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The relevance of interaction in virtual learning environments during COVID-19

La importancia de la interacción en el aprendizaje en entornos virtuales en tiempos del COVID-19

新冠疫情期间虚拟学习中互动的重要性

Важность взаимодействия в обучении в виртуальной среде во времена COVID-19

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Abstract

The pandemic context has generated greater challenges for the articulation of the interaction processes that characterize our Learning Ecologies. At the level of higher education, this problem has been especially relevant due to the difficulties of restructuring learning and to the feeling of isolation that has been generated due to the forced migration of face-to-face teaching processes to virtual environments. This contribution analyzes a pedagogical and technological proposal for the design of CSCL (Computer Supported Collaborative Learning) which underlie the need to structure cognitive, social and organizational interactions that converge in a successful training framework. The purpose of the study is to understand the aspects that must be considered in the interaction for the expected learning to take place and to analyze the perceptions of the students in relation to the types of interaction that occur in the collaborative learning process. The study follows a non-experimental quantitative methodology, through a questionnaire, and had the participation of 106 students from 5 undergraduate subjects that implement CSCL. The results show that students associate cognitive, social and organizational interaction with motivation and improvement of academic performance, highlighting the development of skills to collaborate in the future and valuing the feelings of belonging to the learning community linked to the experience.

Keywords: Cooperative / collaborative learning, Higher education, Learning strategies, Communication mediated by technologies, Learning ecologies.

Resumen

El contexto de pandemia ha generado mayores desafíos para la articulación de la interacción que caracteriza nuestras Ecologías de Aprendizaje. En el nivel de la educación superior, esta problemática ha sido especialmente relevante a causa de las dificultades de restructuración de los aprendizajes y por la sensación de aislamiento que se ha generado debido a la migración forzosa de los procesos de enseñanza presenciales a los entornos virtuales. En esta contribución se analiza una propuesta pedagógica y tecnológica para el diseño de procesos de aprendizaje CSCL (Computer Supported Collaborative Learning) en los que subyace la necesidad de estructurar las interacciones cognitiva, social y organizativa que confluyen en un marco formativo exitoso. El propósito del estudio es comprender los aspectos que deben contemplarse en la interacción para que se produzcan los aprendizajes esperados y analizar las percepciones de los estudiantes en relación con los tipos de interacción que suceden en el proceso de aprendizaje colaborativo. El estudio sigue una metodología cuantitativa no experimental, a través de cuestionario, y contó con la participación de 106 estudiantes de 5 asignaturas de grado que implementan CSCL. Los resultados muestran que los estudiantes asocian la interacción cognitiva, social y organizativa con la motivación y la mejora del rendimiento académico, destacando el desarrollo de habilidades para colaborar en el futuro y valorando los sentimientos de pertenencia a la comunidad de aprendizaje ligada a la experiencia.

Palabras clave: Aprendizaje cooperativo/colaborativo, Educación superior, Estrategias de aprendizaje, Comunicación mediada por tecnologías, Ecologías de aprendizaje.

概要

疫情为学习生态中的互动协调带来了巨大的挑战。在高等教育层面，重组学习上的困难和将面对面教学过程被迫迁移到虚拟环境而产生的孤立感使该问题尤其突出。本文分析了CSCL（计算机支持的协作学习）学习过程设计的教学技术提案，其中强调了构建处于成功

培训框架中的认知、社会和组织互动的需求。该研究的目的是了解在预期学习的互动过程中应考虑的方面，并分析学生对协作学习过程中发生的互动类型的看法。该研究采用非实验定量方法，对进行CSCL 的 5 个本科学科的 106 名学生进行问卷调查。结果表明，学生将认知、社会和组织互动与学习动机和学习成绩的提高联系起来，突出了未来合作技能的发展，并重视对与体验相关的学习社区的归属感。

关键词: 合作/协作学习, 高等教育, 学习策略, 以技术为中介的交流, 学习生态。

Аннотация

Контекст пандемии породил более серьезные проблемы для формулирования взаимодействия, которое характеризует наши учебные экологии. На уровне высшего образования эта проблема особенно актуальна в связи с трудностями реструктуризации обучения и чувством изоляции, возникшим из-за вынужденного переноса очных учебных процессов в виртуальную среду. В данном материале анализируется педагогическое и технологическое предложение по проектированию процессов обучения CSCL (Computer Supported Collaborative Learning), в основе которого лежит необходимость структурирования когнитивных, социальных и организационных взаимодействий, которые сходятся в успешной структуре обучения. Цель исследования - понять, какие аспекты должны быть учтены в процессе взаимодействия для получения ожидаемого результата обучения, и проанализировать восприятие студентов в отношении типов взаимодействия, которые происходят в процессе совместного обучения. Исследование проводится по неэкспериментальной количественной методологии, с помощью анкеты, в нем приняли участие 106 студентов из 5 предметов бакалавриата, внедряющих CSCL. Результаты показывают, что студенты связывают когнитивное, социальное и организационное взаимодействие с мотивацией и улучшением успеваемости, подчеркивают развитие навыков сотрудничества в будущем и ценят чувство принадлежности к учебному сообществу, связанное с этим опытом.

Ключевые слова: Кооперативное/ коллаборативное обучение, высшее образование, стратегии обучения, технологически опосредованная коммуникация, экологии обучения.

Introduction

Although we are still far from being able to carry out a detailed analysis of the consequences of the Pandemic derived from COVID-19 in our lives, and, specifically, of the effects on educational processes, we already have partial evidence of its impact on our Learning Ecologies (Aucejo, French, Ugalde, & Zafar, 2020; Darling-Hammond & Hyler, 2020). In the context of higher education, and, in particular, students who are settled in vulnerable environments, many students found their learning trajectory affected; they have delayed their graduation, lost their placement or suffered other dire consequences in their training process (Aucejo, French , Ugalde, & Zafar, 2020; Darling-Hammond & Hyler, 2020).

That is why, now more than ever, we must assume the commitment to preserve a look that integrates the social aspects of learning, together with the pedagogical and technological elements that configure it (Garrison, Cleveland-Innes, & Fung, 2010; Onrubia & Engel, 2012, Hernández-Sellés, González-Sanmamed, & Muñoz-Carril, 2014). In this sense, Learning Ecologies propose a very useful paradigm for the analysis of

this context, since they observe the interrelation and connection of the elements that weave the architecture of our learning, in formal or informal, face-to-face or virtual contexts (González-Sanmamed et al., 2020; González-Sanmamed, Muñoz-Carril, & Santos, 2019).

The online modality has prevailed in the field of higher education during the first months of the pandemic and even today many institutions maintain this modality in the learning processes. Other institutions have had to adopt hybrid models, named so for combining face-to-face learning with e-learning (Osorio, 2010). In this context, debates have arisen, both at a social and at an academic level, in order to compare online learning, supported and mediated from technological environments, with face-to-face learning (Hodges et al., 2020). It is evident that this debate arises from the enormous complexity of the pandemic context; the forced migration to virtual learning environments has led to feelings of isolation, with a social and individual affectation. Institutions and teachers have had experiences that need to be reviewed and reinforced, analyzing the cases of other institutions and their faculty in the same context of the pandemic, together with studies that provide a complementary vision. This reflection should be based on a macro analysis of educational ecosystems and aimed at identifying the elements that support good practices in the different modalities, online, offline or hybrid, in order to explore the potential of their integration.

Conceptual framework

Computer Supported Collaborative Learning (CSCL) has spread in the field of online education because it proposes a learning process mediated by technologies where interaction acquires a preponderant role by requiring that students, in small groups, collaborate to solve complex problems. The challenge is to design, implement and evaluate a process that articulates the interaction necessary to produce learning, contemplating this construct from a broad and diverse perspective: interaction with content, between students, with the teacher, with the interface and with the learning tools (Hernández-Sellés, Muñoz-Carril, & González-Sanmamed, 2020).

In a natural way, the culture of collaboration is an intrinsic element of our learning ecologies, where the cognitive, social and organizational aspects are integrated. This integration supports convergence process entailed in the resolution of complex problems. This process of interaction that implies the negotiation and operation of the problem or project response results in different types of learning, associated with the abilities to collaborate and with the characteristics of the problem to be solved (Weinberger, Stegmann, & Fischer, 2007; Garrison et al., 2010; Onrubia & Engel, 2012; Borge, Ong, & Rosé, 2018).

Learning, therefore, is established through the mediation of interaction and, in this sense, studies that analyze interaction models in the CSCL have identified a positive and significant influence between: teacher-student interaction and student interaction in their working groups; student interaction in work groups and intragroup emotional support; student's interaction in their work groups and collaborative learning; collaborative work tools and interaction in work groups (Molinillo, Aguilar-Illescas, Anaya-Sánchez, & Vallespín-Arán, 2018; Hernández-Sellés, Muñoz-Carril, & González-Sanmamed, 2019).

Previously we pointed out that cognitive, social and organizational aspects are integrated in the collaboration process, therefore, the interaction that accompanies learn-

ing must contemplate these three elements and the teacher will have to articulate a context where they are promoted. In this sense, interaction must be designed to trigger socio-cognitive negotiation processes that, according to studies, improve individual learning outcomes and increase student satisfaction (Johnson, Johnson, & Stanne, 2000; King, 2007; Medina & Suthers, 2008; Kwon, Liu, & Johnson, 2014). In this sense, the tasks or projects must be complex and unstructured, favoring the processes of convergence (Knowledge convergence) and divergence in the negotiation to respond to the task, in a way that encourages the group to strive to integrate each individual contribution into a common construct (Stahl, 2006; Weinberger et al., 2007; King, 2007; Borge et al., 2018). In this process, students consider the development of critical and self-critical capacity, as well as the ability to make consensual decisions one of the great contributions of CSCL (Hernández-Sellés et al., 2020).

In order to establish the group commitment to achieve the common goal, and thereby favor the context where individuals negotiate, contribute, review their premises and elaborate arguments, students need to feel that they belong to a community that, in addition to the academic objectives, integrates a vision that considers them as human beings who harbor emotions, have needs, experience ups and downs and wish to feel motivated and accompanied (Rovai, 2002; Kreijns, Kirschner, & Jochems, 2003, Pérez-Mateo & Guitert, 2012). When this socio-emotional interaction is articulated, it is possible to improve cognitive development and promote skills for collaboration -with an individual character and in the global character of the group-. In addition, the feeling of belonging is connected to team achievements but also to the global context -the subject, the teacher, the institution- (Rovai, 2002; Kreijns et al., 2003, Medina & Suthers, 2008; Kwon et al., 2014). Studies strongly point out that social interaction does not occur spontaneously and, if the teacher does not contemplate it, groups tend to socialize at a very basic level, which results in a poor learning experience, a feeling of loneliness and, therefore, to academic failure (King, 2007; Garrison et al., 2010; Onrubia & Engel, 2012; Reyes, Brackett, Rivers, White, & Salovey, 2012; Kwon et al., 2014). To activate it, it is necessary that teacher-student interaction focuses on motivation and support, as well as on immediate quality feedback, and that a the group relationship fosters respect, tolerance and support (Packhan, Brychan, & Miller, 2006; Kuo, Walker, Schrodery, & Belland, 2014, Hernández-Sellés et al., 2020).

As it is inferred, articulating interaction processes that integrate social and cognitive aspects is not easy, for this reason different authors have worked on the design and evaluation of Collaboration Scripts that provide a framework to accompany teachers and to guide students in the organizational processes that underpin CSCL. These Scripts depict the rational beyond collaboration, the kind of learning linked to the process, the type of exchanges expected to occur (referring to cognitive and socio-emotional exchange), they support group organization, and the writing of group agreements as well as the planning processes and, of course, state how the process and the project result will be evaluated (Strijbos, Martens, & Jochems, 2004; King, 2007; Dillenbourg & Hong, 2008; Onrubia & Engel, 2012; Sobreira & Tchounikine, 2012; Näykki et al., 2017). These scripts, along with the design of projects and collaboration processes, are of the utmost importance since in CSCL the teacher intervenes more actively in the initial phase, but once the project is activated, group members assume the responsibility. In fact, it is precisely from this autonomy that the deepest learning emerges, such as the development of skills related to collaboration and significant learning derived from the opportunities for cognitive divergence and convergence (Hernández-Sellés et al., 2020).

To reinforce autonomy, promote group empowerment in the learning process, and in order to highlight the importance of the different types of interaction, assessment needs to integrate aspects related to the process (learning, collaboration process) and to the result of group interaction (Macdonald, 2003; Lee, Chan, & Van Aalst, 2006; Pachler, Daly, Mor, & Mellar, 2010; Gikandi, Morrow, & Davis, 2011; Balderas et al., 2018).

It has been pointed out that in CSCL, the appropriate choice of learning tools positively and significantly influences the interaction of students in their work groups and on intragroup emotional support (Molinillo et al., 2018; Hernández-Sellés et al., 2019). For this reason, the choice of tools should try to favor a fluid collaboration that accompanies the resolution of problems. In this sense, the learning platforms used in higher education LMS (Learning Management System) make available tools for synchronous or asynchronous collaboration, such as forums, video-forums, blogs, wikis or chats. On the other hand, tools such as Padlet, Flipgrid or Diigo, allow sharing and commenting on multimedia resources, and on the other hand, widely used Social Networks such as Instagram, Twitter or WhatsApp are also effective in articulating the interactions that promote learning in CSCL and, in fact, they are preferred by students (Bowman & Akcaoglu, 2014; Bouhnik & Deshen, 2014; Hamid et al., 2015; Hernández, Muñoz, & González, 2015).

Methodology

The research has been carried out at La Salle University, in Madrid, with the participation of students from five subjects taught online. All of those have developed CSCL projects in the degrees of Teacher in Primary Education and Teacher in Early Childhood Education.

To guarantee homogeneous conditions, a CSCL model was designed based on contrasted experiences in research papers. Every project was constituted with the same elements and milestones with the support of an expert CSCL tutor who guided the teachers in the process. The design had the following elements: 1) Collaboration script with description, pedagogical justification of the collaborative work, main milestones related to the development of the task, description of available tools, proposal to write group agreements and description of the values that they cement collaborative work; 2) Spontaneous group formation by students; 3) Drafting of group agreements; 4) Review of the agreements and response of the teachers, prior to the beginning of the interaction; 5) Development of projects with the support of teachers; 6) Formative and summative co-evaluation process.

The research objectives to which the study responds are the following:

- Revise student's perception in relation to the designed interaction process, which includes social, cognitive, and organizational interaction.
- Identify if there are significant differences in the perception of the interaction process based on student's years of experience working in virtual environments.

The study has an exploratory and descriptive intentionality, the methodology adopted is quantitative, of a non-experimental nature, based on a survey (McMillan & Schumacher, 2005). Therefore, a questionnaire was designed with a Likert-type scale with five response levels. To ensure the validity conditions, the questionnaire was subjected to expert judgment and, additionally, a pilot study was carried out before consolidat-

ing the final version. The sampling was non-probabilistic, consisting of requesting the participation of informants based on their availability or ease of access, this is known as "convenience sampling" (McMillan & Schumacher, 2010). The students responded anonymously and voluntarily, and a sample of 106 responses was collected, constituting 83.46% of the population.

In order to characterize the sample, the distribution of students by subjects and grades is presented, together with an analysis of frequencies and percentages of the variables "age", "gender" and "years of experience working in a team collaboratively in a Virtual environment".

Table 1

Subjects participating in the Degree in Early Childhood Education

Subject	Course	N Students
Educational policies of the European Union	2	23
Knowledge of the social and cultural environment in Infant Education.	3 Group A	21
Knowledge of the social and cultural environment in Infant Education.	3 Group B	20

Table 2

Subjects participating in the Degree in Primary Education

Subject	Course	N Students
Sociology of education	1	12
Foreign Language II (English)	2	30

Table 3

Grouping of participating students in age ranges

Age	Frequency	Percentage
21 - 25	21	22.26
26 - 30	40	42.4
31 - 35	27	28.62
36 - 40	13	13.78
+ 40	3	3.18
No answer	1	1.06

Table 4

Frequency and percentage of the variable "gender"

Gender	Frequency	Percentage
Female	90	84.906
Male	16	15.094

Descriptive analyzes were developed incorporating frequencies and percentages, as well as measures of central tendency and dispersion. In addition, and in order to identify significant differences in relation to the years of experience of the students training in virtual environments, bivariate statistical analyzes were carried out. The years of experience working in virtual environments is a data collected in the initial questions of the questionnaire, aimed at knowing the characteristics of the participants. For the statistical contrast of independent variables with more than two categories, the non-parametric Kruskal-Wallis test was used with a risk of error of 5% (α = .05).

Results

Table 5 incorporates the descriptive analyses related to the students' evaluations in relation to the interaction process in the team during the development of CSCL. All the items analyzed are reviewed together with their resulting frequencies and percentages, measures of central tendency (mean) and dispersion (standard deviation).

Table 5

Descriptive analysis of the students' evaluations in relation to the interaction process in the team during the development of CSCL

	DK/NA		Very low		Low		Medium		High		Very high		Mean	SD
	n	%	n	%	n	%	n	%	n	%	n	%		
1 My team has developed an effective management and organization process.	2.0	1.9	.0	.0	2.0	1.9	14.0	13.2	44.0	41.5	44.0	41.5	4.25	.760
2 The organization has encouraged members to take responsibility for their work within the team.	2.0	1.9	.0	.0	2.0	1.9	18.0	17.0	37.0	34.9	47.0	44.3	4.24	.806
3 The organization has facilitated task-related learning.	2.0	1.9	.0	.0	4.0	3.8	9.0	8.5	46.0	43.4	45.0	42.5	4.27	.779

	DK/NA		Very low		Low		Medium		High		Very high		Mean	SD
4 Developing organizational guidelines has taught us to work as a team.	1.0	.9	.0	.0	5.0	4.7	20.0	18.9	41.0	38.7	39.0	36.8	4.09	.867
5 The organization has favored team cohesion.	2.0	1.9	1.0	.9	3.0	2.8	20.0	18.9	38.0	35.8	42.0	39.6	4.13	.889
6 The success of group work has depended on the individual effort of the team members.	2.0	1.9	.0	.0	3.0	2.8	10.0	9.4	42.0	39.6	49.0	46.2	4.32	.767
7 The interaction process has favored the development of teamwork skills.	2.0	1.9	1.0	0.9	1.0	0.9	16.0	15.1	46.0	43.4	40.0	37.7	4.18	.798
8 If it has been the case, conflicts have been dealt with in a constructive way.	2.0	1.9	1.0	.9	1.0	.9	16.0	15.1	46.0	43.4	40.0	37.7	4.13	.891
9 Personal ties have been established.	2.0	1.9	7.0	6.6	9.0	8.5	16.0	15.1	33.0	31.1	39.0	36.8	3.85	1.213
10 The team has offered support, help, or encouragement at times when it was necessary.	2.0	1.9	1.0	0.9	2.0	1.9	10.0	9.4	31.0	29.2	60.0	56.6	4.41	.820
11 Teamwork has helped me feel more integrated in the study of the subject.	2.0	1.9	.0	.0	10.0	9.4	12.0	11.3	37.0	34.9	45.0	42.5	4.13	.962
12 Contact with the team has motivated me to develop the task.	2.0	1.9	1.0	.9	5.0	4.7	12.0	11.3	33.0	31.1	53.0	50.0	4.27	.916

The aim is to analyze the students' impressions about group interactions at the cognitive, organizational and social levels. Research focusses on some elements that seem to be decisive to achieve the objectives associated with the collaborative work proposals based on the review of the reference literature:

1. Appreciation of group members performance and commitment; Appreciation of group management and organization in the development of the task.

2. Group exchanges to learn and develop the task.
3. Exchange in the group for the development of relationships and bonds (cohesion, social dimension).

Students value that their groups have developed an effective work process, since all the items on which they have been consulted have obtained averages higher than 4, except one, "Personal ties have been established" with an average of 3.85. The responses to the various items are concentrated in the High and Very High values.

Regarding the assessment of work management and organization during task development, students consider that the teams have developed an effective management and organization process (item 1, average of 4.25), and that the organization has favored members to take responsibility for their work within the team (item 2, mean of 4.24). Students perceive that the organization has favored learning (item 3, mean 4.27) and team cohesion (item 5, 4.13).

In relation to the development of transversal teamwork skills, students state that developing organizational guidelines has taught them to work as a team (item 4, mean of 4.09) and that the interaction process has favored the development of teamwork skills (item 7, mean of 4.18).

On the other hand, in relation to the feeling of belonging or community, students indicate that teamwork has contributed to making them feel more integrated in the study of the subject (item 11, mean of 4.13), and that contact with the team has motivated them to develop the task (item 12, mean of 4.27). In any case, the item "Personal ties have been established, item 9" has obtained an average of 3.85 and is the one that shows the greatest response variability (1.213). This seems to indicate that the experience in the groups and, particularly, the experiences of their individuals, has been diverse and that the establishment of personal ties has not been generalized.

As shown below in Tables 6 and 7, the Kruskal-Wallis test indicates that there are statistically significant differences between the variables: "The organization has facilitated learning related to the task", "The organization has favored team cohesion "," If it has been the case, conflicts have been dealt with in a constructive way "," Personal ties have been established "and the years of experience of the students in virtual environments. Specifically, observing the average ranges in Table 3, it is the students with more than one year of experience working in virtual environments who give the highest scores to the aspects contemplated in the variables.

Table 6

Contrast statistics years of experience in virtual environments

Contrast statistics[a,b]			
	Chi-square	gl	Sig. asintót.
1 My team has developed an effective management and organization process.	4.393	2	.111
2 The organization has encouraged members to take responsibility for their work within the team.	3.261	2	.196

Contrast statistics[a,b]			
3 The organization has facilitated task-related learning.	6.506	2	.039
4 Developing organizational guidelines has taught us to work as a team.	.696	2	.706
5 The organization has favored team cohesion.	7.125	2	.028
6 The success of group work has depended on the individual effort of the team members.	.798	2	.671
7 The interaction process has favored the development of teamwork skills.	1.060	2	.589
8 If it has been the case, conflicts have been dealt with in a constructive way.	7.468	2	.024
9 Personal ties have been established.	9.899	2	.007
10 The team has offered support, help, or encouragement at times when it was necessary.	2.883	2	.237
11 Teamwork has helped me feel more integrated in the study of the subject.	1.616	2	.446
12 Contact with the team has motivated me to develop the task.	5.462	2	.065
a. Kruskal-Wallis Test			
b. Grouping variable: years of experience in virtual environments			

Table 7

Average ranges of years of experience in virtual environments

Rangos			
	years of experience in virtual environments	N	Mean range
1 My team has developed an effective management and organization process.	Years_none	33	51.77
	Years _1tops	32	44.63
	Years _+ 1	38	58.41
	Total	103	

Rangos			
	years of experience in virtual environments	N	Mean range
2 The organization has encouraged members to take responsibility for their work within the team.	Years_none	33	54.64
	Years _1tops	32	44.72
	Years _+ 1	38	55.84
	Total	103	
3 The organization has facilitated task-related learning.	Years_none	33	53.98
	Years _1tops	32	42.22
	Years _+ 1	38	58.51
	Total	103	
4 Developing organizational guidelines has taught us to work as a team.	Years_none	33	52.27
	Years _1tops	33	49.61
	Years _+ 1	38	55.21
	Total	104	
5 The organization has favored team cohesion.	Years_none	33	56.20
	Years _1tops	32	41.08
	Years _+ 1	38	57.55
	Total	103	

Rangos			
	years of experience in virtual environments	N	Mean range
6 The success of group work has depended on the individual effort of the team members.	Years_none	33	49.67
	Years _1tops	32	55.44
	Years _+ 1	38	51.13
	Total	103	
7 The interaction process has favored the development of teamwork skills.	Years_none	33	51.68
	Years _1tops	32	48.47
	Years _+ 1	38	55.25
	Total	103	
8 If it has been the case, conflicts have been dealt with in a constructive way.	Years_none	31	51.73
	Years _1tops	31	40.16
	Years _+ 1	38	57.93
	Total	100	
9 Personal ties have been established.	Years_none	33	52.74
	Years _1tops	32	40.00
	Years _+ 1	38	61.46
	Total	103	

Rangos			
	years of experience in virtual environments	N	Mean range
10 The team has offered support, help, or encouragement at times when it was necessary.	Years_none	33	50.18
	Years _1tops	32	47.28
	Years _+ 1	38	57.55
	Total	103	
11 Teamwork has helped me feel more integrated in the study of the subject.	Years_none	33	53.79
	Years _1tops	32	46.84
	Years _+ 1	38	54.79
	Total	103	
12 Contact with the team has motivated me to develop the task.	Years_none	33	53.80
	Years _1tops	32	43.03
	Years _+ 1	38	57.99
	Total	103	

Discussion and conclusions

In the context of this study, it is observed that the students who have developed CSCL consider that the three types of interaction: cognitive, social and organizational favor individual learning, both related to the learning of the subject and the development of skills to collaborate in the future. In addition, and in line with other studies (Kwon et al., 2014; Reyes et al., 2012; Hernández-Sellés et al., 2020), students perceive that the activation of the interaction at the three levels is aligned with motivation and encourages them to feel more integrated in the study of the subject.

The conception of learning as a process of interaction and relationship is established in a vast tradition linked to pedagogical currents such as constructivism, socio-constructivism or social learning. However, in the university environment it is common for learning to be exclusively associated with the cognitive level, avoiding the social interaction that mediates these processes and which is fundamental in our Learning Ecologies, which are articulated around human and technological interaction (González- Sanmamed et al., 2019; González-Sanmamed et al., 2020; Romeu-Fontanillas, Guitert-Catasús, Raffaghelli, & Sangrà, 2020). The natural interrelation of the three types of interaction will be the network in which our students will sustain themselves in the professional future, where cognition will be an important element. But, as is the case in group work in the educational field, it will be necessary that they have acquired skills to cooperate and educate.

Higher education institutions have a great responsibility to emulate future professional experiences and to facilitate the acquisition of a broad set of competencies. In fact, virtual campuses and other initiatives that promote the use of media in learning processes are adopting methodologies that prioritize the interaction between different educational agents (Stahl, 2004; Bates & Sangrà, 2011).

The context of the pandemic has highlighted the enormous relevance of social interaction and also of the organization that is necessary to articulate solutions in these types of contexts. This great social challenge should help us to review and adjust training proposals, recognizing students in a socio-emotional dimension that supports the structuring of learning and the development of curricular and extracurricular competencies.

Limitations and future lines of action

This study has potential limitations. It would be interesting to increase the number of participants, as well as their degree of heterogeneity, for example, with students from different universities that offer online or technology-mediated education that teach using CSCL in the subjects.

Scientific evidence, collected from the experience of teachers, students and through observation, confirms the need to establish the different types of interaction for learning to take place (cognitive, social and organizational interaction). The need for a fluid interaction between the actors involved (students, teachers, educational materials, technology) is also confirmed. Future lines of action should be aimed at preparing a diagnosis that identifies which are the aspects that converge towards this goal, and which are those that obstruct it. We should try to identify what is necessary to review in Higher Education Institutions, so that the interaction processes manage to articulate university studies linked to the strategic elements of Quality and Sustainability of the teaching processes: referring on the one hand to the development of professional competencies and retention of learning, linked to a good academic experience and, on the other hand, to establish those links with the academic context that promote the desire to continue training throughout life. Another objective will be to continue analyzing Learning Ecologies in the informal context, the ways in which students choose to learn, to try to incorporate them into formal contexts.

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