



The interdisciplinary design work through collaborative and project-based learning

La interdiscipliniedad del diseño mediante el aprendizaje colaborativo y basado en proyectos

Juan Ernesto Alejandro Olivares Gallo
FIRST AUTHOR
CONCEPTUALIZATION - PROJECT
ADMINISTRATION - SUPERVISION - VALIDATION
VISUALIZATION - WRITING AND REVIEW
juan.ogallo@academicos.udg.mx
University of Guadalajara
Guadalajara, Jalisco, Mexico
ORCID: 0000-0002-5448-8019

Mariana Noemi Campos Barragan
SECOND AUTHOR
CONCEPTUALIZATION - PROJECT
ADMINISTRATION - SUPERVISION - VALIDATION
VISUALIZATION - WRITING AND REVIEW
mariana.campos@academicos.udg.mx
University of Guadalajara
Guadalajara, Jalisco, Mexico
ORCID: 0000-0001-7097-3690

Eva Guadalupe Osuna Ruiz
THIRD AND CORRESPONDING AUTHOR
CONCEPTUALIZATION - PROJECT
ADMINISTRATION - SUPERVISION - VALIDATION
VISUALIZATION - WRITING AND REVIEW
guadalupe.osuna@academicos.udg.mx
University of Guadalajara
Guadalajara, Jalisco, Mexico
ORCID: 0000-0001-7944-439X

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Abstract

This research aims to promote and develop skills and strategies for managing, locating, searching and evaluating information, to take students to a closer insight of their own experiences in the construction of knowledge, based on an interdisciplinary project through project-based learning and collaborative learning. It was held at the University Center of Art, Architecture and Design of the University of Guadalajara with students from the Graphic Communication Design, Industrial Design and Design, Art and Interactive Technologies majors. It was carried out through applied research with a quasi-experimental method, because groups from the three before mentioned careers participated, and the participants were not randomly selected due to the previously made groups. The findings and reflections are related to the application of theoretical knowledge and technical skills of each discipline to carry out complex projects. The learning of the students allowed them to collaborate and participate with experiences beyond their disciplinary field, and led them to understand that it is convenient to share scenarios in the development of interdisciplinary projects during their professional activity.

Keywords: interdisciplinary, design, project-based learning, collaborative learning

Resumen

Esta investigación tiene como objetivo fomentar y desarrollar habilidades y estrategias de gestión, localización, búsqueda y evaluación de información, para acercar a los estudiantes a la reflexión de sus propias experiencias en la construcción del conocimiento, a partir de un proyecto interdisciplinario mediante el aprendizaje basado en proyectos y el aprendizaje colaborativo. Se llevó a cabo en el Centro Universitario de Arte, Arquitectura y Diseño de la Universidad de Guadalajara con estudiantes de las carreras de Diseño para la Comunicación Gráfica, Diseño Industrial y Diseño, Arte y Tecnologías Interactivas. Se realizó a través de una investigación aplicada con un método cuasiexperimental, debido a que participaron grupos de las tres carreras antes referidas, y los participantes no fueron seleccionados aleatoriamente porque los grupos ya estaban conformados. Los hallazgos y reflexiones se relacionan con la aplicación de conocimientos teóricos y habilidades técnicas de cada disciplina para realizar proyectos complejos; el aprendizaje de los alumnos les permitió colaborar y participar con experiencias más allá de su campo disciplinar, y los llevó a comprender que es conveniente compartir escenarios en el desarrollo de proyectos interdisciplinarios durante su actividad profesional.

Palabras clave: interdisciplina, diseño, aprendizaje basado en proyectos, aprendizaje colaborativo

◆ Introduction

This pedagogical innovation experience describes the implementation and results obtained from an interdisciplinary project in which two strategies are used: project-based learning (PBL) and collaborative learning, with the participation of students with a basic and intermediate level of studies of three design majors: Design for Graphic Communication, Industrial Design and Design, Art and Interactive Technologies, which are offered at the University Center of Art, Architecture and Design, of the University of Guadalajara. The objective of this research was to promote and develop skills and strategies for managing, locating, searching and evaluating information to take students to a closer insight of their own experiences in the construction of knowledge, based on the interdisciplinary project.

With PBL, optimal interactions between teachers and students are encouraged, facilitating the teaching-learning process, with previous and current knowledge. In addition, the student acquires different skills, among which are market identification, project management, as well as the design and development of a product from meeting design needs, up until reaching the final development.

◆ Interdisciplinary work

Interdisciplinary work is presented as a new perspective of knowledge. Although it considers the disciplines per se, it also encourages integration between them through constant intercommunication, thus generating collective knowledge (Pazmino, 2021). Interdisciplinary training in design involves actions that seek the integration of knowledge and approaches from different disciplines to address complex problems and develop innovative solutions, which requires an open mindset and a willingness to work collaboratively with people from different disciplines and perspectives.

In a complementary way, Tresserras (2015) points out that “interdisciplinarity in design is structured in three levels of action: the conceptualizing

level, the projective level and the operational level. Variables may occur depending on the design typology” (p. 7).

On the other hand, Ringvold and Nielsen (2021) mention that the construction of future scenarios as part of a design school project can function as an interdisciplinary learning process and framework that allows gaining perspectives and knowledge that contribute to the capacity of students to better see the consequences and understand the complexity of the problems.

In the field of design disciplines, it can be understood that with collaborative relationships work is achieved with other related disciplines, such as, in this case, graphic design, industrial design and design in interactive technologies. In addition, other areas of knowledge could be considered. This collaboration allows different perspectives and knowledge to be combined in order to address design challenges from multiple angles.

In this sense, the interdisciplinary approach in design, as part of the social sciences, allows the generation of new knowledge regarding specific didactics based on adult teaching criteria, which, up to date, has been little documented. This provides the opportunity to build new narratives that favor, on the one hand, teaching development and, on the other, the opening of broad horizons in the thinking of the student.

With the participation of students from different disciplines, different perspectives contribute to the interdisciplinary problem or project. This can enrich the discussion and the generation of ideas, allowing a more complete and comprehensive analysis of the topic. However, interdisciplinary work can present various challenges that must be addressed to achieve effective collaboration.

On the other hand, in interdisciplinary work, the role of the teacher is to foster the curiosity of the students constantly, with the aim of problematizing the context and exposing the knowledge requirements of other disciplines to provoke inquiry and the development of other more knowledge beyond the classroom (Pazmino, 2021).

Project-based learning

Project-based learning is an educational methodology that focuses on the development of skills and competencies through the completion of projects. In design, project-based learning can be a very effective tool for teaching practical skills and encouraging creativity. On the other hand, “in project-based learning, interdisciplinary, long-term, and student-centered learning activities are developed” (Challenge 2000 Multimedia Project, 1999, as cited in Estrada, 2012, p. 128).

To carry out this research work, we start from project-based learning which, as established by Harel and Papert (1991) --in the field of education and technology, is related to the idea that learning is more effective when Students are actively involved in the construction of tangible artifacts, in accordance with the theory of constructivism developed by them.

On the other hand, Dewey (2004) considers project-based learning as an educational approach focused on experience and action, establishing that learning through problem-solving and project execution is fundamental for its development and approach to productive life at the end of their training, and that involves the active participation of the student.

Alternatively, to address learning, we consider what Sánchez Martínez and Ruvalcaba Ledezma (2023) point out about how project-based learning “invites students to become protagonists of their own learning by developing projects that respond to real-life problems, it is even more participatory than traditional methods and helps students develop meaningful learning” (p. 46). On the other hand, Portal Innovacion Educativa (2017), as cited in Sánchez Martínez and Ruvalcaba Ledezma (2023), mentions that project-based learning is carried out through the following three stages:

1. Project planning: The learning objectives, contents and skills to be developed are proposed. Information is collected and based on an initial question a schedule of activities is proposed.
2. Preparation and development of the project based on available resources (research).
3. Project evaluation: Assess the process, product and reflection on learning. (p.1)

Collaborative learning

Collaborative learning has become an essential pedagogical approach in higher education, as it recognizes the importance of social interaction and teamwork in the knowledge acquisition process. Various theorists have contributed to the understanding of how collaboration can enrich the educational experience, from the socio-constructivist approach of Vygotsky (2012) to the community of practice theories of Lave and Wenger (1991).

This type of learning offers several significant advantages both for students and for the educational process in general. Based on coordinated and joint actions, students must analyze information, evaluate arguments and make informed decisions. Teamwork and collaboration foster effective communication, conflict resolution, negotiation,

and cooperation skills. With this, students become active participants in their own learning process, favoring active learning, which also promotes critical thinking and problem solving.

Vygotsky (2012) introduced the concept of the zone of proximal development, which highlights the gap between the skills a student can achieve independently and those they can achieve with the help of a more competent peer; idea that highlights the importance of social interaction and collaboration in the learning process, where students can raise their level of knowledge with the help of their peers. While Jean Lave and Etienne Wenger (1991) developed the theory of community of practice, which emphasizes how learning is a social activity that occurs in communities of people with shared goals and knowledge. This perspective highlights how collaboration in these communities promotes the joint construction of knowledge. In the context of higher education, this theory highlights the importance of fostering environments where students can actively participate in creating knowledge through collaboration.

Collaborative learning in higher education is based on a solid theoretical foundation provided by prominent pedagogues, such as Vygotsky (2012), Lave and Wenger (1991), and Kolb (1984). These theorists have highlighted the importance of social interaction, the joint construction of knowledge and practical application in the educational process. By incorporating these approaches into course planning and pedagogical growth strategies, higher education institutions can cultivate rich learning environments that promote collaboration and student academic and personal learning.

Without a doubt, an important part of collaborative learning is promoting the development of reflective practices. According to Schön (1987), learning by doing is essential for professional development, since professionals who practice constant reflection are more likely to improve their skills and make more informed decisions over time. In this same sense, to strengthen this learning model, dialogue can be induced, which makes it possible to help students clarify their thinking and develop a deeper understanding of the problems they face; This dialogue generates learning synergies from the collaboration of students from different careers who collaborate in solving the project.

Method This work was carried out through applied research with a quasi-experimental method, because groups from three different majors participated (Design for Graphic Communication, Industrial Design and Design, Art and Interactive Technologies) from the University Center of Art, Architecture and Design, from the University of Guadalajara, in which

the participants were not randomly selected due to the previously made groups.

A total of 79 students participated, as follows: 34 were from the Graphic Communication Design major, from the Design Projects II and Digital Graphic Expression subjects; 9 of the Industrial Design degree, in the subject of Design of Urban Elements; and 36 of the Design, Art and Interactive Technologies degree, in the subjects of Basic Elements for Modeling and Digital Product Modeling. These educational programs were selected because the academics who develop the line of generation and application of knowledge related to interdisciplinary work influence these careers. It is worth mentioning that the participating students belong to the initial and intermediate levels of study.

The participating students, together, contributed collaboratively to the development of the project called "Interdisciplinary studies of design in higher education", based on a practical project titled "Thematic amusement park", in which through their field discipline provided: a) a graphic proposal, name and theme of the amusement park, and b) a furniture and product proposal. This second proposal was developed from a representation technique, based on the conceptual proposal provided by the Graphic Communication Design students, as well as the modeling of the furniture provided by the Design, Art and Interactive Technologies students.

Likewise, teachers with suitable profiles and sufficient experience participated in this interdisciplinary project, as described below:

One of the teachers has experience in the area of 3D animation and digital post-production, and has been a teacher for 14 years. Currently, it is one of the main actors in the development of the career and learning units in Design, Art and Interactive Technologies. He is trained as a Graphic Communication Designer and has specialized in the management of technologies applied in communication projects.

Similarly, a professional in industrial design participated, with extensive experience in knowledge, application and manipulation of materials for the development of innovative processes in product design, who is also an expert in teaching-learning processes in the higher education and has 33 years of group work. He has managed to identify the needs in each of the stages of his teaching work, adapting to generational changes and the use of technologies inside and outside the classrooms. He led the design of the study plans for the degrees in Industrial Design, Design for Graphic Communication and Design, Art and Interactive Technologies.

In addition, two teachers participated in the Graphic Communication Design program, both are professionals in graphic communication processes and have a specialization in the development of graphic messages and argumentative processes, with a user-centered design approach.

With teaching experience of more than a decade, they have actively participated in the design of learning units and have academic pedagogical training, in which they have carried out research and significant contributions to the higher education institution in which they work.

The research implemented project-based learning and collaborative learning in an interdisciplinary project, through the following eight phases:

Phase 1. Identification of the research problem and participants: the research problem was identified in which the need to understand the impact of project-based learning, collaborative learning, as well as the active participation of students in the development of a design project.

Phase 2. Selected study groups: Five groups were selected from the three different educational programs.

Phase 3. Definition of key concepts: key concepts were defined, such as interdisciplinary work, project-based learning and collaborative learning.

Phase 4. Initial data collection: Before implementing the project, initial data on students' academic performance, participation and perceptions, in relation to the current educational approach, were collected.

Phase 5. Implementation of the treatment: the project called "Interdisciplinary design studies in higher education" was presented, based on project-based learning and collaborative learning, where students from the three educational programs worked cooperatively on the development of the practical design project, entitled "Themed amusement park".

Phase 6. Data Collection and Analysis: After project implementation, data on student learning, engagement, perception, and collaboration were collected. These data were obtained by applying a questionnaire, which was designed with closed multiple choice questions and with the possibility of expanding the answer through the other item. The technique used was the survey applied through a Google Form. The data collected was analyzed to identify patterns, trends, and differences between student groups.

Phase 7. Interpretation of results: the results were interpreted based on the objective of this research, which was to promote and develop skills and strategies for management, location, search and evaluation of information, to bring students closer to reflecting on their own experiences. , in the construction of

knowledge, based on the interdisciplinary project. The implementation of project-based learning and collaborative learning was evaluated to understand the impact of learning on students.

Phase 8. Conclusions and communication of results: the conclusions of the study were presented, highlighting the observed effects of project-based learning and collaborative learning.

Results There were 79 students participating in the project called “Interdisciplinary design studies in higher education”, based on a practical project titled “Themed amusement park”. On the other hand, 43 students responded to the survey applied through the Google Form, of which 21 correspond to the Graphic Communication Design major, 19 to Design, Art and Interactive Technologies and 3 to Industrial Design. The following results were obtained:

Participating students according to the career

The participating students, according to their major, were: 48.8% from Design for Graphic Communication, 7% from Industrial Design and 44.2% from Design, Art and Interactive Technologies (see figure 1).

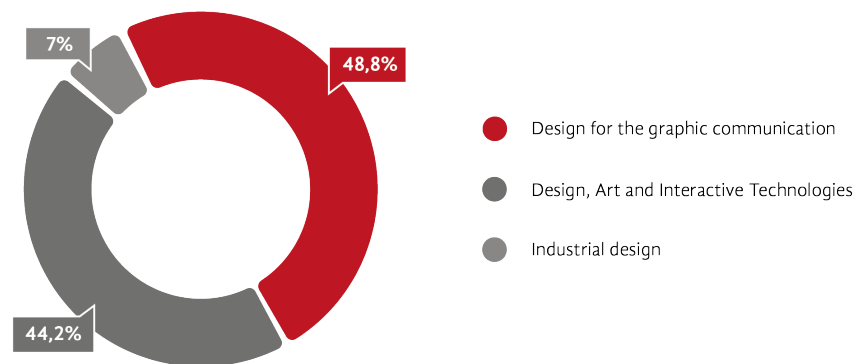


Figure 1. Participating students according to major. Source: self-made.

Learning strategies

When carrying out this interdisciplinary project, the type of learning strategy identified by the students, in which they selected more than one strategy, was the following: 58.1% recognized project-based learning, 55.8% indicated collaborative learning and, in a smaller percentage, 18.6% identified problem-based learning, as seen in figure 2.

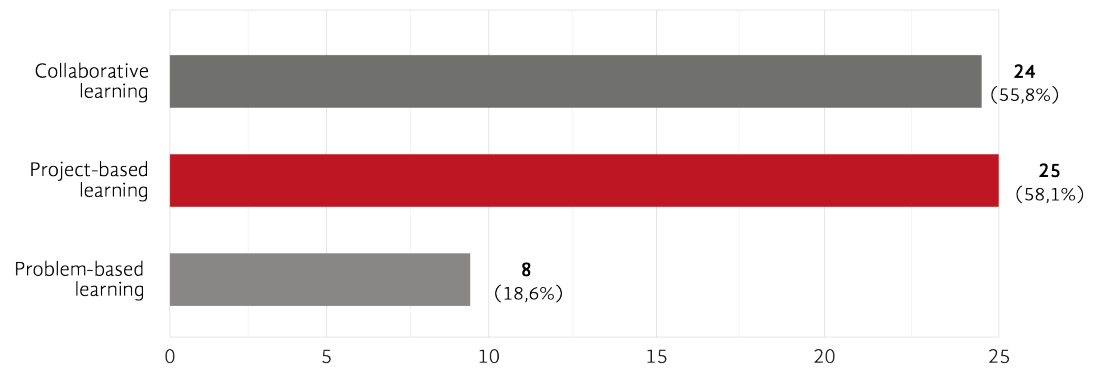


Figure 2. Learning strategies.
Source: self-made.

It can be highlighted that the students, in their responses, identified collaborative learning and project-based learning as two strategies that contributed to the completion of the interdisciplinary project.

Project based learning

To obtain the opinion of the students regarding their own experience when carrying out this type of projects through project-based learning, specifically in terms of how they think their learning was, a numerical value scale was established, where 5 corresponds a lot and 1 a little. It was observed that 51.2% selected 5, so their learning was significant; 37.2% chose 4, which means that the learning was sufficient; and 11.6% opted for number 3, which refers to having obtained moderately sufficient learning (see figure 3).

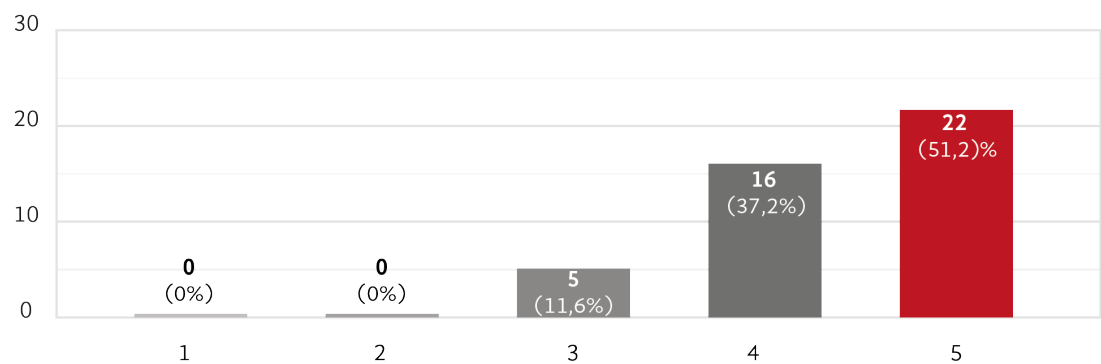


Figure 3. Project-based learning.
Source: self-made.

With the experience of a project developed through collaborative learning in interdisciplinary work groups, it was detected that half of

the students managed to learn significantly, and that another representative percentage mentioned that their learning was sufficient.

Learning obtained regarding collaborative work

It was relevant to know the level of learning obtained through collaborative work with colleagues from other disciplines. For this question, a numerical value scale was used, where 5 corresponds to a lot and 1 to a little. It stands out that 23.3% of the students mentioned that their learning was high, 46.5% of the students responded that their learning was notable, and 20.9% indicated that it was good. On the other hand, 4.7% indicated that it was regular and another 4.7% that it was very little (see figure 4).

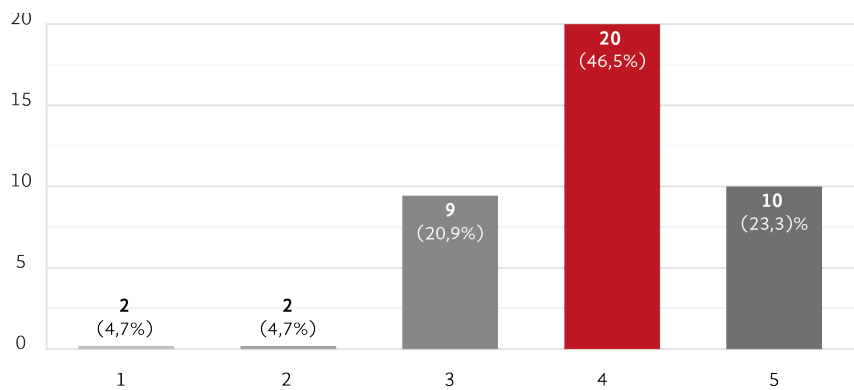


Figure 4. Learning obtained regarding collaborative work. Source: self-made.

The results obtained demonstrate the relevance of developing joint work skills, the organization of the members of the work groups to carry out the activities, as well as the control of learning mediated by themselves. Therefore, it is concluded that the students were co-responsible for their learning.

Perspective for the formation of work teams

Another aspect analyzed was the perspective for forming work teams and information on the way of working to carry out the project. For this, three values were used: adequate and sufficient, moderately adequate and sufficient, and inadequate and deficient; 62.8% responded that it was adequate and sufficient, while 37.2% thought it was moderately adequate and sufficient (see figure 5).

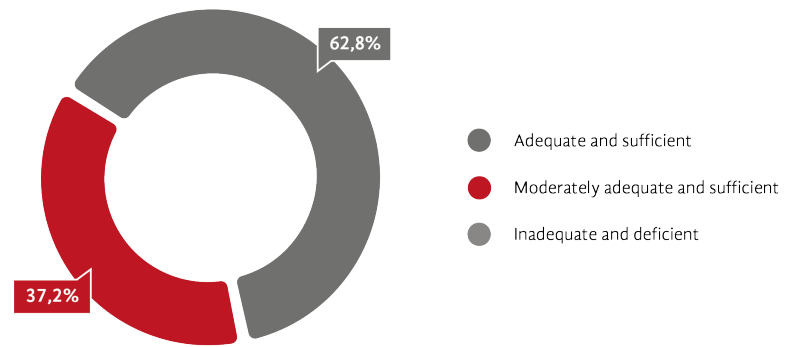


Figure 5. Perspective for team formation. Source: self-made.

One of the main problems of teamwork is the need to guarantee the formation of balanced work teams. Sometimes, teams tend to be formed organically by bonds of friendship and not by the skills that each individual could contribute in their respective work team, so it is necessary for teachers to establish strategies for the integration of work teams, to guide their adequate formation, and that it is possible to achieve the collective goals set.

Prior learning

To reaffirm the previous question, *prior learning* was evaluated, for this purpose it was asked if when reading and analyzing the manual made up of activities and instructions on conceptual learning, the students had understood it, if they had found it difficult to understand, and other. It was observed that 93.01% stated that they had understood the activities and instructions, while 2.33% found it difficult to understand the activities and instructions. In the other item there were two different responses: the first, equivalent to 2.33%, stated that there was no quality control of the materials delivered, some teams provided quite poor references; the second, which also corresponds to 2.33%, mentioned not remembering such a manual (see figure 6).

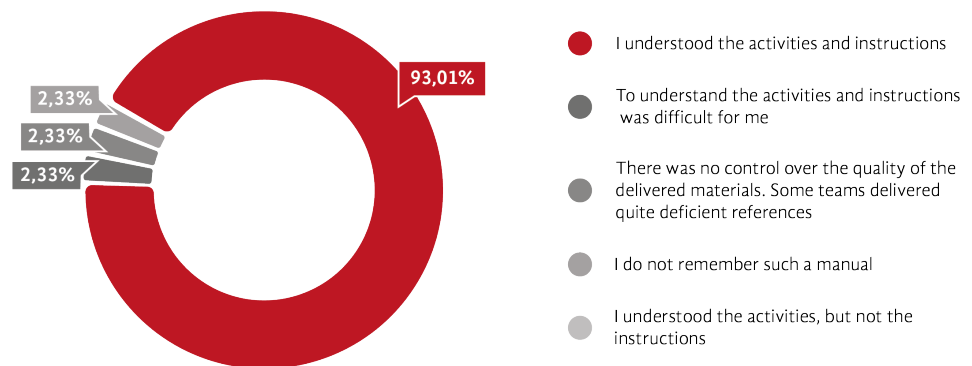


Figure 6. Prior learning. Source: self-made.

Communication between different work teams

In relation to the evaluation of communication between members of the different work teams, the students expressed that it was efficient with a percentage of 34.88%; while 32.56% stated that it was moderately efficient and 23.26% declared it sufficient. On the other hand, 4.65% indicated that it was average, and another 4.65% declared that it was poor (see figure 7).

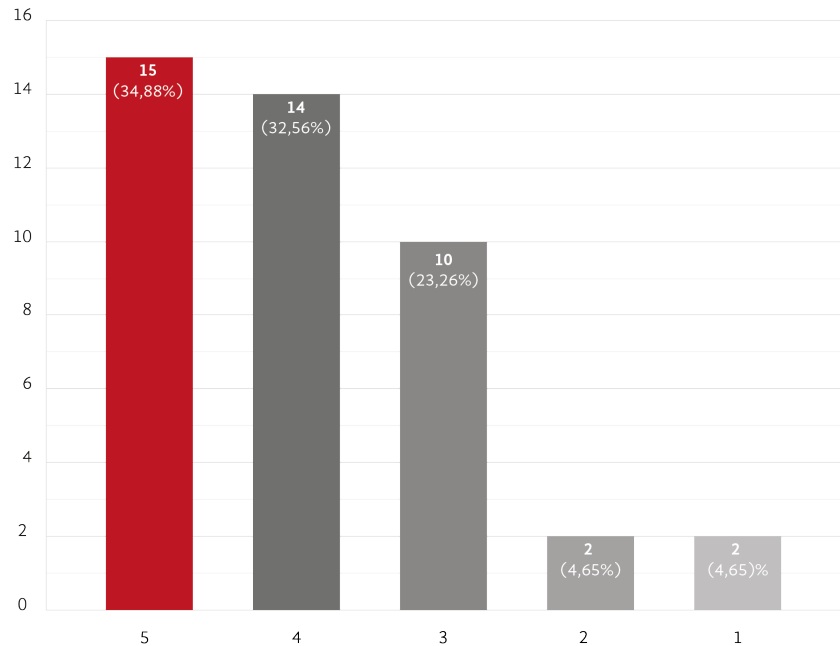


Figure 7. Communication between the different work teams. Source: self-made.

One of the main strategies in the development of collaborative projects and activities are the communication channels between the members of the work teams and between the teams themselves. It is important to establish communication policies between teams and members, as well as communication tools to be used. The person or persons responsible for this communication must pass the information on to the other members of the team, as well as confirm that it has been clear and understood by everyone.

Interpersonal relationship

On the other hand, the interpersonal relationship between the members of each of the work teams was valued by the students themselves, who were able to choose more than one response option. The following data were obtained: friendly (86%), cooperative (79.1%), reliable (53.5%), participatory (51.2%), satisfactory (46.5%), dialogue (32.6%), autonomous (25.6%), with procrastination (16.3%), individualistic

(9.3%), absent (7%), competitive (4.7%) and frustrating (4.7%) (see figure 8).

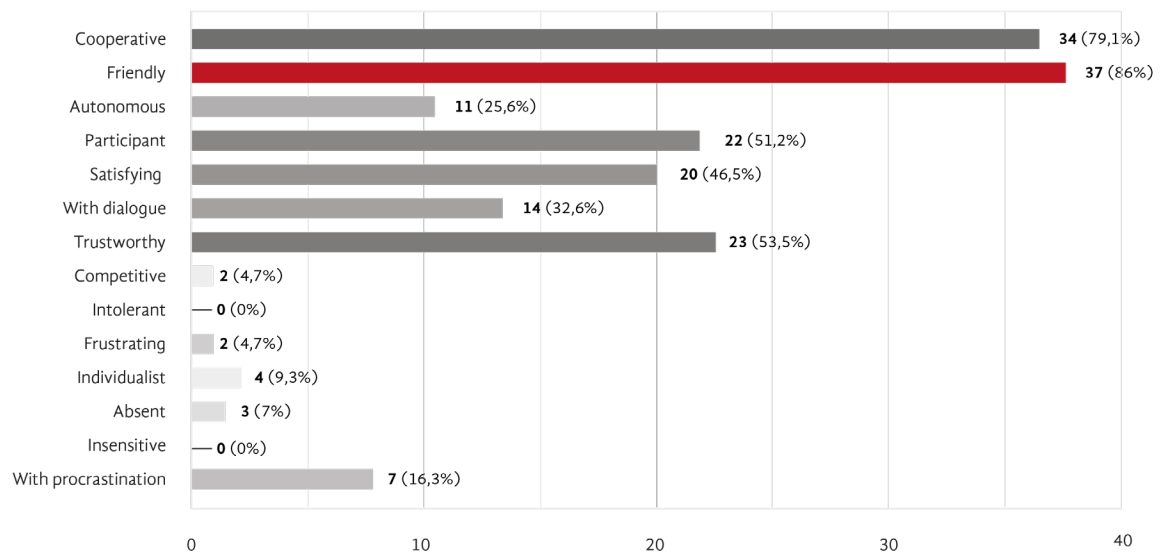


Figure 8. Interpersonal relationship. Source: self-made.

This type of activity presents important learning from experiences to interact with work teams and, based on this data, be able to organize balanced teams.

Communication between teams in relation to the terms applied between the three disciplines

Likewise, it was important to know how communication occurred between the teams based on the terminology applied in the different disciplines. In this regard, 81.4% mentioned that it was understandable; 16.3% responded that it was barely understandable and 2.3% said that it was difficult to understand (see figure 9).

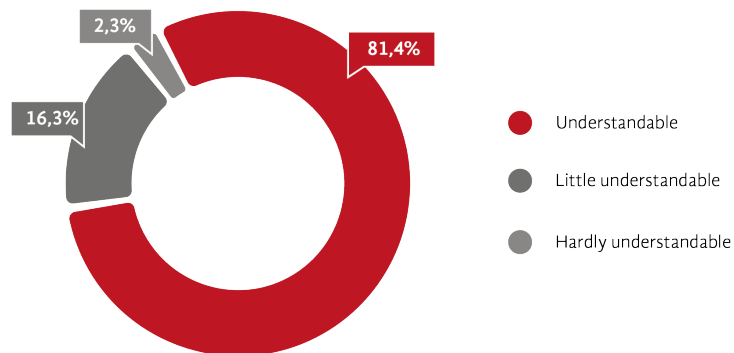


Figure 9. Communication between teams in relation to the terms applied between the three disciplines. Source: self-made.

According to these responses, it is evident that it is appropriate for team members to analyze, to the same extent, both the communication tools used and that have led to effective communication of the applied terminology, and the tools used (or not used) that resulted in little or difficult to understand communication of the mentioned terminology. The above, with the purpose of identifying the functional elements or, otherwise, those that generate communication failures, to implement adjustments to the work strategies that benefit the next generations.

Learning obtained in relation to the project items

Regarding the learning obtained in relation to the items of the project, based on what the teams of the different subjects observed, proposed and/or presented, the students mentioned two items in the highest percentage (62.8%): raising concepts and presenting the project; while the visualization importance item obtained 60.5%. On the other hand, the use of sketches (58.1%), materials (51.2%) and materials and dimensions (48.8%) was also important in their learning, as well as the use of specific software (41.9%) and finishes (39.5%) as seen in figure 10.

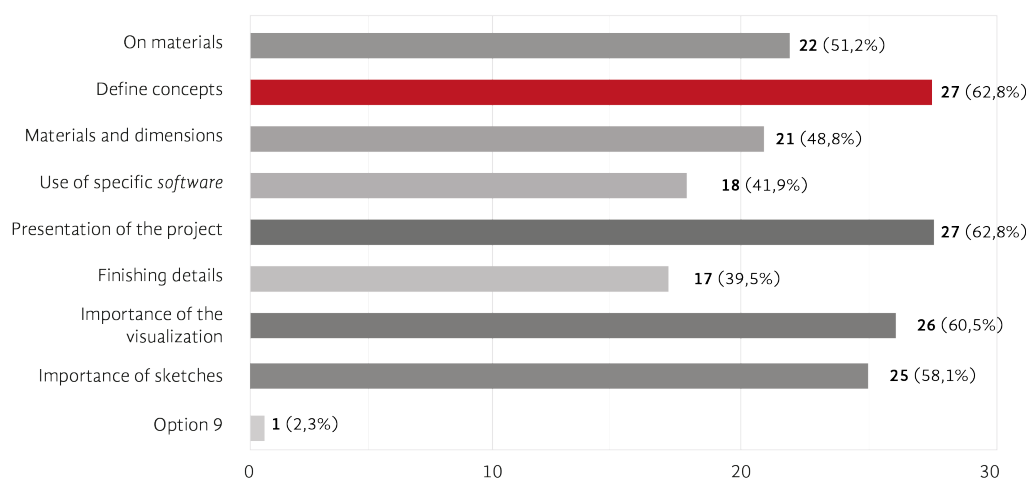


Figure 10. Learning in relation to the project items. Source: self-made.

Interdisciplinary learning

Finally, to assess the interdisciplinary learning experience based on what was presented by each of the teams from the other subjects, a numerical value scale was used, where 5 corresponds to substantial and 1 to not very substantial. The students' response was that 46.5% considered interdisciplinary learning to be substantial, 39.5% believed it to be moderately substantial, and 14% thought that interdisciplinary learning was good (see figure 11).

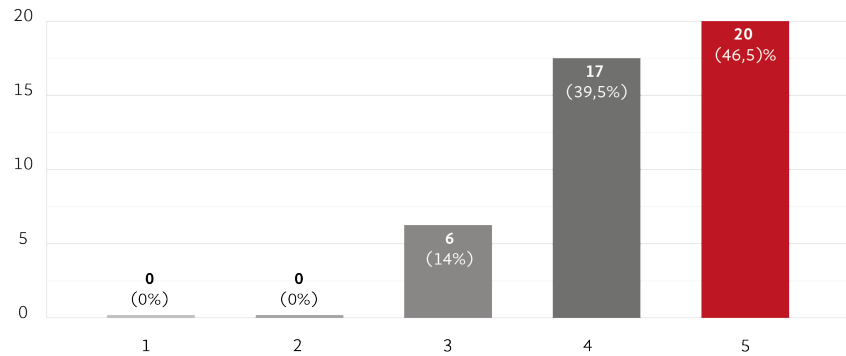


Figure 11. *Interdisciplinary learning.*
Source: *self-made.*

Interdisciplinary learning is comparable to the real relationship of work activities found in industry or other sectors of working life. Activities like these can help the student understand the importance and potential of more complex deliverables in interdisciplinary projects in relation to individualistic projects.

◆ Conclusions After the execution of the interdisciplinary project, and considering the premises of the use of learning strategies, such as project-based learning and collaborative learning, the following conclusions were found, which imply an improvement in the results obtained. These results are not only related to the design itself, but also to the skills, learning and collaboration between students. Some of the conclusions are:


- ◆ Practical application of knowledge: Students had the opportunity to apply the theoretical knowledge and technical skills acquired in their respective disciplines in a practical and real context. This can strengthen your understanding of how your areas of study relate to the real world.
- ◆ Development of collaboration skills: Interdisciplinary teamwork encourages collaboration and communication between students with different backgrounds. Students learned to communicate their ideas and understand others' perspectives, which is essential in professional situations.
- ◆ Holistic problem solving: When faced with a design problem that involves multiple perspectives, students learned to approach it holistically. This can lead to more complete and creative solutions that consider various characteristics of the problem.

- ❖ **Fostering creativity:** The diversity of approaches and perspectives of interdisciplinary students can stimulate creativity. Design challenges are approached from different angles, allowing for more innovative solutions.
- ❖ **Broadening horizons:** Students expanded their horizons beyond their primary discipline by learning about other areas and approaches. This motivates them to consider new directions for their own learning and future career.
- ❖ **Respect for diversity of opinions:** Working with students from different disciplines leads to greater tolerance and respect for different opinions and approaches. This can be valuable in a diverse and globalized world.
- ❖ **Self-directed learning:** Project-based learning promotes student autonomy. Students make decisions about how to approach the project and how to divide tasks among team members, encouraging self-directed learning.
- ❖ **Effective Presentation and Communication:** By presenting their projects to an interdisciplinary group, students develop strong presentation and communication skills, which is crucial in many professions.
- ❖ **Reflection on the learning process:** At the end of the project, students reflected on what they have learned, and how their teamwork has improved.

In summary, project-based learning and collaborative learning in design projects with interdisciplinary teams can lead to a number of positive conclusions that go beyond the outcome of mastering the content and design skills themselves. As Tresserras (2015) expresses it, “the current design incorporates a complexity, which forces within its process to efficiently organize the relationship between disciplines, to achieve the intended objective” (p. 9), so students must develop competencies for your personal and professional growth, as well as to address complex challenges from multiple perspectives and build a deeper appreciation of the complexity and interconnection of knowledge in the real world.

It is important to turn to classic authors, since they contain the bases for the subsequent generation of new theories that allow us to continue disseminating results and establishing derived positions in future research.

With respect to collaborative learning, we agree with Garcia-Valcarcel-Muñoz-Repiso, Basilotta-Gomez-Pablos and Lopez-Garcia (2014), who conclude that the main advantages of this type of learning are those related to the development of transversal skills. that stimulate social skills, problem solving, self-sufficiency, responsibility and the capacity

for reflection and initiative, which are considered of great relevance by teachers to achieve a comprehensive education in students. 

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About the authors *Juan Ernesto Alejandro Olivares Gallo*

Doctor in Teaching Methodology from the Mexican Institute of Pedagogical Studies, master in Product Development and graduate in Industrial Design from the University of Guadalajara. He was director of the Technology and Processes Division, head of the Design Projects Department and the Production and Development Department, as well as coordinator of the Industrial Design and Design for Graphic Communication careers, at the University Center of Art, Architecture and Design of the University of Guadalajara. He is a member of the National System of Researchers as a candidate and has been teaching design as a teacher for more than 36 years. He currently participates in Academic Body 1169 “Interdisciplinary Design Studies in Higher Education” and has published in different specialized magazines, as well as in book chapters related to graphic and industrial design.

Mariana Noemi Campos Barragan

Graduate in Design for Graphic Communication, master in Teaching Methodology and doctor in Teaching Methodology. She is a professor of subject B at the University of Guadalajara, a member of the National System of Researchers and a collaborator in Academic Body 1169 “Interdisciplinary studies of design in higher education.” Participated in the design of the learning units of the degree in Design for Graphic Communication implemented in 2019 and the degree in Design, Arts and Interactive Technologies. He has participated in academic and management activities at the University Center of Art, Architecture and Design, and has also published in magazines and book chapters. In addition, he has participated with presentations in national and international conferences.

Eva Guadalupe Osuna Ruiz

Doctorate in Higher Education Management and master in Higher Education Planning from the University of Guadalajara. She is a full-time professor with Prodep Desirable Profile at the University Center of Art, Architecture and Design, at the University of Guadalajara. He is also a member of Academic Body 1169 “Interdisciplinary Design Studies in Higher Education”, and a teacher in the degrees in Visual Arts for Photographic and Plastic Expressions, Performing Arts for Theatrical and Dance Expressions, Design for Graphic Communication, and in the master's degrees in Management and Cultural Development and Information Design and Digital Communication. She is a tutor for students of the degree in Visual Arts for Plastic Expression and the degrees in Design for

Graphic Communication, as well as a tutor, director and co-director of students of the master's degree in Management and Cultural Development and the master's degree in Information Design and Digital Communication. She has experience in management, having collaborated as a member of the Center Council, member of the Divisional Board, member of the Editorial Board and administrative secretary of the University Center, and Research and Postgraduate coordinator.



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