Collaborative online international learning between Spain and Mexico: a microlearning experience to enhance creativity in complexity

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Abstract

Purpose – The aim of this paper was to analyse the creative competence of students before and after a micro-learning experience carried out in a collaborative online international learning (COIL) environment between Spanish and Mexican university students in the field of education and entrepreneurship.

Design/methodology/approach – A single-group quasi-experimental design with pre-test and post-test measures was adopted. The composition of the group was natural and included a total of 57 students who participated in the COIL experience. The duration was three weeks, where students from both countries were linked together in the development of a micro-learning project. The creativity self-efficacy scale was used as a data collection instrument.

Findings – The micro-learning activities through COIL developed the creative competence of the participating students. In particular, the groups from both universities improved their scores on the creative competence in the post-test compared to the pre-test measure.

Research limitations/implications – The limitations of this study were linked to the sample loss of some cases, as some students did not complete the post-test measure. The main implication of the study was to demonstrate that COIL experiences are suitable for developing certain skills in students, such as creative competence or co-operative work.

Originality/value – COIL experiences break down the barriers of physical space and give students an active role, allowing them to fully develop competences and offering an intercultural perspective, which encourages open-mindedness and understanding of the world.

Keywords COIL, Microlearning, Creativity skills, Higher education, International learning, Complexity

Paper type Research paper

Introduction

What could be the path(s) to achieve the ability to interconnect, from our gaze, the different dimensions of the real, the way in which the historian and philosopher Edgar Morin invites us to begin to observe the world?

Throughout history, doubt, fear, nature itself has pushed humanity to seek answers to the questions it was presented with in various spatial-temporal environments. These answers constructed cultural spaces that shaped the reality of new societies. Although the connections between diverse social groups have been the axis of the great transformations of society, the 21st century finds us in a superlative era of communication that involves a great speed and an infinite amount of its diffusion.

Perhaps it is time to stop and be able to analyse this historical moment that will allow us to be able to observe the true complexity of the present. To this end, we believe that the starting point should be the creation of spaces for interaction between different points of view that provoke motivation and creativity, allowing us to abstract ourselves and be able to identify the characteristics of each of the components of the observed realities from subjectivity (understood as a subject that forms part of the process).

Constant changes in all spheres of society have brought with them new opportunities for complex realities. In this complexity, digital technology, the internet and artificial intelligence are means that tend to be transformed into ends, according to the application of intelligence itself (Morin, 2020). Sanabria *et al.* (2022) state that the development of complex thinking is not among the objectives of citizen science, despite the strong link with Education 4.0 and the formation of citizens committed to society. In the field of complexity, Education 4.0 is postulated to promote design scenarios that integrate new methodologies, platforms, competences and infrastructure with a wide possibility of connection with external agents (Miranda *et al.*, 2021), as well as methods with cloud computing infrastructures, hybrid active methodologies, technological ecosystem and horizontal competences 4.0 (Fidalgo-Blanco *et al.*, 2022). In particular, training in reasoning skills for complexity, within the framework of education 4.0, advocates promoting critical, systemic, scientific and creative thinking (Ramírez-Montoya *et al.*, 2022).

This article focuses on the presentation of an international training experience to assess one of these complex competences, creativity. A theoretical framework is presented with experiences and good practices of collaborative online international learning (COIL) and creative competence in the framework of complexity, where the objectives and hypotheses of the study are located. The method used and the results are discussed in order to end with conclusions that address the limitations of the study and future lines to continue contributing to the field of educational innovation and international education.

Literature review

COIL is distinguished by the integration of learning experiences with participants from different contexts around the world, supported by digital technologies to link them and develop diverse competences. Mestre-Segarra and Ruiz-Garrido (2022) examined students' reflections on a collaborative international online learning project in an Integrating Content and Language in Higher Education context and found that applying a COIL approach can help students gain confidence in applying their knowledge in a real-world experience. Cotoman *et al.* (2022), in turn, argue that working together collaboratively online not only mitigates the physical constraints of pandemic and sustains a global learning space; it also provides for active and affective learning particular to an intercultural virtual environment that grounds classroom experiences even in post-pandemic higher education. COIL are experiences designed by academics from institutions in different countries with the aim of putting into perspective training opportunities for internationalisation, inter-culturality, innovation and interdisciplinary, among others.

COIL can be a driver for raising awareness among students to become global citizens and in turn, can provide an opportunity for curriculum improvement changes. Munoz-Escalona et al. (2022) focused on COIL at three institutions as an approach to internationalising the curriculum as an important mechanism for promoting intercultural competences, international perspectives and ethical sensitivities, while contributing to the enhancement of students' abilities to develop as responsible global citizens. Another perspective came through a COIL between the United States and England, with authors Ingram et al. (2021) providing a model for other institutions that are interested in developing innovative and intercultural distance learning opportunities, with an outlook for the academic enterprise that expands the confines of physical institutions.

In turn, Jacobs et al. (2021) presented iKudu, a project co-funded by Erasmus+1, focused on capacity building for curriculum transformation through internationalisation and the development of collaborative online virtual exchange of international learning with the delivery of an internationalised and transformed curriculum using COIL. Hammond and Radjai (2022) present an experience of curriculum internationalisation in Japanese higher education in English-medium instructional programmes and the findings suggest that curriculum internationalisation remains a novel concept in Japan that may evolve into a dramatically altered higher education landscape in the future.

Cultural differences can be located in the space that distinguishes one group of people from another, in an area of differing perceptions, attitudes and behaviours, which can be an opportunity to grow from integrating new knowledge at the margin of those dissonances (Saeed and Moustafa, 2022). Virtual collaboration provides learners with the opportunity to develop cultural intelligence while fitting into the team where members are from diverse cultures (Swartz and Shrivastava, 2022). In a COIL project between the United States of America USA and Ecuador, results revealed that there were significant changes in cultural competence among participants in one study, where students said that collaborative learning through COIL helped them achieve good academic performance (West et al., 2022). Also King-Ramírez (2020) contributes with a COIL conducted among university students from the United States and Mexico, enrolled in universities located in the Arizona–Sonora Mega region, where students demonstrated global citizenship skills, such as the ability to analyse international relations, critically consume media and identify points of global interconnectedness. Harris et al. (2021) emphasise that there is a need for university students to develop global perspectives and acquire cultural awareness to become responsible global citizens; from this perspective they provide an experience between the United States and the Netherlands through a unique cultural lens of a health educator.

Teaching strategies in COIL environments are a way to provide collaborative and inclusive learning pathways. Klerk and Palmer (2022) provide a perspective with the application of COIL for students living with disabilities to transform their learning experiences and unlock new pathways for their development. In turn, Álvarez-Barreto et al. (2022) constructed a COIL experience between Mexico and Ecuador where they supported project-based learning, with continuous evaluation of student satisfaction and skills developed, leading to increased engagement through greater social interaction and collaboration. Feng et al. (2021) present covert and overt approach strategies in the form of text-based chats through chat logs from two COIL projects and found significant differences in characteristics such as openness (overt, covert), linguistic approach (mechanical, lexical and grammatical) and source (code, message).

In the field of sustainable development, Adefila et al. (2021) developed EcoCOIL as a versatile model to expand the tools and principles of coalition building, promote environmental citizenship and develop multi-layered communities of practice (students and university staff, technical experts, business leaders and entrepreneurs, social innovators, policy makers, community-based social organisations, etc.), where co-creation between intercultural, intergenerational and transdisciplinary actors; brought an innovative and

participatory angle to curriculum development by integrating the principles of lifelong learning and practical facilitation of sustainable behaviour within communities in real time.

Creative competence in the framework of complexity

Creative competence is the ability to seek, discover and generate new solutions to multiple perspectives and problems. Igor *et al.* (2016) state that creative competences are understood by the authors as the ability of a specialist to find a uniquely responsible solution in extraordinary situations. Zanfir (2020) delineates the concept of "creative competence" of the future activity of a university student as a complex personality education, encompassing the sphere of intelligence, emotions, moral values and acting on a fundamentally new and integrative level of transferring acquired competences from one industry to another to achieve a fundamentally new result of the activity, or the performance of activities at a fundamentally new qualitative level.

The challenge we face is not just to teach content, but to help students exploit their incredible potential to apply their problem-solving skills and, at the same time, to be citizens of the world, so that it is not just about knowing, but about doing something with that knowledge. Hence, in the words of Uzakbaeva *et al.* (2013) our students need to do something with their knowledge, to share ideas to help solve situations in their communities, cities, countries and the world itself by having self-confidence and respecting society, nature, different opinions, races, etc. Lifelong learning must be sown from the formative instances that postulate for problems that form the creative competence of future professionals and citizens of the world.

In various disciplines, creative competence is a driving force for the training of professionals. For example, Saorín *et al.* (2017) emphasise that engineers need creativity to achieve different solutions to the same problem, hence they designed an educational activity with 44 engineering students at the University of La Laguna to stimulate creative competence, with digital fabrication techniques to convert ideas into digital designs, and these into tangible products through 3D printing offer an opportunity for the development of creativity. In turn, Steinbeck (2011) presents design thinking, a human-centred innovation methodology that has been implemented in a design innovation programme at Stanford University, as well as in one of the most successful design consultancies. In particular Levin *et al.* (2016) found through a study that advertising agencies deliver value and build trust through aspects of creativity as well as project management processes. In the area of teacher education, Tadjievichkhodjiev *et al.* (2020) worked on the psychological and pedagogical foundations of the formation of the creative competence of a future teacher, where they concretised the creative competence of the future teacher and formulated a definition of the phenomenon of "scientific co-creation".

Creative competences can be fostered through collaborative experiences. As part of the creative immersion and experimentation academic unit, Mexican students in a COIL experience were challenged to develop an interactive transmedia installation in collaboration with the hypermedia arts and experimental entertainment group at the Los Libertadores University Foundation in Colombia (Vázquez *et al.,* 2022). Bonet *et al.* (2017) point out that creative competence enables people to achieve different solutions to the same problem and proposed an educational activity designed to stimulate creative competence, where the results showed that activities with digital editing and 3D printing tools are valid for the development of creative competence. On the other hand, Karimova *et al.* (2016) introduce game simulation as an educational technology in the process of English language training aimed at developing a creative educational space that defines the development of professional-creative competence of students, future specialists in foreign language and culture. Ponce-Márquez and García (2020) propose a formative model, based on the translation of humorous texts, which, when implemented systematically, makes learners aware of the importance of activating creative competence in order to produce fluent natural translations.

In summary, the objectives of the study were: (i) to develop a micro-learning experience in a COIL and (ii) to analyse the creative competence of the students before and after the experience. To this end, the following hypotheses were established.

H1. There are significant differences in creative competence between the groups of students according to their socio-demographic factors.

H2. Students who engage in micro-learning activities obtain statistically significant higher creative competence.

H3. Students' socio-demographic factors influence creative competence.

Method
Participants
Participants were undergraduate students from the University of Granada (UGR) in Spain and postgraduate students from the Tecnológico de Monterrey (TEC) in Mexico. The invitation to participate in the study was sent via email to each of the students and data were collected from an online survey in Google Forms. The research was conducted on the basis of a convenience sampling design with students participating in a COIL between the two universities.

Participants answered questions related to their socio-demographic data and a scale to assess creative competence. Specifically, the sample was defined by 3 men and 54 women belonging to the Bachelor's Degree in Early Childhood Education and the Master's Degree in Entrepreneurship and Innovation, aged between 19 and 41 years ($M = 22.66$; Standard Deviation (SD) = 4.24). The sample decomposition in relation to gender was due to the fact that in education studies in Spain the majority of students are female (Aznar-Díaz *et al.*, 2020). Table 1 shows the remaining socio-demographic data of the participants.

All procedures performed in the study conformed to the ethical standards of the institutional research committee and to the 1964 Helsinki declaration and its subsequent amendments or comparable ethical standards. Thus, participants were informed of the purpose of the research, of the anonymous treatment of their data and gave their informed consent before participating in the study.

The pre-test was administered on 5 November 2021, while the post-test was administered on 23 November 2021.

Measure
Socio-demographic data. Socio-demographic information was collected from the participants on gender, age, university of origin, whether they had any difficulties in passing the studies they were enrolled in, whether they had ever failed a course, whether they planned to have a job related to the studies they were doing and whether they were sure they would find a job when they finished their studies.

Creativity self-efficacy scale (EAC). The EAC (Yi *et al.*, 2008) was used to assess creative competence. This instrument measures creative self-efficacy through five items on a four-level Likert scale (1 = never; 4 = always). The scale scores range from five to 20 points, with higher values indicating a higher degree of creative competence. The EAC has adequate psychometric properties and has been validated in Spanish (Aranguren *et al.*, 2011). The Cronbach's alpha reliability data obtained in the study were adequate in the pre-test measurement ($\alpha = 0.68$) and in the post-test measurement ($\alpha = 0.83$).).

Research design
A single-group quasi-experimental design with pre-test and post-test measures was adopted (Hernández *et al.*, 2016). The sample selection procedure was non-probabilistic, specifically using a subjective method called convenience sampling (Pérez, 2016). The composition of the

Socio-demographic data	n	%
Gender		
Male	3	5.3
Female	54	94.7
Age		
20 or less	22	38.6
21 or more	32	61.4
University		
UGR	43	75.4
TEC	14	24.6
Difficulty in coping with studies		
Yes	2	3.5
No	55	96.5
Failing any course		
Yes	5	8.8
No	52	91.2
Have a job related to studies		
Yes	55	96.5
No	2	3.5
Finding a job after graduation		
Yes	33	57.9
No	24	42.1

Table 1.
Socio-
demographic data

group was natural and included a total of 57 students from both universities who participated in the COIL experience. Thus, sample size was not an influential factor in making comparisons in a single population of students (Chou and Feng, 2019).

Prior to the central analysis, the normality of the distribution of scores was calculated using the Kolmogorov–Smirnov test with Lilliefors significance correction. Subsequently, the descriptive statistical values of means and standard deviations, Mann–Whitney U, p-value and Cohen's d-value were calculated to test hypothesis 1.

For hypothesis 2, the decision was made to use the non-parametric Wilcoxon z-test. Finally, hypothesis 3 was tested by establishing a multiple linear regression model. The data analysis was carried out using SPSS (Statistical Package for Social Sciences) v.25 statistical software.

Procedure and materials

The activity was strategically developed in the collaborative framework of two international universities: Tecnológico de Monterrey (Mexico) and UGR (Spain), through the COIL in order to connect students and professors in different countries for collaborative projects and discussions as part of their coursework (SUNY, 2022). The experience was based on the premise that working together could strengthen capabilities of a heterogeneous group to develop a joint project. The aim was to boost international vision through sharing with people of different latitudes, profiles, academic levels and backgrounds.

The objective of this COIL activity was to develop students' ability to communicate effectively through online interaction with people from different cultures and disciplines. And also, to develop innovative, critical and analytical thinking, recognising and highlighting the existence and validity of other types of thinking, as well as reflecting, coexisting, dialoguing, sharing, acting and solving problems in contexts marked by social and cultural diversity.

Participant's learning outcomes included the understanding and working efforts with colleagues from diverse cultures, sharing perspectives on specific situations. Also, the development of micro-learning videos with the intention of documenting examples of innovations, thus reinforcing new ways of generating, transferring and certifying learning in formal, non-formal and lifelong learning environments. Moreover, evidence in how to collaborate in international online learning, through participation in shared tasks using Information and Communication Technologies (ICT) tools such as Padlet, Slack and Zoom.

Graduate students from the Tecnológico de Monterrey (Mexico) and undergraduate students from UGR (Spain) connected for three weeks to foster teamwork and technologies for learning and knowledge, innovation and critical thinking. The announcement of the COIL formative experience is presented in Figure 1.

The following are the academic activities carried out in five stages during the three-week COIL:

(1) **Icebreaker activity:** Using Padlet, participants recorded a video presenting their primary information, interests and passions. This activity created a space for mutual acquaintance, knowledge sharing and interactivity. Link to Padlet: https://padlet. com/embed/r87rd3jns3k8kmib

Figure 1.
Collaborative online international learning (https://tinyurl.com/ugrtec2021)

(2) **Kick-off:** This was the first synchronous project meeting, a suitable space to transmit the activities to be carried out and the weighting of each toward passing the experience (Figure 2). It was also when we applied the pre-test, gathering the socio-demographic data of the students and the creativity self-efficacy scale, as stated in the methodology. The synchronous session was conducted with Zoom.

Figure 2.
Kick off session and
meeting recording

(3) **Teamwork:** This was the stage of the group work carried out through different communication platforms. Slack (a collaboration and teamwork platform) was selected as the main starting ICT for collaboration. The participants organised their work times and followed the project work guidelines. They began the teamwork phase seeking to achieve the objectives their teams established. This primary stage allowed the students to design their work methodology, considering the answers they had to give to opening questions for analysis.

(4) **Reflection**: The students had to generate a narrative about the project experience, the virtual meeting among the participants and the academic-professional reflection. The final reflection was presented in Padlet, and the videos generated were uploaded to an open institutional repository to share the teams' productions. Link to Padlet: https://padlet.com/embed/9zfdcz8tw9lmcifi

(5) **Final Live Session**: The students presented their collaborative projects they co-created. They were designed as a response to the problems of innovation in education (Figure 3).

There was a special prize for the team that evidenced the achievement of learning objectives. Hence, during the final session it was announced that one team received support to attend an online conference.

Results

The Kolmogorov–Smirnov normality test with Lilliefors significance correction showed that the data did not follow a normal distribution, since the p-value was below 0.05 for both the pre-test measure (K-S $= 0.162$; $df = 56$; $p = 0.001$) and the post-test measure (K-S $= 0.129$; $df = 56$; $p = 0.020$).

The results derived from the comparisons between the groups of students according to their sociodemographic factors in the post-test phase show that significant differences were found with respect to gender ($p = 0.021$) and university of origin ($p = 0.033$). Thus, hypothesis 1 was partially accepted, since in some socio-demographic factors there are significant differences between groups and in other cases such differences have not been confirmed (Table 2).

Regarding hypothesis 2, the data obtained from the Wilcoxon test, highlight the effectiveness of the micro-learning activities to increase creative competence in the group of students, where there was an increase in the competence level between the measurements made before and after attending the COIL experience within the UGR group ($Z = -2.639$; $p = 0.008$), within the TEC group ($Z = -1.845$; $p = 0.065$) and between the groups ($Z = -3.158$; $p = 0.002$) (Table 3). However, hypothesis 2 is partially accepted, since only the intra-group measurements with the UGR students and with the total group was found to be significant.

On the other hand, the mean scores obtained in the post-test measure were higher than the pre-test measure (Figure 4). Establishing in this case, the improvement of creative competence at the end of the micro-learning activity on the part of the students. In the case of the Tecnológico de Monterrey students, the baseline competence was higher than that of the UGR students.

As for the multiple linear regression model for hypothesis 3, the model presented an adequate fit, although it was not significant ($R^2 = 0.133$; F-statistic $= 1.076$; $p = 0.393$) (Table 4). Furthermore, no independent variable was significant. Hypothesis 3 was therefore rejected.
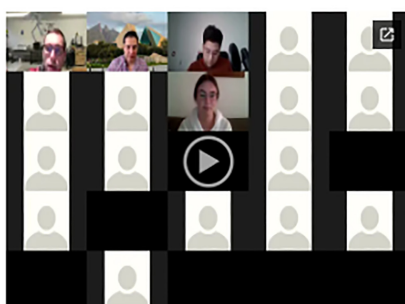

Figure 3.
COIL final session

Discussion and conclusion

It has been possible to demonstrate, in response to the main objective, that micro-learning activities through COIL experiences develop the creative competence of the participating students. After carrying out the Wilcoxon test, it was possible to verify this statement, which corresponds to hypothesis 2, since an increase in the level of competence was obtained between the measurements taken before and after the COIL experience; among the students at the UGR, the score went from 15.63 in the pre-test to 16.6 in the post-test, and in the case of the Tecnológico de Monterrey, from 17.29 to 18.07. The data from the results of the comparisons between the groups of students, taking into account the demographic factors, showed that there are significant differences with respect to gender ($p = 0.021$) and the university of origin ($p = 0.033$), partially confirming the first hypothesis.

Sociodemographic data	n	M	SD	u	p	d
Gender						
Male	3	19.67	0.57	19.000	0.021*	1.80
Female	54	16.81	2.17			
Age						
20 or less	22	16.95	1.78	373.500	0.849	−0.00
21 or more	35	16.97	2.46			
University						
UGR	43	16.60	2.26	187.000	0.033*	−0.74
TEC	14	18.07	1.63			
Difficulty in coping with studies						
Yes	2	19.50	0.70	16.500	0.102	1.61
No	55	16.87	2.19			
Failing any course						
Yes	5	16.80	2.38	121.000	0.816	−0.07
No	52	16.98	2.21			
Have a job related to studies						
Yes	55	16.93	2.24	40.000	0.553	−0.67
No	2	18	0			
Finding a job after graduation						
Yes	33	16.94	2.31	394.000	0.974	−0.03
No	24	17	2.10			

Table 2.
Differences between groups according to their socio-demographic factors

Note(s): *$p < 0.05$

Group	n	M	SD	z	p	d
UGR						
Pre-test	43	15.63	1.71	−2.639	0.008	−0.48
Post-test	43	16.60	2.26			
TEC						
Pre-test	14	17.29	1.97	−1.845	0.065	−0.43
Post-test	14	18.07	1.63			
Total						
Pre-test	57	16.04	1.90	−3.158	0.002	−0.44
Post-test	57	16.96	2.21			

Table 3.
Intra-group and inter-group comparisons on creative competence

This result coincides with the conclusion reached by Vázquez *et al.* (2022) in their study, which confirms that creative competences are fostered through collaborative experiences. Many studies have demonstrated the potential of COIL experiences for the development of complex competences such as: intercultural competence, ethical sensitivity, global and responsible citizenship development and improved academic performance, among others (Harris *et al.*, 2021; Jacobs *et al.*, 2021; King-Ramírez, 2020; Hammond and Radjai, 2022; Mestre-Segarra and Ruiz-Garrido, 2022; Cotoman *et al.*, 2022; Muñoz-Escalona *et al.*, 2022; West *et al.*, 2022).

In light of the results, it can be affirmed that COIL experiences are an innovative and highly effective way of developing complex competences that are fundamental for students' personal and professional futures. In particular, it has been shown that creative competence can be developed in this way, which allows for solving any kind of problem in the most appropriate way, which is essential in all disciplines.

It is essential to develop complex competences that enable students to function effectively in the complex society in which they live. In this line, some of the key skills focus on the promotion of critical, systemic, scientific and creative thinking.

Moreover, COIL enables the integration of learning experiences with students from different contexts around the world, through digital technologies, bringing collaborative learning to all individuals, without spatial limitations. This learning methodology provides active learning within a virtual environment, enabling the development of complex competences as well as training responsible global citizens and enabling curricular changes.

It can be concluded that, with the use of these collaborative experiences, it is possible to develop the creative competence that is so important for the future employment of students in any field of knowledge.

The limitations of this study were linked to the sample loss of some cases, as some students did not complete the post-test measure. In addition, the development of the group work among the students was somewhat complex due to time and cultural differences. Nevertheless, the sample was more than sufficient to justify the study data and the COIL was carried out without any impediment.
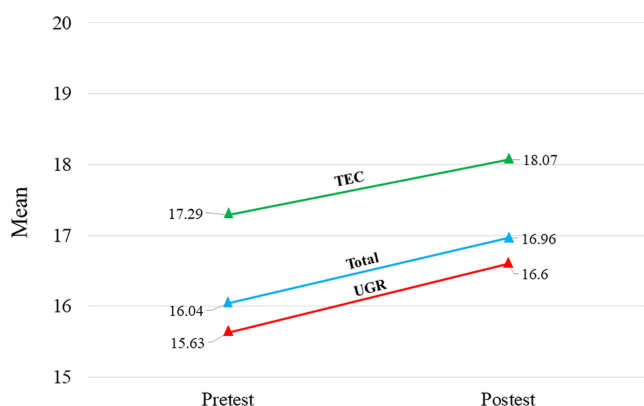
Figure 4.
Comparison of the level
of creative competence
between the
measurements before
and after the micro-
learning experience

Independent variable	B	SE	T	β	p
Gender	−0.237	2.374	−0.979	−0.237	0.332
Age	−0.047	0.639	−0.335	−0.047	0.739
University	0.200	0.768	1.329	0.200	0.190
Difficulty in studies	0.019	2.767	0.083	0.019	0.934
Failing any course	0.039	1.121	0.266	0.039	0.791
Have a job related to studies	0.105	1.682	0.745	0.105	0.460
Finding a job after graduation	0.061	0.623	0.434	0.061	0.666

Note(s): B = coefficient; SE = Standard error; T = coefficient based on the T of Student; β = standardized coefficient; *p < 0.05

Table 4.
Multiple linear
regression analysis
before micro-learning
experience

With regard to future lines of research derived from this work, it is proposed to continue investigating the evaluation of other complex competences that the use of COIL can develop, in order to have a global idea of the potential of this type of virtual collaborative learning.

It is clear that the future of learning is moving towards other forms of global learning that break down the barriers of physical space and give the learner an active role. This allows them to fully develop their competences and offers them an intercultural perspective, which favours open-mindedness and understanding of the world.

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