Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

https://doi.org/10.23913/ride.v15i29.2087

Scientific articles

El Aprendizaje basado en proyectos en un contexto virtual y su impacto en el aprendizaje del inglés

Project Based Learning in a Virtual Environment and Its Impact in English Learning

Aprendizagem baseada em projetos em contexto virtual e seu impacto na aprendizagem de inglês

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Resumen

El Aprendizaje Basado en Proyectos (ABP) es una metodología utilizada para facilitar el aprendizaje del idioma inglés en entornos presenciales y virtuales. Sin embargo, los informes de investigación, hasta ahora publicados, han documentado el impacto de esta metodología en el aprendizaje del inglés en contextos virtuales desde la perspectiva de los estudiantes. Aquellos que se han enfocado a evidenciar el resultado de esta metodología mediante evaluaciones diagnóstica y final han sido en contextos presenciales. Con estos antecedentes como antesala, se propuso como objetivo de la presente investigación evaluar, mediante un examen diagnóstico y un examen final, el impacto en el aprendizaje de los estudiantes de una

intervención educativa de inglés en modalidad virtual guiada en la metodología del ABP. Se condujo una investigación cuantitativa de tipo pre-experimental con un diseño de preprueba/posprueba con un solo grupo. La muestra fue de conveniencia y estuvo conformada por 16 estudiantes. Previo a la intervención se aplicó un examen diagnóstico y al concluir, un examen final. La prueba de los rangos con signos de Wilcoxon dio como resultado que se rechazara la hipótesis nula ya que si hubo diferencia significativa entre los resultados de ambos exámenes. El valor W fue menor al .5% del valor crítico W. Aunque la muestra fue reducida y no se analizaron aspectos tales como frecuencia de interacción con los contenidos del curso, resultado de los proyectos realizados o percepción de los estudiantes, los resultados permitieron valorar el impacto del ABP en el aprendizaje de los estudiantes.

Palabras claves: Aprendizaje virtual, evaluación, inglés.

Abstract

PBL (Project Based Learning) is a methodology employed to facilitate English language learning in face to face and virtual environment. However, research reports have informed the impact of this methodology in virtual contexts only from students' perspectives until now. Those studies that have focused their attention to evidence the impact of this methodology via diagnostic and final examinations have been in face-to-face contexts. With this background panorama, the present research study aims to evaluate, through a diagnostic and a final exam, the impact of an English virtual intervention based on PBL methodology on student learning. A pre-experimental quantitative investigation was carried out with a pretest/posttest design involving a single group. The sample consisted of 16 students selected for convenience. Prior to the intervention, a diagnostic exam was administered; and after concluding, a final exam was conducted. The Wilcoxon signed-rank test provided sufficient evidence to reject the null hypothesis. This rejection indicates that there is a statistically significant difference between the results of the two tests. The W value was less than 0.5% of the critical W value. Although the sample size was small, and aspects such as interaction frequency with course content, project outcomes, and student perception were not analyzed, the results allowed for an assessment of the impact of PBL on student learning.

Keywords: Virtual learning, evaluation, English.

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Resumo

Project Based Learning (PBL) é uma metodologia utilizada para facilitar o aprendizado da língua inglesa em ambientes presenciais e virtuais. No entanto, os relatórios de investigação publicados até agora documentaram o impacto desta metodologia na aprendizagem de inglês em contextos virtuais na perspectiva dos alunos. Aqueles que se concentraram em demonstrar o resultado desta metodologia através de avaliações diagnósticas e finais foram em contextos presenciais. Tendo esse pano de fundo como prelúdio, o objetivo desta pesquisa foi avaliar, por meio de um exame diagnóstico e um exame final, o impacto na aprendizagem dos alunos de uma intervenção educacional de inglês na modalidade virtual orientada pela metodologia PBL. Foi realizada uma pesquisa quantitativa pré-experimental com delineamento pré-teste/pós-teste com grupo único. A amostra foi de conveniência e composta por 16 estudantes. Antes da intervenção foi aplicado um exame diagnóstico e ao final um exame final. O teste dos postos sinalizados de Wilcoxon resultou na rejeição da hipótese nula, uma vez que houve diferença significativa entre os resultados de ambos os testes. O valor W foi inferior a 0,5% do valor crítico W. Embora a amostra tenha sido pequena e não tenham sido analisados aspectos como frequência de interação com os conteúdos do curso, resultados dos projetos realizados ou percepção dos alunos, os resultados permitiram-nos avaliar o impacto do PBL na aprendizagem dos alunos.

Palavras-chave: Aprendizagem virtual, avaliação, inglês.

Reception Date: April 2024 **Acceptance Date:** September 2024

Introduction

English is a language of communication that facilitates access to cutting-edge science and technology, enables international business transactions, provides better job opportunities, and enables effective interaction when traveling abroad. In short, “English is the language of technology, commerce, and science” (Graddol, 2006 as cited in Santana-Villegas *et al.*, 2016, p. 80). Currently, this language has 1,452 million speakers in the world (Fernández, 2023).

As a consequence, since it is a language of communication, alternative ways to the face-to-face modality have been sought to spread its learning. One of the alternatives is virtuality. For example, in countries such as Colombia and Costa Rica, this modality has been implemented as a government educational initiative. The Ministry of National Education of Colombia promotes “the use of new technologies in the teaching-learning of foreign languages through virtual training” (Mendoza-González, 2015, p. 126). And in Costa Rica,

since 2013, “approximately 25,000 students have benefited from the 'Ceibal' program in English” (p. 131).

In Mexico, virtual learning is an option that has been used to promote English learning in institutions such as the National Autonomous University of Mexico, the National Polytechnic Institute, and the Open and Distance University of Mexico. These institutions provide study materials and practice activities so that students can progress independently and at their own pace. For example, the Virtual Language Environment website of the National Autonomous University of Mexico specifies that the materials are for practice and self-assessment (UNAM-CUAED).

While the National Polytechnic Institute (IPN), according to the information that appears on the portal of the Center for Foreign Languages (sf), offers two alternatives, one gives access to the platform so that the student can carry out the activities at his own pace. The second is for the student to carry out the activities according to a schedule (Center for Foreign Languages, sf). In turn, the Latin American Institute of Educational Communication (sf) in collaboration with the Open and Distance University of Mexico, has a virtual program called Sepa Inglés *Online,* which provides materials by level and offers the support of teachers. Public education in the country also needs to invest material and human resources in the development of distance learning plans as an alternative for higher education students, say Aguirre-Caracheo. *et al.* (2022).

According to the above descriptions, the courses offered by these institutions have two main features: autonomy and flexibility so that the student can progress at his or her own pace. This is accurate if one considers that both autonomy and flexibility characterize learning environments in virtual settings (Sangrá and Girona, 2013; Quijada-Monroy, 2014). However, one must also consider that in virtual environments “it is possible [for students] to carry out activities in collaboration with other classmates and together build knowledge” (Quijada-Monroy, 2014, p. 7).

It is precisely through the Project-Based Learning (PBL) methodology that collaboration between students and the learning of English in a virtual environment can be encouraged. In general, PBL is a student-centered methodology (Parra-Pineda, 2003). Its foundations are attributed to Dewey due to the importance attributed to multidisciplinary projects, as well as to social learning through collaboration (Gómez-Pablos, 2018). According to Mergendoller, *et al.* (2006, as cited in García- Varcálcel Muñoz-Repiso and Basilotta Gómez-Pablos, 2017) “empirical evidence suggests that PBL has a positive effect

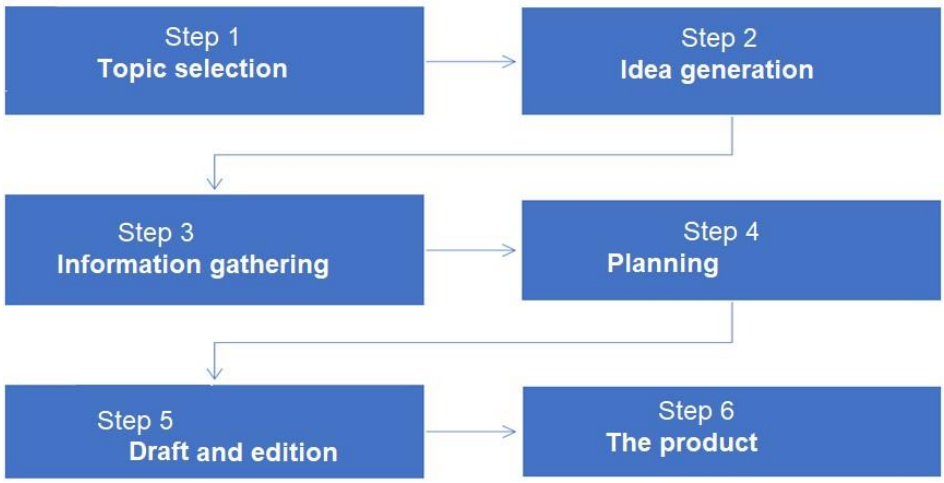
on students' acquisition of knowledge, the development of skills such as collaboration, critical thinking, and problem solving" (p. 115).

According to Herrera-López and Moreno-Beltrán (2023), one of the most complex aspects that teachers face when establishing PBL is the selection and formulation of a problem or project topic that is relevant and is attached to the contents displayed in the course. The problem or project topic as such must maintain a high expectation, as well as a constant motivation for the students. Adding to the above, Olivo-García *et al.* (2023) affirm that education has acquired increasing importance in the current context. Both teachers and students face difficulties due to the lack of knowledge in the use of technological tools and in the application of good practices with this type of learning.

In regard to English, through the completion of projects, the integration of the four basic skills (speaking, listening, reading and writing) is achieved (Harmer, 2010). In addition, PBL allows the student to "participate in assertive communication while completing activities satisfactorily, making use of natural language" (Tsiplakides and Fragoulis, 2009, as cited in Aldana-Pérez, 2018, p. 142). This methodology facilitates interaction, language practice and, therefore, learning is promoted as well as the development of the four skills. Likewise, as Hernández-Ham *et al.* (2024) affirm, teaching and learning a language other than the native language presents a variety of mechanisms, many of which are adapted to the individual needs of the student.

The implementation of PBL follows a sequence consisting of six stages. Figure 1 shows the process to be followed for the implementation of PBL as a teaching strategy.

Figure 1. Stages for implementing a project.



Source: Prepared by the authors based on Harmer (2010).

First, the topic is selected. To do this, the teacher, the students or by mutual agreement decide on the topic of the project.

Students then decide, with the guidance of the teacher, what to include in the project and where to research. Students then conduct research in various sources (newspapers, encyclopedias, the Internet, etc.).

Students then decide what information to include in the project presentation. To do this, they draft an outline of what will be included in the product (project). Feedback can be provided by the teacher or other students.

Finally, the product (project) is created, which can be a written report, an oral presentation, a video or an audio, to mention a few examples.

Several studies have shown evidence of the impact of implementing PBL on learning in face-to-face environments; for example, Yang and Puakpong (2016) investigated the effect of this methodology through the application of diagnostic and final exams. The results showed that students' oral expression improved significantly. Among the reasons are that project-based learning "integrates real-life activities and projects that are meaningful and related to students and the curriculum" (Yang and Puakpong , 2016, p. 423). In addition, it was observed that students took responsibility for their own learning by working independently and collaboratively with their peers. Regarding the acceptance of this methodology, it is worth mentioning that most students considered that they had worked in a pressure-free learning environment.

On the other hand, Asensio-Arjona (2017) showed, as a result of the implementation of PBL, that the means of the diagnostic and final exams reflected, overall, a significant difference. The mean of both exams was 5.48 and 6.79 respectively. These results, together with the assessment of qualitative aspects such as satisfaction and self-perception, teacher observation and assessment of oral expression allowed the implementation of PBL to be evaluated as positive because learning was motivated and contextualized through the practice and development of the four skills (p. 324).

Likewise, Astawa *et al.* (2017) found a significant difference in the results of the diagnostic and final exams. Students obtained a higher grade in the final exam; therefore, their written and oral production skills improved. Consequently, these authors suggest the integration of PBL especially in contexts where English is taught as a foreign language (p. 1153).

As far as virtual environments are concerned, research reports related to PBL are limited and have mainly focused on analyzing its benefits from the learner's perspective. For example, Asfihana *et al.* (2022) found that, according to students' opinions, participation and motivation are also promoted in a virtual environment. In addition, digital skills, critical thinking, collaborative work, and communication are developed. In turn, Mali and Timotius (2018) investigated students' behavior in relation to positive attitude, self-confidence, and anxiety regarding the PBL methodology in a computer-assisted language learning environment. The results showed no significant differences in students' attitudes, confidence, and anxiety levels before and after taking the course.

In summary, PBL and its impact on English language learning has been examined primarily in face-to-face contexts. With regard to virtual learning contexts, research on this topic has essentially focused on recognizing how students perceive the benefits of this methodology. However, no studies were found that aimed to evaluate the impact of PBL on English language learning through examinations. Based on this reality and on the grounds that:

1) Virtuality is considered an effective modality for learning English, according to Mendoza-González (2015).

2) The results of a diagnostic study carried out at the Language Center of the Coatzacoalcos-Minatitlán Region of the Universidad Veracruzana showed the interest of students in the virtual modality and in the PBL methodology (Marín-Sánchez and Moreno-Beltrán, 2022).

3) This institution did not offer general-purpose English courses in virtual mode. The objective of this research was to evaluate the impact on student learning by implementing an English educational intervention guided by the PBL methodology in virtual mode through a diagnostic exam and a final exam.

During the planning of the educational intervention, the course curriculum was developed, the instructional design was done, and the virtual learning objects (VLOs) were created. It was decided to carry out an initial level intervention, since it would be the first time that a general purpose English course would be taught in virtual mode at the institution where the research was conducted.

As regards the classification of levels, according to the Common European Framework of References for Languages, level A1 corresponds to the initial level. The

speaker who has level A1 can interact in a simple way by means of questions and simple statements on everyday topics (Council of Europe, 2020).

Based on the descriptors for level A1 of the Common European Framework of Reference for Languages, the general objective was set and the topics of the two modules of the course were integrated. The general objective of the course was that the student would be able to use simple phrases in English about personal information and about their environment through interactive activities that would allow them to practice reading and listening comprehension in order to develop written and oral expression. Table 1 shows the general data of the educational intervention.

Table 1. General characteristics of the intervention.

Level	Mode	Methodology	Instructional design	Duration	Name of Modules
A1 of the Common European Framework of References for Languages	Virtual	Project Based Learning (PBL)	Model 4C/DI (Four Components of Instructional Design: a learning task, supporting information, procedural information, and practice of parts of the task)	25 hours	My classmates and me A place I know well

Source: Own elaboration.

A fundamental part of creating a course is choosing the instructional design model. Its purpose is to guide students in their learning process through the content; that is, the materials, strategies, and activities. The content in turn obeys the stated learning objectives. Instructional design is considered to be "the applied art and science of creating a clear and effective instructional environment and materials that will help students develop the ability to accomplish certain tasks" (Broderic, 2001, as cited in Álvarez-Duarte, 2020, p. 29).

Similarly, Vergara-Avalos et al. (2024) argue that it is crucial to reflect on the changes that have occurred in the instructional design of e-learning courses, as these modifications have shown that online education has the potential to offer flexible and accessible opportunities for learning, although they have also underlined the need for careful planning and constant attention to the quality of the design.

Additionally, online instructional design models and approaches can be useful for developing effective virtual education courses tailored to the needs of stakeholders, so that they can communicate without having an assigned space (Olivo-García *et al.,* 2022).

The intervention design process followed the guidelines of the 4C/ID model developed by Van- Merriënboer (2019). The four components of this model are: a) a learning task, b) supporting information, c) procedural information, and d) practice of parts of the task. These elements were reflected in the intervention content as follows: a) the project; b) vocabulary, grammatical structures, pronunciation of words, etc.; c) text, audio, and video guides for the development of the project and for practice activities; as well as d) interactive exercises through the OVAs, interactions in the forums and video forums, synchronous sessions for practicing oral expression, and preliminary activities to create the project.

The H5P tool was used to create the OVAs because, in addition to being free, it allows the creation of interactive educational content. Additionally, it offers a user-friendly environment for both the designer and the end user. Multiple choice exercises, word dragging, fill in the blanks, true and false questions, as well as memory games, among others, can be designed. In addition to the above, it is considered that the interactivity that this tool offers makes it suitable for a virtual learning environment (Vallejo and González, 2018).

Table 2 shows the contents of the educational intervention in terms of objectives, OVAs, learning activities and tools for each module. The design was made in such a way that the characteristics of PBL and the 4C/ID instructional model were met.

Table 2. Contents of the educational intervention.

Introductory English in virtual mode		
Module I: My classmates and me (April 25 to May 5) Suggested study hours: 7		
Module objective: The student will be able to formulate in English, in written and oral form, personal and third-party information by practicing the corresponding vocabulary and linguistic structures.		
OVAs created	Learning activities	Tools
▪ Introducing yourself- how to do it ▪ Introducing yourself (Some grammar points) ▪ Personal information questions ▪ What's the topic? ▪ Expressing occupations ▪ Hi, I'm ... ▪ School subject	▪ Submit the diagnostic exam. ▪ Interact in the welcome forum. ▪ Participate in the synchronous welcome session. ▪ Review and practice with the OVAs and additional materials provided. ▪ Interacting in video chat ' Introducing yourself '. ▪ Participate in the synchronous session for practicing oral expression	From the platform: ▪ Content ▪ Forums ▪ Activities ▪ Messages Additional: ▪ Google forms ▪ Flip ▪ Zoom
Module 2: I place I know well (May 6-26) Suggested study hours: 18		
Module objective: Students will be able to explain in English what their environment is like in relation to climate, customs, commercial activities and means of transport, in written and oral form, by practising the corresponding vocabulary and linguistic structures.		
OVAs created	Learning activities	Tools
▪ The weather and the temperature ▪ Locating town, city and country ▪ Adjectives - vocabulary ▪ Celebration - vocabulary ▪ Celebrations around the world ▪ Transportation - vocabulary ▪ What do people do in their jobs? ▪ Economic Activities in Peru	▪ Review and practice with the OVAs and additional materials provided. ▪ Interact in the video chat ' How do people around you commute to work or school?' ▪ Carry out the project according to the indicated process. ▪ Participate in the synchronous session to present the project through a dynamic. ▪ Interact via videoconference with an English user in which you introduce yourself and exchange personal information. (This conversation must be video recorded and uploaded to the corresponding forum). ▪ Present the final exam.	From the platform: ▪ Content ▪ Forums ▪ Activities ▪ Messages ▪ Exams Additional: ▪ Flip ▪ Zoom ▪ Tandem

Source: Own elaboration.

The educational intervention was designed in such a way that:

a) Students would interact with the OVAs and additional materials.

b) They would practice oral expression in synchronous group and team sessions.

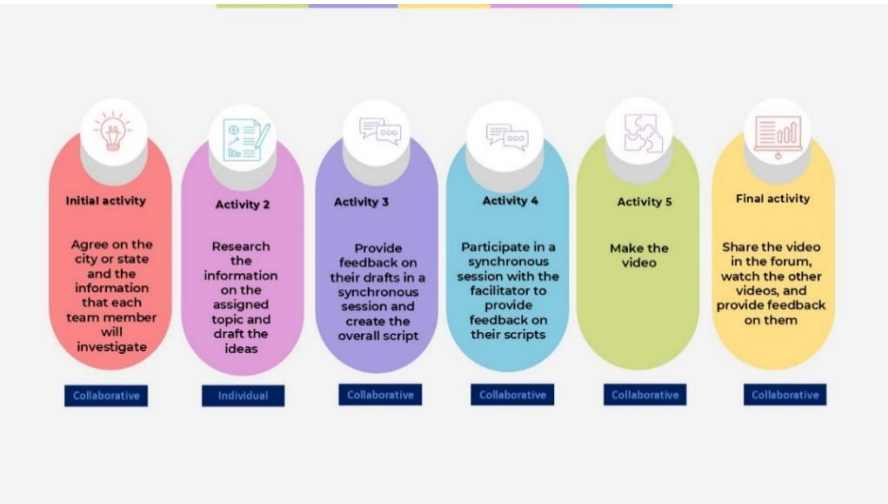
c) They would communicate in writing in discussion forums and orally through video chats.

In addition, guidelines for developing the project were provided, as well as a timetable and an evaluation framework.

The activities were designed to comply with the characteristics of the PBL methodology by carrying out collaborative work, practicing English and providing feedback to peers. The facilitator would act as a guide.

Figure 2 shows the process indicated for the development of the project and the types of interaction generated by each of the activities.

Figure 2. Process for carrying out the project.



Source: Own elaboration.

As part of the activities for the project, students would have three synchronous sessions, two in teams and one in groups. In them they would interact to:

a) review the information that each team member would research and write;

b) carry out the project;

c) present their projects through a communicative activity.

It should be mentioned that in addition to the activities that the students would carry out to develop the project, an attempt was made to encourage study and practice with the content that was created specifically for the intervention.

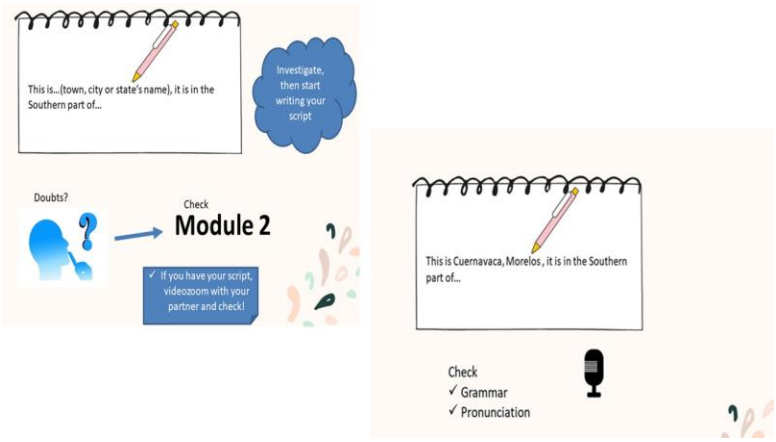
Regarding the project, it consisted of making a video about a city or state in the Mexican Republic. The students had to integrate vocabulary and linguistic structures from the course topics into the script. For this reason, they were provided with a list of topics that should be taken into account for the project and a series of guiding questions (see figure 3).

Figure 3. Guiding questions and topics for creating the script.

Source: Own elaboration.

It was also considered appropriate to indicate the writing process that they should follow and to show an example. Figure 4 presents the instructions and suggestions provided as a guide for writing the script.

Figure 4. Writing process and example.



Source: Own elaboration

Finally, Figure 5 shows the criteria that served as a guide for students to identify, before creating the product (project), whether it met the requested requirements. If not, they could edit it or do it again.

Figure 5. Guiding criteria for video development.

Source: Own elaboration.

The purpose of providing a criterion for the production of the video was to guide the students in such a way that the work was not hindered by a lack of clarity in the tasks to be performed. The development of a project and the relationships between the members of a team are two aspects that can be affected if the instructions are not adequate. The lack of clarity could hinder the development of the project; in this regard Silva-Quizoz (2011) mentions that "when there is no clarity [in the instructions] there are problems of disagreement in the group or team that divert energy and time into clarifying them instead of working" (p. 43) .

Method

Pre-experimental approach with a pretest/posttest design with a single group of participants. This type of research consists of "a group being tested prior to the experimental stimulus or treatment, then receiving the treatment, and finally receiving a post-stimulus test" (Hernández-Sampieri *et al.*, 2010, p. 136).

Prior to the design of the instruments, a review of three free English assessments available online was conducted: Cambridge University Press and Assessment (2024), Education First (sf) and Easylingo (sf). However, none of these were considered suitable for collecting the information that would allow the objectives of this research to be met.

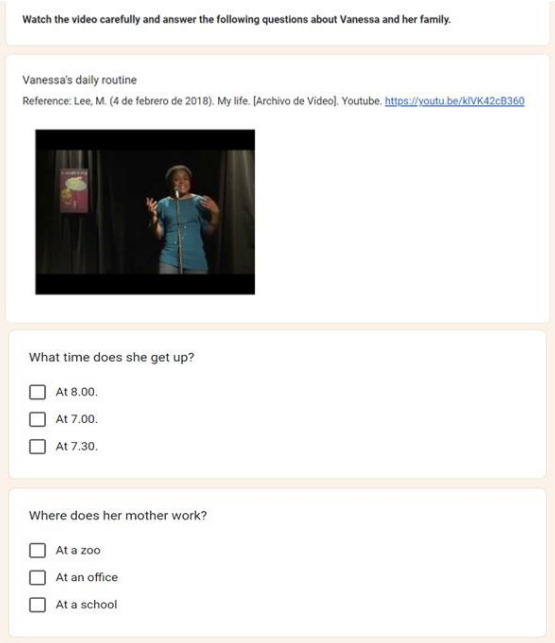
Two instruments were created for data collection, a diagnostic test and a final exam. It was considered pertinent to integrate items to evaluate reading and oral comprehension, as well as written production.

These instruments were used to measure in a general way the students' prior knowledge regarding the topics to be addressed in the intervention. The same instrument was not used in the two assessments to minimize the effect of familiarity.

However, the items corresponded strictly to the course topics and were integrated in such a way that there was a correlation between them and the content of the intervention, and the materials used in the virtual course (Rea- Dickins, 2000). It is worth mentioning that only the written production section was identical in both in order to make a comparison of the development of this skill.

The diagnostic test consisted of 30 items distributed in three sections. The first assessed reading comprehension; the second, written expression; and the third, listening comprehension. Two sections were multiple choice, and one was fill-in-the-blank. Figure 6 shows an excerpt from this section of the test.

Figure 6. Extract from a section of the diagnostic examination.

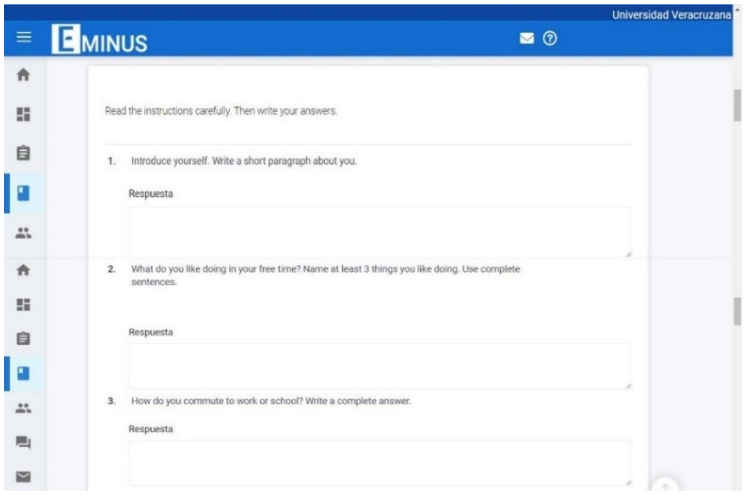


Source: Own elaboration.

The final exam consisted of 40 items distributed in four sections. The first section assessed reading comprehension, the next two assessed written expression, and the last section assessed listening comprehension. Two sections were multiple choice, one was fill-

in-the-blank and the other was fill-in-the-blank. Figure 7 presents an excerpt from the written expression section.

Figure 7. Extract from a section of the final exam.



Source: University of Veracruz (2024).

Both instruments were written with a communicative approach and were reviewed by experts (Salinas, 2004, as cited in Roig-Vila, 2007), piloted with a group of students with similar characteristics to the population studied (Niño-Rojas, 2011) and adjusted before their application.

The sample used in this research was a convenience sample (Arias-Gómez *et al.*, 2016).

The sample consisted of students who agreed to be part of the study. Although 21 authorized their participation through an informed consent protocol, only the data from those students who answered both instruments were analyzed. The sample consisted of 16 people (12 women and 4 men). The participants in this research included high school, college, and university students, as well as teachers, employees, and housewives. Their ages ranged from 15 to 60 years.

Data collection process

The diagnostic test was administered prior to the start of the course. Students were urged to refrain from consulting any material before or during the test to avoid obtaining answers that did not correspond to their prior knowledge. The test was designed to be answered only once and with a time limit.

At the end of the educational intervention, the students took the final exam. Like the diagnostic exam, it could only be answered once and had limited time to prevent them from reviewing the course content or any other support material. Figure 8 summarizes the process followed for data collection.

Figure 8. Data collection process.

Source: Own elaboration.

Analysis of results

To make the comparison between the students' prior knowledge and the effectiveness of the implemented course, a statistical analysis was carried out using the nonparametric Wilcoxon W test. This statistic was chosen because the group was less than 30 students and because it was a single group (Bautista-Díaz *et al.*, 2020). In addition, it is the most convenient when "you want to demonstrate the results of a test before and after" (López-Moreno, 2021, p. 212). It should be noted that in this research it was not possible to have an experimental group and a control group because, as mentioned above, the course was implemented for the first time.

The matrix was developed with the data from both tests. Afterwards, data was cleaned by identifying the number of individuals; this action avoided duplication or omission of any participant (Bizquerra-Alzina, 2009, p. 263). Table 3 shows the data matrix that was used to compare the results of both instruments.

Table 3. Data matrix with exam results.

Student	Diagnostic test	Final exam
1	3.25	8.1
2	7.375	8.8
3	4.625	9.5
4	4.75	8.6
5	5.125	8.8
6	7.5	8.8
7	7	8.3
8	2.5	8.8
9	3.5	10
10	3.5	8.8
11	6	9.5
12	8.25	9.3
13	6.625	8.5
14	1.5	6.4
15	6.375	9.1
16	5.25	10

Source: Own elaboration.

By comparing the scores obtained in both exams, the median was identified because it is "the measure of central tendency most commonly used in this type of statistics [nonparametric tests]" (López-Moreno, 2021, p. 211). The median of the diagnostic exam was 5.18 and that of the final exam was 8.8. A table of critical values was used to calculate the Wilcoxon signed rank test.

The statistical hypotheses established for this research were the following:

H0: There is no significant difference between the results of the diagnostic examination applied before the intervention and the final examination applied after it.

H1: There is a significant difference between the results of the diagnostic examination applied before the intervention and the final examination applied after it.

The identification of the critical value W was done using the data shown in Table 4, taking the .5% error. The null hypothesis is rejected because the value W is less than the critical value W.

Table 4. Sign test.

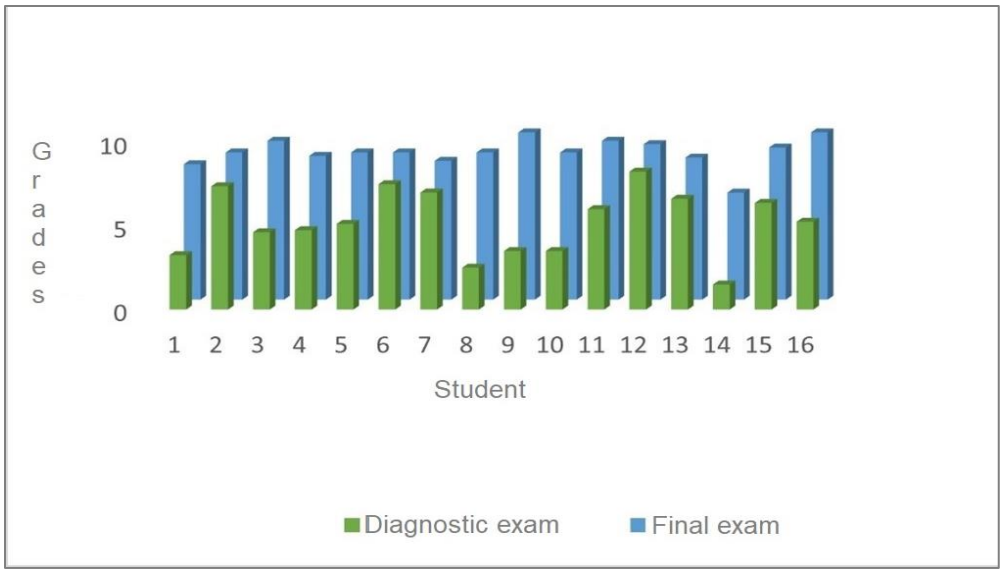
N +	0
Expected value	8
Variance (N+)	4.000
p-value (two-sided)	< 0.0001
alpha	0.05
The -p value is calculated using an exact method.	

Source: Own elaboration.

The Wilcoxon signed rank test showed significant differences between the results of the diagnostic test applied at the beginning of the course and the final test applied at the end of the implementation. Based on these results, the null hypothesis (H0) is rejected and the alternative hypothesis (H1) is accepted; that is, there is a significant difference between the results of the diagnostic evaluation applied before the intervention and the final test applied after it.

It is worth mentioning that all students obtained a higher grade in the final exam, that is, after the intervention. As can be seen in Figure 9, the results obtained in the first exam were significantly lower compared to the results of the second.

Figure 9. Comparative results of the diagnostic and final evaluations.



Source: Own elaboration.

It should be added that several students received a failing grade on the diagnostic exam, but their score improved on the final exam. Most of them received a grade higher than 8 on the evaluation carried out after the intervention. This contrast of results allows us to identify the progress of the students throughout the course.

In addition, in the written production section of the diagnostic exam, students left items unanswered; they expressed their ideas in Spanish or wrote their answers in English with short sentences, sometimes with grammatical errors.

In the same section of the final exam, complete statements were observed with a minimum of errors. As an example, Table 5 shows the answers obtained in one of the items.

Table 5. Comparison of responses to the item on personal information.

Student	Diagnostic test	Final exam
1	Answer in Spanish	I am […], I'm [...] teacher in my free time I go for a walk with my husband, sometimes we have coffee. I really like my job. Thank you.
2	Unanswered	Hi, my name is […], I'm from Coatzacoalcos, I'm 42 years old, I'm an accountant and I like pizza.
3	My name is […], I industrial engineering, I work in […].	Hello, my name is […], my last name is […], I'm twenty six years old, I work at […], I am a project control engineer, I to commute bus and taxi to work.

Note: Personal data of students has been omitted by using brackets and ellipses. Example […].

Source: Own elaboration.

It was also striking that in their responses they used vocabulary and linguistic structures from the intervention content. For example, in the item in which they were asked for personal information, they were able to expand their answers and provide additional information to their name and age. The use of vocabulary for occupations (*teacher, accountant, project control engineer*), tastes and preferences (*I like pizza, I like my job*) and daily activities (*go for a walk, have coffee, work, commute).* In addition to the almost always correct integration of the linguistic structures of the verb *to be and* the simple present (see table above).

Discussion

The instruments applied in this research allowed us to achieve the stated objective since it was possible to know the impact of the PBL methodology on learning English in an intervention implemented in a virtual environment. It cannot be denied that, although information and communication technology tools are used in daily life for countless activities, their acceptance is almost nil in education (Parra, 2022). In the same way, the spaces, resources and functionalities of technological tools allow the development of new ways of teaching and learning to improve virtual education, Vergara-Avalos *et al.* (2022).

The results obtained in this research shed light on the effectiveness that the implementation of virtual courses based on the 4C/ID model and PBL can have for learning the English language. Students scored significantly higher on the final exam compared to the results of the diagnostic exam. These results coincided with the reports by Asensio-Arjona (2017) and Astawa *et al.* (2017) who, although their studies were carried out in a face-to-face environment, showed that students obtained a higher score in the final exam as a result of the implementation of the PBL methodology. Similarly, Moreno-Beltrán (2020) states that, by implementing these strategies, students correctly relate prior knowledge with new knowledge.

Regarding the written production section, the results were significantly different. In the diagnostic test, applied before the intervention, unanswered items, answers in Spanish or with short sentences were observed. However, in the final exam, the answers were more complete, entirely in English and with a minimum of errors. Additionally, the use of vocabulary and linguistic structures, reviewed through interaction with the OVAs and which they also integrated into their projects, were observed. These results coincide with those obtained by Barahona-Mora (2020) regarding the use of vocabulary and appropriate use of linguistic structures.

The results obtained in both instruments allow us to affirm that there was a positive impact on student learning. In this educational intervention, the PBL methodology and the 4C/ID model were combined in such a way as to promote student-content, student-student, and student-facilitator interaction. It is worth mentioning that student-student interaction was fostered through forums and video chats, but also for the creation of the project in teams and in the interactions of the synchronous sessions. These practices influenced the final exam score and, therefore, their learning.

These results must be interpreted with caution because the sample size was small. Only 16 students were able to participate, and the intervention was implemented only once. However, the difference in the results of both tests allows us to affirm that the educational intervention that integrated the PBL methodology and the 4C/ID instructional design through the creation of learning objects for a virtual context had a positive impact on student learning. This generalization is made based on previous studies that, although they documented the results in face-to-face contexts, coincided with the results obtained in this research. The difference between the scores of the diagnostic test and the final exam was significantly different. The students scored better on the final exam, this as a result of the intervention.

It is necessary to clarify that, in order to obtain favorable results, as in this research, it will be pertinent to make a rigorous design in which contents are integrated based on the guidelines of PBL and the 4C/ID instructional design. Since sometimes the student is not guided regarding the process and attention is only paid to the result of the requested project or projects. When what influences students to practice the English language and learn to communicate is the interaction with their classmates and the guidance during the development of the course project(s).

Conclusions

By comparing the results of the diagnostic and final exams, it was shown that English language learning can be fostered in a virtual environment. The difference obtained in both scores measured the prior knowledge and the favorable outcome of the intervention. The practice of vocabulary and linguistic structures through the VLOs and the collaboration and interaction in a virtual environment to do the project influenced the performance obtained in the final exam since the students scored higher. In addition, because the students were able to write their ideas in English in an efficient way; they used vocabulary and linguistic structures reviewed and practiced during the intervention.

The results of this research support the proposal to develop virtual English courses whose methodology promotes collaboration between students through PBL, as well as 4C/ID instructional design.

In conclusion, these results showed that 1) English language learning can take place in a virtual environment; 2) practicing vocabulary and linguistic structures through the VLOs and collaborating and interacting in a virtual environment to do the project influenced the performance obtained in the final exam and 3) students were able to write down their ideas

in English in an efficient way. Therefore, the findings of this research support the feasibility of integrating the PBL methodology in English courses for a virtual environment as an alternative to promote English learning.

Contributions to future lines of research

The research documented here focused on demonstrating the impact of the PBL methodology on learning the English language through an educational intervention framed in level A1 of the CEFR in virtual mode through exams focused on reading comprehension, oral comprehension and written production. Therefore, the following are proposed as future research topics:

Evaluate the impact of this methodology on the development of oral expression through diagnostic and final evaluations.

Identify the impact of an intervention with these same characteristics, but at other CEFR levels such as A2, B1 or B2, to mention a few.

To understand students' perception of the PBL methodology in a virtual intervention.

Evaluate the impact of the PBL methodology based on the time spent interacting with the intervention materials.

Acknowledgements

We express our sincere gratitude to the Autonomous University of Querétaro, the University of Veracruz and the National Council of Humanities, Sciences and Technologies, Mexican institutions that together made this research possible.

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