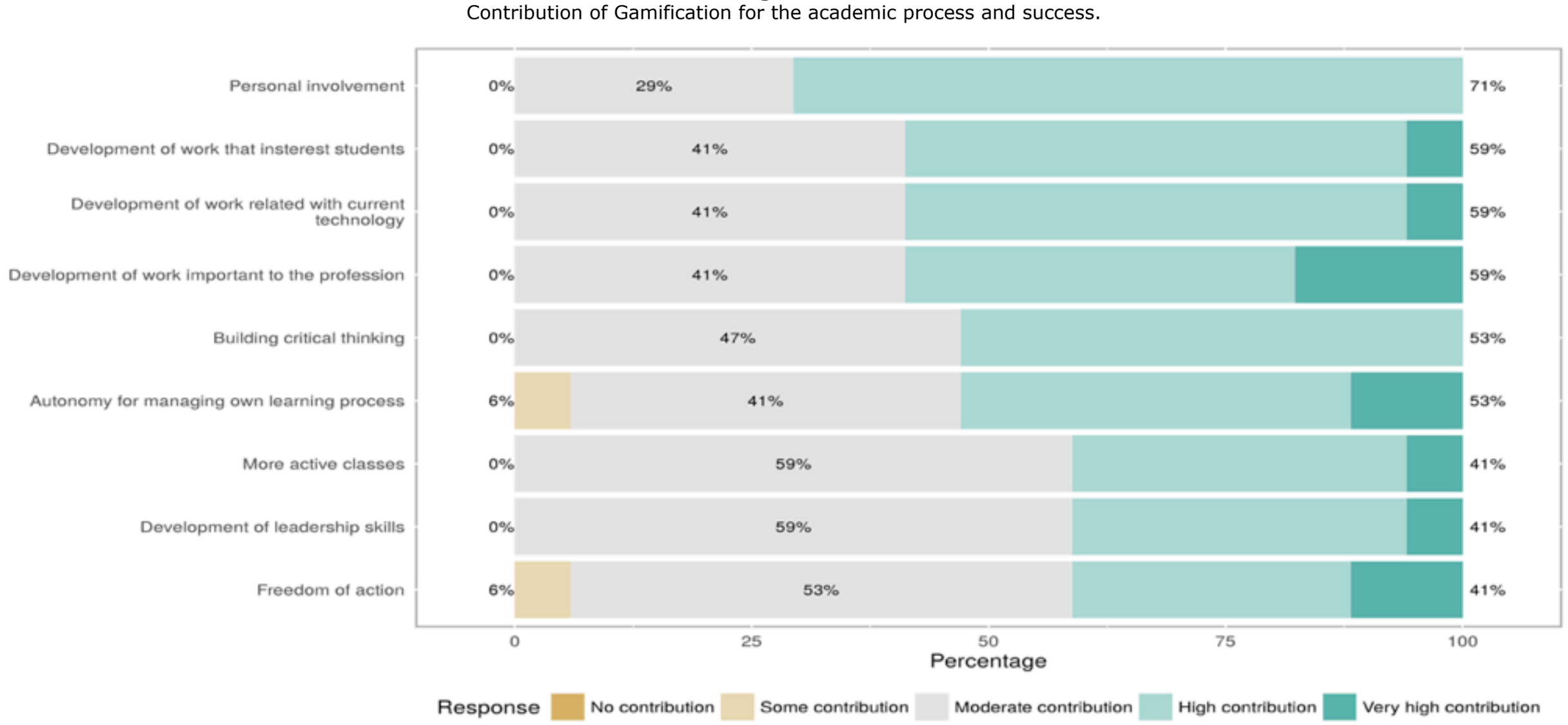
These strategies demand active participation of students, autonomous work, and a higher degree of interactivity with peers. They felt difficulties in the relation with colleagues (2.59 – Gamification and 2.64 – IBL) and group work (2.94 – Gamification and 2.71 – IBL), as well as being autonomous in the learning process (3.00 – Gamification and 2.53 – IBL). Moreover, in the IBL case, students had to manage interaction with several groups, forcing them to work with colleagues that they were not used to work with (2.67).

Although there was no formal question related to the evaluation in the IBL questionnaire, students felt comfortable, considering that the system was fair and appealing to their participation in the global assessment. In the Gamification case, students felt the assessment system very adequate (4.00).

Attending to the specificities of the Gamification and IBL strategies, the data was analysed separately, in three categories: contribution of the learning experiences in the academic process and success, development of higher-order thinking skills, and satisfaction with the teacher performance. Each response was scaled in five levels, with a Likert scale, and the questions were sorted descending with the most favourable first.

Considering the contribution of the learning experiences in the academic process and success, the students in the Gamification gave the highest value to the personal involvement the learning experiences required (Figure 4). They also recognize that Gamification contributes to the development of work that interest them, as well as work related with the current technology and that is important to their future profession.

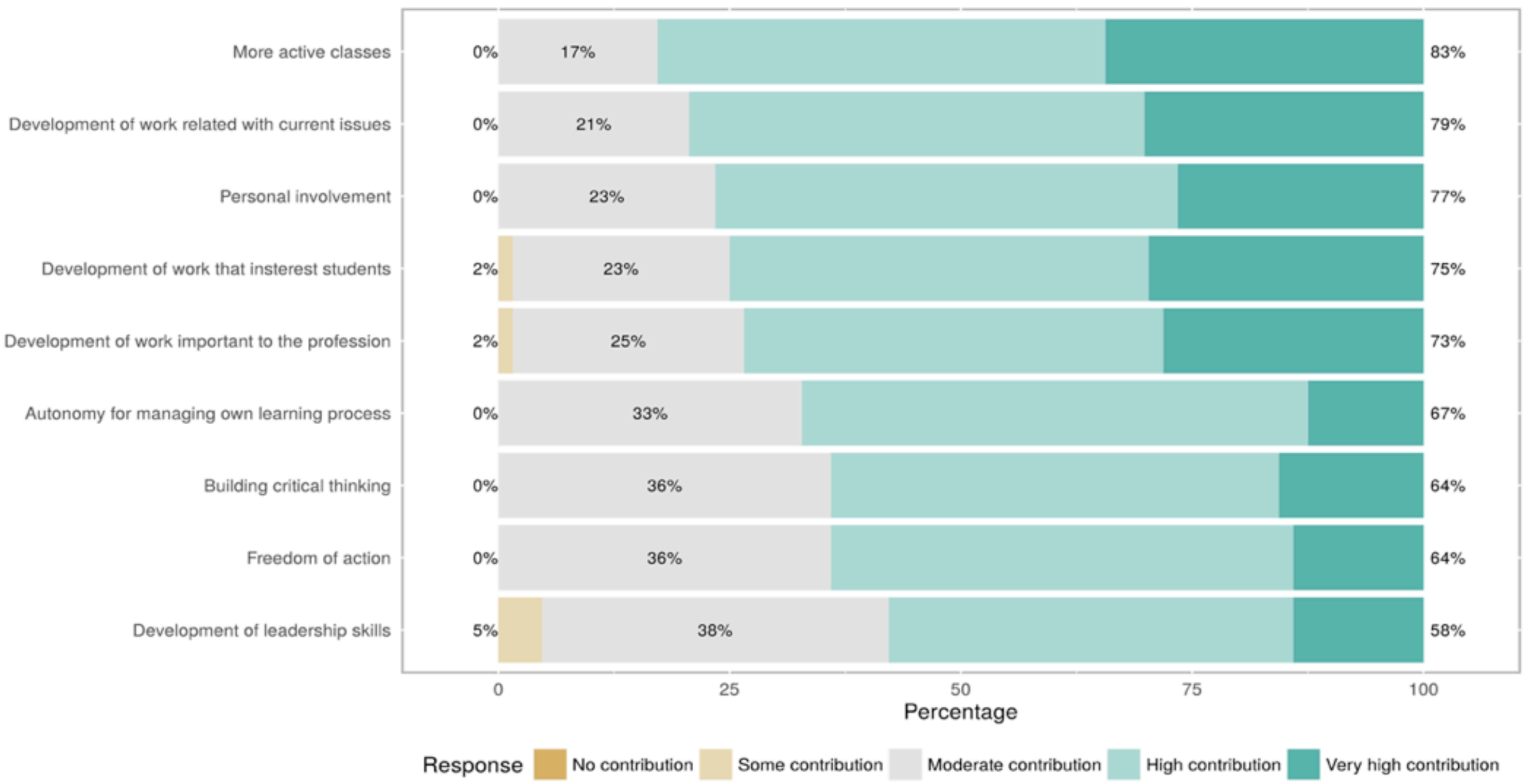
Figure 4
Contribution of Gamification for the academic process and success.



However, they consider the contribute of Gamification for developing of critical thinking and for the development of autonomy on managing their learning process moderate. Regarding the nature of the classes, they think that gamification does not make the learning environment more active and do not give them more freedom of action. Gamification, as it was structured in this scenario, appeals to autonomous and personal work. Although involving group and interaction between peers, the learning experiences favoured teamwork with shared responsibilities, not contributing to the development of leadership skills, as confirmed by the students' opinion.

In the IBL case, students recognize that it relies heavily on active classes, demanding strong personal involvement (Figure 5). They assume that IBL allows them to work with current issues, relevant to their future profession, and that interest them.

Figure 5
Contribution of IBL for the academic process and success.

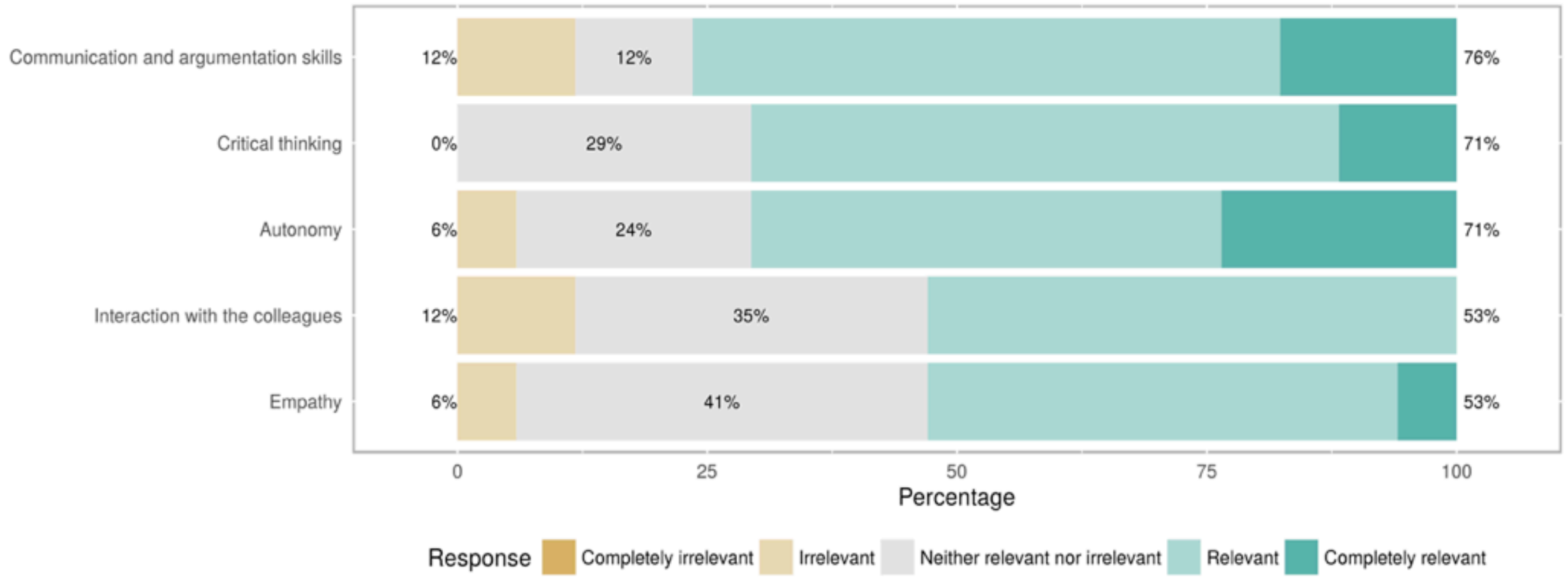


The issues that were researched and discussed in class between all the groups, allowed them to reflect about different points of view, building critical thinking, autonomy, and managing their learning process, without compromising their freedom of action. However, although the process requires them to manage the work with other groups, they do not feel that they have developed leadership skills.

The development of higher-order thinking skills happen simultaneously with the development of the cognitive skills. Considering the characteristics of the subjects and the degrees (Informatics Engineering for Gamification and Social Work for IBL), as well as the learning experiences designed within the pedagogical strategies, five skills were considered: communication and argumentation, critical thinking, autonomy, interpersonal relationships and empathy. Each of the skills was sorted according to the importance attributed by the students, from the most important to the least.

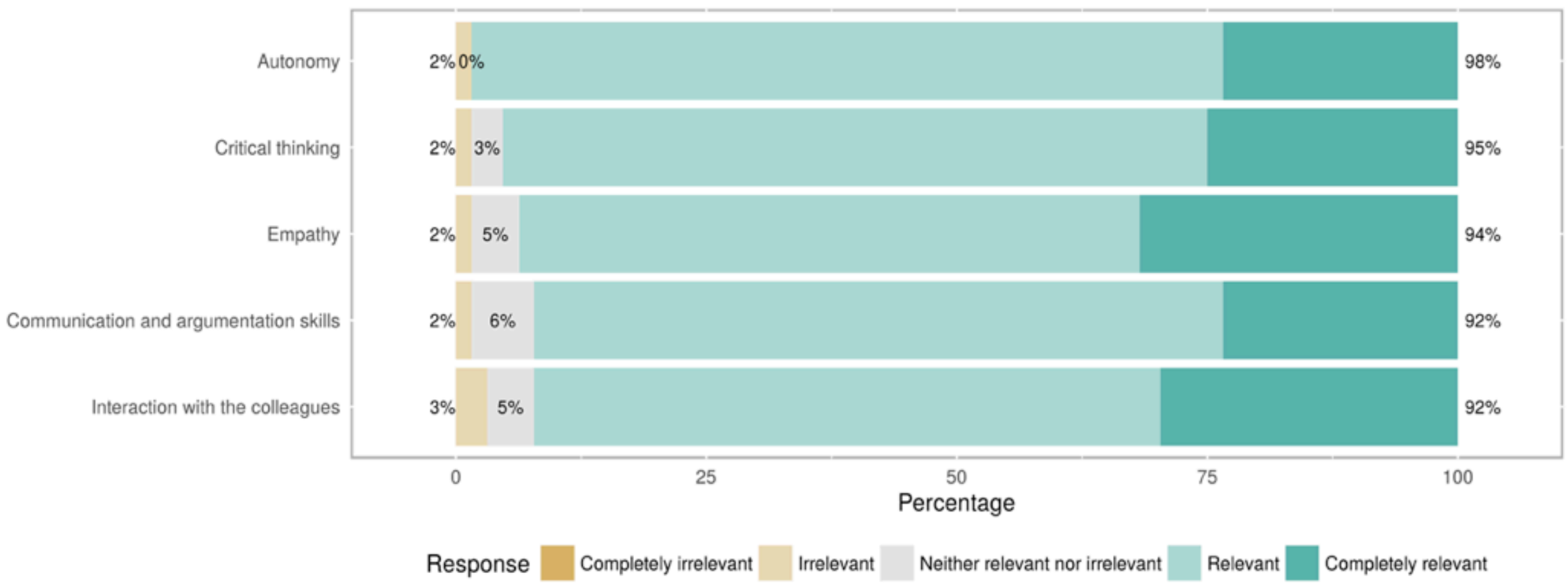
The Informatics Engineering students considered that Gamification contributed, in the highest degree, for the development of their communication and argumentation skills, immediately followed by the development of their critical thinking and autonomy (Figure 6). They valued moderately the work and the interaction with colleagues as well as the empathy, confirming that they believe the work could be more comfortable if more self-centered.

Figure 6
Gamification for the development of higher-order skills.



The Social Work students, involved in the IBL approach, have a very positive and strong feeling regarding all five skills (Figure 7). They strongly feel that IBL is a strategy that contributes to the development of their autonomy, critical thinking and sense of empathy. This is very meaningful, because all of these competences are very important for the professional profile of the Social Worker. Previously, students mentioned some difficulties managing the group work and interaction with their peers. Maybe because of that, although still with a very high percentage, the interaction with the colleague is the least valued competence, with the same percentage of the communication and argumentation skills development.

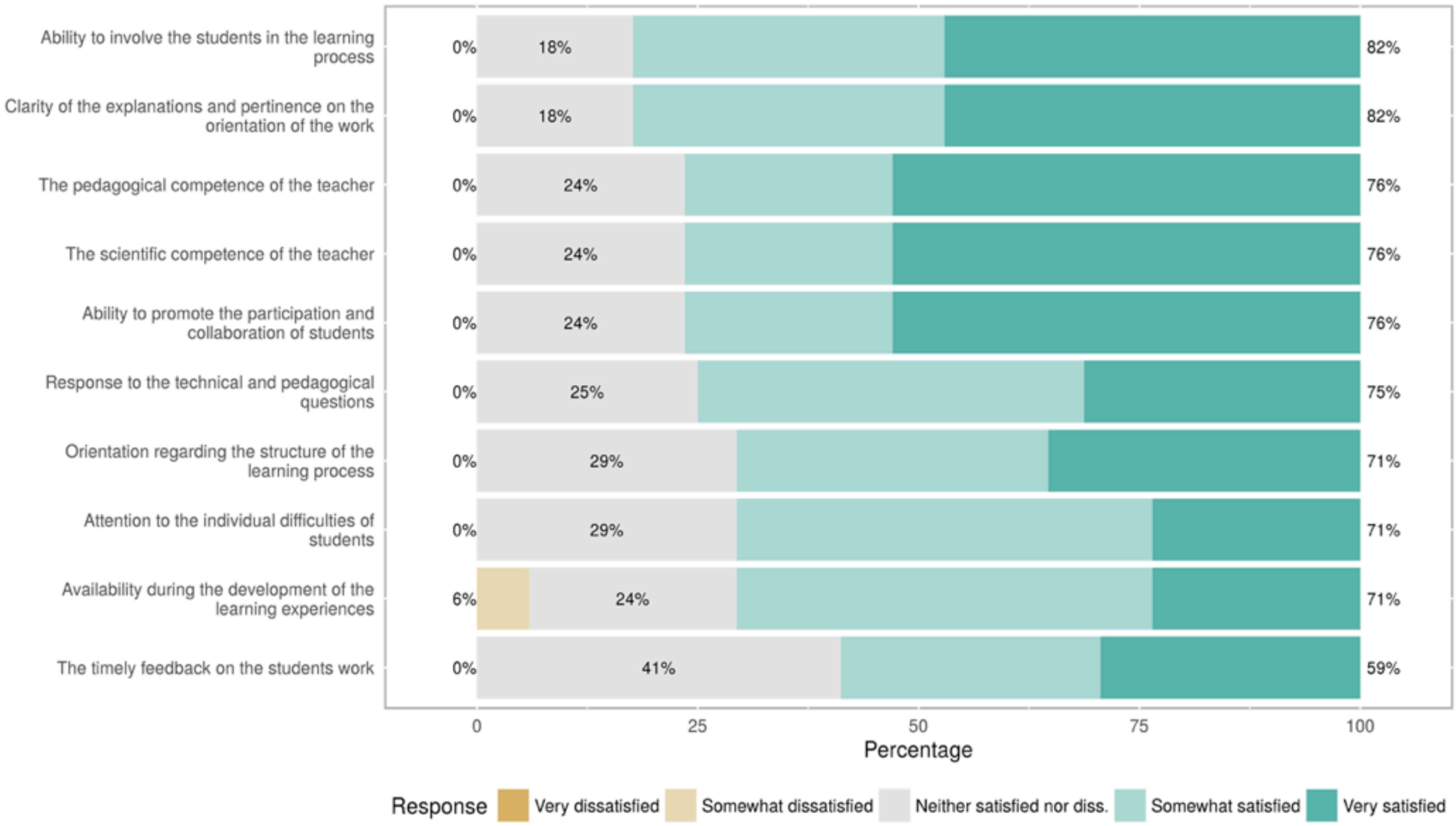
Figure 7
IBL for the development of higher-order skills.



The implementation of an innovative pedagogical strategy, such as Gamification or IBL, require the teacher to be aware of the students' difficulties, questions and doubts. There is an urge in both knowing the students, all the aspects involved in the learning experience and to get a detailed understanding of the complexity of the whole process. It is necessary to have a solid scientific and pedagogical knowledge, to be self-confident and to lead the students through all the questions and hesitations they have. For this, it is necessary to find answers and solutions to all possible situations, as well as having the courage to face new ones. Before adopting, in class, the new strategy, it is necessary to go through a detailed research procedure, that involves studying and reflecting on several subjects and areas, reading and analysing several reference papers and studies and define an evaluation methodology, to measure the impact of the teacher action. It is important to get the students' opinion concerning the teacher attitude, competence and confidence on the whole process and how does it contribute to their learning process.

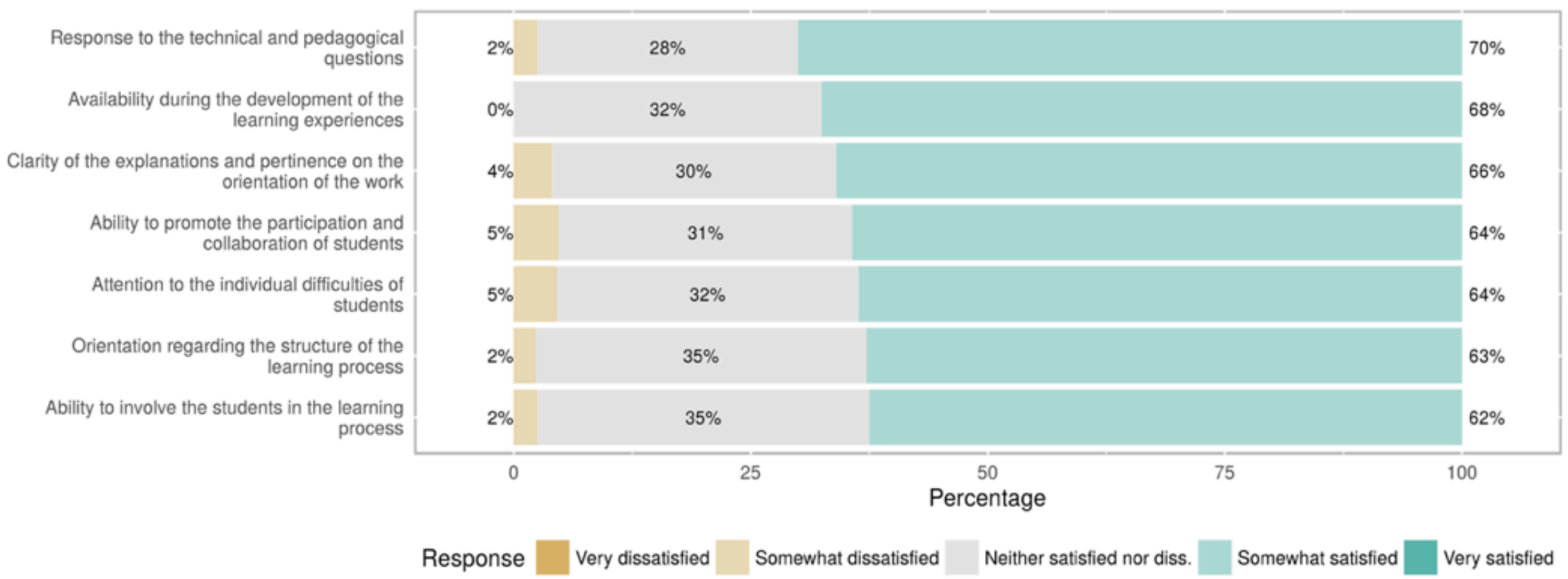
In the Gamification approach, students recognize the ability of the teacher to involve students in the learning process (Figure 8). They also recognize solid knowledge of the whole process and strong pedagogical and scientific competence. They also think the teacher is able to promote participation and collaboration between students and to pay attention to individual difficulties students have. It seems that students feel that the feedback on their work, although timely and up-to-date, can be improved. Confirmed by the scientific literature, students find the constant and update feedback on of the most important aspect of the learning process, thus demanding more from the teacher.

Figure 8
Satisfaction with the teacher performance in Gamification.



In the IBL scenario, students also recognize the solid knowledge of the pedagogical strategy and the ability the teacher has in answering their questions during the development of the pedagogical experience (Figure 9). They also think that the teacher has a strong pedagogical and scientific knowledge, giving clear and thorough explanations and orienting adequately the students' work.

Figure 9
Satisfaction with the teacher performance in IBL.



In a class with 75 students, it is difficult to attend to all individual difficulties and needs. They also feel that the orientation of the learning process as well as the ability to involve students could be better.

5. Conclusions

One of the missions of HEI is to train people at a higher level, so that society can benefit from the set of skills that graduates have. Of these, higher-order thinking skills are fundamental, both for the development of responsible, creative, efficient, adaptive, and autonomous professionals, and for socially aware citizens. Pedagogy in higher education should promote the development of more than just technical or cognitive skills. The structure and strategies in class should be designed to help students to make connections between the scientific and technical knowledge and the importance that this development have for societies.

This work describes the impact that the application of two learner-centre pedagogical strategies had for the development of higher-order thinking skills. They were applied in two different subjects of two different degrees.

Students recognize that both IBL and Gamification are teaching-learning strategies that effectively contribute to the construction of new knowledge and to maintain high degrees of motivation. They recognize that what they learned and the way they did it, meet the professional profile they seek.

As confirmed by the interviews performed in the beginning of the implementation of these strategies, the teaching model experienced by students, since they enroll in higher education, is, essentially, teacher-center. They work, almost exclusively, to pass the subject, in a summative assessment model (Lopes & Mesquita, 2016). Since they are not used to these strategies, they had some difficulties to understand their complexity, to adopt a different work methodology, to adapt to a more active and demanding role, and to interact with the colleagues. However, the results highlight that these pedagogical strategies engage students to be active learners, because they feel jointly responsible for the development of the learning experiences.

It should be noted that most of the students considered that the learning experiences contributed to the development of HOTS. However, students had some difficulty dealing with the communication and argumentation skills. This can result from the lack of scientific vocabulary and too much influence from the others opinion, lacking reflection on the words of the authors and sources they read, resulting in weaker argumentative positions. This is an aspect that must be improved.

The role of the teacher is fundamental both for the design of the whole process and for the monitoring and guidance of the students. Students recognize the importance of the teacher’s pedagogical and scientific knowledge. In this type of strategies, the participation and involvement of students demand a constant and up-to-date feedback. This is one of the aspects that has to be improved, according to the students’ opinion. This is conditioned by the number of students in class.

This study results in a challenge for the future. We feel that the development of HOTS depends on the quality of the teachers’ action. Moreover, we believe that the isolated development of learning strategies in a single subject of a degree may not be sufficient to get more than technical and cognitive skills. The connectedness between subjects and areas will be necessary to reward commitment to quality on teaching and learning processes.

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