



## Gamification and collaborative online learning: an analysis of strategies in a Mexican university

### *Gamificación y aprendizaje colaborativo en línea: un análisis de estrategias en una universidad mexicana*

 **Dr. William Reyes-Cabrera** is a professor and researcher at Universidad Autónoma de Yucatán (México) ([wreyes@correo.uady.mx](mailto:wreyes@correo.uady.mx)) (<https://orcid.org/0000-0002-3443-6385>)

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### Abstract

Despite distance education has proved its benefits in the teaching process, one of its main shortcomings is the lack of its own strategies, however, gamification is considered as an effective tool to work with on this modality. Based on the above, a pre-experimental, exploratory, quantitative research study was carried out in a Mexican university following the next objectives: identifying the level of incidence that gamification strategies have regarding collaborative learning in a distance course from the perspective of university students; as well as checking if there are significant differences between the different gamification strategies in collaborative learning of university students. A distance course was used, for this purpose where three gamification strategies were performed (PBL, Digital StoryTelling and Escape Room); students answered then the COLLES instrument at the end of each of these strategies to find contrast to the responses obtained. Thus, the means, standard deviations and ANOVA of one factor for repeated samples were compared. The results indicated that all three strategies had a positive impact on collaborative learning, however, there are significant differences in their scales. It is concluded that the characteristics of each strategy are key in achieving online collaborative learning. It is recommended to select and articulate gamification strategies when designing a distance course considering constant measurements to identify and maintain the levels of collaborative learning.

**Keywords:** Education, measurement, learning, collaboration, gamification, strategy.

### Resumen

Aunque la educación a distancia ha demostrado sus beneficios en el proceso de enseñanza, una de sus principales carencias es la falta de estrategias propias; sin embargo, la gamificación se considera como una herramienta efectiva para trabajar en esta modalidad. Por ello, se realizó una investigación de enfoque cuantitativo, de alcance exploratorio del tipo preexperimental en una universidad mexicana con los siguientes objetivos: identificar el nivel de incidencia que tienen las estrategias de gamificación en el aprendizaje colaborativo en un curso a distancia desde la perspectiva del estudiantado universitario; y comprobar si existen diferencias significativas entre las diferentes estrategias de gamificación en el aprendizaje colaborativo del estudiantado universitario. Se utilizó un curso a distancia donde se emplearon tres estrategias de gamificación (Tríada PET, Digital StoryTelling y Escape Room); el alumnado contestó el instrumento COLLES al finalizar cada una de estas para contrastar las respuestas obtenidas, por lo que se compararon las medias, desviaciones estándar y la ANOVA de un factor para muestras repetidas. Los resultados indicaron que las tres estrategias incidieron en el aprendizaje colaborativo, aunque existieron diferencias significativas en sus escalas. Se concluye que las características de cada estrategia son determinantes para lograr el aprendizaje colaborativo en línea. Se recomienda seleccionar y articular las estrategias de gamificación en el diseño de un curso a distancia y realizar mediciones constantes para identificar y mantener los niveles de aprendizaje colaborativo.

**Descriptores:** Educación, medición, aprendizaje, colaboración, gamificación, estrategia.

## 1. Introduction

Distance learning (DL) has become more relevant in recent years, driven mainly by the evolution of technology, social, economic and recent changes as an alternative to continuing daily activities from home, as a result of the pandemic that affects humanity. In addition, it has demonstrated its advantages over face-to-face education, mainly because of the flexibility in working hours, in access to resources for carrying out tasks, as well as the technological support that is more affordable for both institutions and most of students (Pattanshetti et al., 2018). Other advantages are the degree of experience that teachers and students have in the management of educational platforms for synchronous and asynchronous activities, in addition to the already widespread social acceptance of this modality (Teo et al., 2020), which allows it to be present at all levels of education. However, gaps have been observed in the planning and implementation of teaching and learning strategies relevant to the DL (Al-Jedaiah, 2020), which has led to the adaptation of strategies from face-to-face education to virtuality or a “repackaging of traditional instructional strategies” (Wiggins, 2016, p. 27), as well as the growing concerns in the little socialization that students have by not interacting physically with other peers, now increased by current mobility restrictions, causing desertion, dropout of studies, and even emotional and psychological problems (Boverman & Bastiens, 2020).

Facing these scenarios, it is essential to have strategies to motivate students to continue formal studies in DL, specially to improve the learning conditions, beyond being considered a technology-based learning (Teo et al., 2020), to achieve unique learning experiences with digital tools and own strategies for DL (Barna & Fodor, 2019). There are various strategies and methodologies aimed at achieving these new ways of learning in virtuality, being gamification an effective tool in distance and online learning (Rebelo & Isaias,

2020) since it can motivate and engage students to continue the training process (Poondej & Lerdpornkulrat, 2019), enhancing the experiences of new generations at all educational levels by using this type of strategies and current technological resources (Duggal et al., 2021).

### 1.1. Gamification and its strategies

Gamification is the “use of game elements in non-playful contexts” (Deterding et al., 2011, p. 2425); a method (Rodriguez & Arias, 2020) addressed to motivate (Laine & Lindberg, 2020), which can induce behavioral changes and strengthen participant engagement (Hamari et al., 2016); however, the superficial application of gamification, only considering the basic aspects of the game and not the pedagogical and learning character, allows gamification to generate frustration and boredom (Khoshkangini et al., 2021), hence, it is recommended to use various strategies to maintain levels of care and motivation. In this sense, Kapp et al. (2014) point out that the structure of gamification events or “interactive learning events” (p. 2) should be focused on the content of the learning units without losing the experiences generated by games. For its part, Kingsley and Grabner-Hagen (2018) state that the entire course, both in vocabulary, mechanics and component design, must be game-oriented; while Werbach and Hunter (2015) point out that for an activity to be considered as gamification, three or more mechanics must be used.

Although gamification does not have strategies of its own, there are several that are related to it (Silva et al., 2019). For example: one of the most widely used strategies is the PBL triad [Points, Badges and Leaderboards] or PET: Points, Emblems, and Leaderboards. PBL is a basic strategy in gamification that consists of using three mechanics: a point system for participants in performing an activity; emblems or badges that are awards for achieving a goal in any of the activities in an outstanding way; and the classification tables, considered a “ranking”



generated according to the scores and emblems obtained by the participants (Werbach & Hunter, 2015; Fernandes et al., 2018). Another of the most widely used strategies is Storytelling or Digital Storytelling if using digital resources (Buendgens, 2021), where the narration of a story that involves the participants is developed, taking the role of the characters in that story. This narrative is divided into chapters or episodes that go through as participants make decisions for the progression and their completion (Lawrence & Paige, 2016; Gambarto & Dabagian, 2016). Finally, the strategy of Escape Room (Fotaris et al., 2016; Bartlet & Anderson, 2019) known in Spanish as the Escape Room or Breakout in English, which consists of having a group of people in a closed room, in which, in order to get out, they must solve a series of clues or puzzles associated with the subject. In distance courses, rooms and puzzles are digitally generated and participants must resolve them collaboratively through their internet-connected devices (Jiménez et al., 2020).

## 1.2. Collaborative Distance Learning

Collaborative learning is an educational approach to teaching and learning for students to work together to solve a problem, complete a task, or create a product (Laal & Laal, 2012). This form of learning has been used in the classroom with good results (Laal & Ghodsi, 2012) and it has allowed DL to develop successfully, especially with the support of information and communication technologies (Al-Samarraie & Saeed, 2018); however, the main challenge lies with teachers and experts when designing learning experiences and academic performance in an online environment (Kumi-Yeboah, 2018). To study collaborative learning, different research has been carried out (Syed-Mohamad et al., 2006; Fraternali & Herrera, 2019; Azhari et al., 2020), which have enabled a number of key indicators to identify collaborative online learning, such as reflexive thinking, interaction, support

from teachers, peers, interpretation, relevance, and others; from which online collaborative learning can be measured using the strategies and materials used in the learning units in a DL course (Taylor & Maor, 2000; Yen et al., 2018).

## 1.3 Research objectives

Aunque se ha demostrado que la gamificación promueve la motivación y el compromiso por aprender, se necesita identificar cómo incide en el aprendizaje colaborativo. Por lo tanto, es necesario conocer el efecto de estas estrategias que son cada vez más utilizadas en los contextos educativos a distancia. A partir de lo anterior, se realizó una investigación con los siguientes objetivos principales:

Although gamification has been shown to promote motivation and commitment to learning, it is necessary to identify how it affects collaborative learning. It is therefore necessary to know the effect of these strategies that are increasingly used in distance learning contexts. Research was carried out with the following main objectives:

O1: Identify the incidence level of gamification strategies in collaborative learning in a distance course from the view of the university student.

O2: Check whether there are significant differences between the different gamification strategies in collaborative learning of university students in a distance course.

## 2. Methodology

### 2.1. Research design

The research is quantitative, exploratory and pre-experimental (Hancock, 2004) because group of students were selected to take an official distance course in which there was an intervention using three gamification strategies and at the end of each one, they answered a



standardized instrument to identify the level of collaborative online learning.

## 2.2. Structure of the Distance Course

The course selected for the research was “Scientific Communication”, taught in the 2020-2021 school year at the Autonomous University of Yucatan (UADY), in a degree in the area of social sciences with a duration of 60 hours, with three learning units, all with the same characteristics in terms of the number of hours allocated, the level of their objectives (Pikhart & Klimova, 2019), the outputs to be presented, the number of topics, the teaching resources, the activities and the number of consultancies. This course

has been taught from 2016 on a distance basis and has used various gamification strategies such as challenges, badges, points, narratives, competencies, escape room, among others. Given the experience gained in using these strategies, it was decided to use the three mentioned above, so in the course design it was considered that in each learning unit the students will carry out the activities using a different gamification strategy. The strategy was also chosen according to its complexity, starting with the PBL triad in unit I, then the Digital Storytelling in unit II and finally the Escape Room in unit III. Table 1 presents the description of each strategy and the objectives used in each unit:

Table 1. List of objectives and strategies used in the distance course

Objective of the Unit	General strategy of the Unit	Overview of the strategy used
I. Identify the relevance of information technologies to disseminate scientific and technological knowledge.	PBL	Trained in teams, they will present a variety of technological resources that allow the dissemination of scientific knowledge. If meeting the requirements, they will receive points. If it is an outstanding job, they will be awarded a badge. The list of points and badges is presented in a team classification table.
II. Identify digital and print media for the publication of research results, as a way of communicating science.	Digital StoryTelling	Teams are presented a case for disseminating research in electronic media. The case will go through chapters, the decision-making of the team will allow the next chapters to continue until their completion.
III. Develop materials to support orally and assisted with computer.	Escape Room	The work teams carry out a series of materials (electronic presentation, infographic and video tutorial) using the resources that the instructor tells them. Each material must be made in a maximum of one day to continue with the following material.

Source: Own elaboration.

It should be noted that the program of the subject was not modified to be adapted to the strategies; modifications were made to the material delivered to students, for example, in the language used and in the graphic design of digital resources, which resembled a video game rather than a schoolwork (Kapp et al., 2014; Kingsley & Grabner-Hagen, 2018; Sheldon, 2012); in addition, the activities and resources of each unit should be directed toward meeting the objective of the unit and the development of the corre-

sponding strategy. The technological tools used for the implementation of the distance course were Moodle platform for asynchronous activities such as discussion forums, tasks, links to videos, and reading materials. Due to the technical characteristics of this platform, the obtaining of badges, unlocking of activities and resources was in an automated way, which helped to enrich the experience with gamification strategies (Barna & Fodor, 2019). On the other hand, for synchronous activities such as consulting and mentoring



sessions, the Microsoft Teams platform was used. Overall, due to the characteristics of both platforms and the strategies employed, it enabled a full course based on gamification for DL.

### 2.3. Participants

The participants were 90 students of the same degree and semester who studied the subject, who were invited to participate voluntarily in the research, explaining them the objectives, scope and that their participation would not modify their experiences with gamification strategies or their qualifications. Finally, 85 participated, out of which 45 were women (53%) and 40 men (47%). It was verified that they all had access to technological resources, a computer and internet connection; most ( $n=66$ , 78%) had these resources at home, while 19 (22%) connected in other places such as a family member's home or from work.

### 2.4. Tool

The constructivist online learning environment survey or COLLES (Taylor & Maor, 2000) was used to measure collaborative learning. This is an instrument for assessing the quality of a distance learning environment from the perspective of Vygotsky's social constructivism (Dougiamas & Taylor, 2002). The instrument consists of 24 reagents divided into six dimensions or scales: 1. Relevance, Reagents 1 to 4; 2. Reflexive thinking, from 5 to 8; 3. Interactivity, 9 to 12; 4. Professor support, 13-16; 5. Peer support, 17 to 20; and 5. Interpretation, 21 to 24 (Yeo et al., 2006). The response to the reagents was made using a five-alternative likert scale, where 1 is "almost never" and 5 is "almost always".

In relation to the reliability and validity of the instrument, these were obtained by analyzing similar studies where an coefficient of 0.80 was checked through the results of internal consistency (Yeo et al., 2006; Rivero, 2018; Azhari et al., 2020). On the other hand, Baker (2005) considers that scales are useful for both teachers and researchers in identifying authentic collaborative learning based on DL; and recently, Gutiérrez and Duche (2021) say that this instrument allows the integration of a model for collaborative online learning during COVID-19.

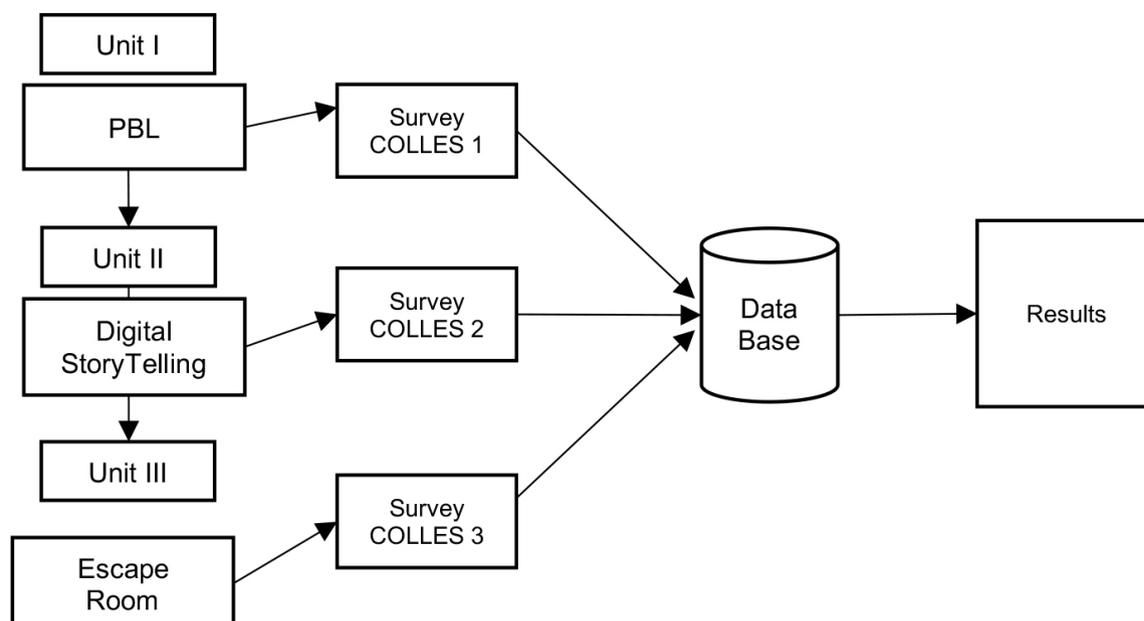
### 2.5. Data Collection and Processing

At the end of each learning unit, all students responded to the COLLES survey available on the Moodle platform. The responses were downloaded to .csv format files that were used to integrate the database. The following figure graphically shows the process used to obtain the information.

Due to the nature of the research and its objectives, the analysis and comparison of means and standard deviations were used, as well as ANOVA for repeated samples. To consider whether there was an incidence in the level of collaborative learning, it was considered that the average score should be higher than three ( $>3.0$ ); otherwise, ( $<3.0$ ) the strategy was considered to have no incidence. This criterion was also applied for each scale that makes up the COLLES instrument (Taylor & Maor, 2000). The significance value defined in the tests was considered to be 0.05 and the size of the effect used was the partial square eta determined at  $>.06$  as a medium effect and  $>.08$  as a large effect (Kraft, 2020). The program used for statistical testing and data processing was SPSS version 24.



Figure 1. Schema of data collection and processing



Source: Own elaboration.

## 2.6. Ethical aspects

As discussed above, all students were informed and agreed to have their answers published. The name of the degree and faculty was intentionally omitted in order to ensure the anonymity of the participants. This information is known and approved by the authorities of the faculty in which the investigation was conducted.

## 3. Results

Once the collected information was processed, the internal validity tests consisting of Cronbach's Alpha and McDonald's Omega were

performed; in the first one  $\alpha=0.947$  and the second  $\Omega=0.949$  were obtained. The following results are then presented when performing the statistical tests indicated in the methodology:

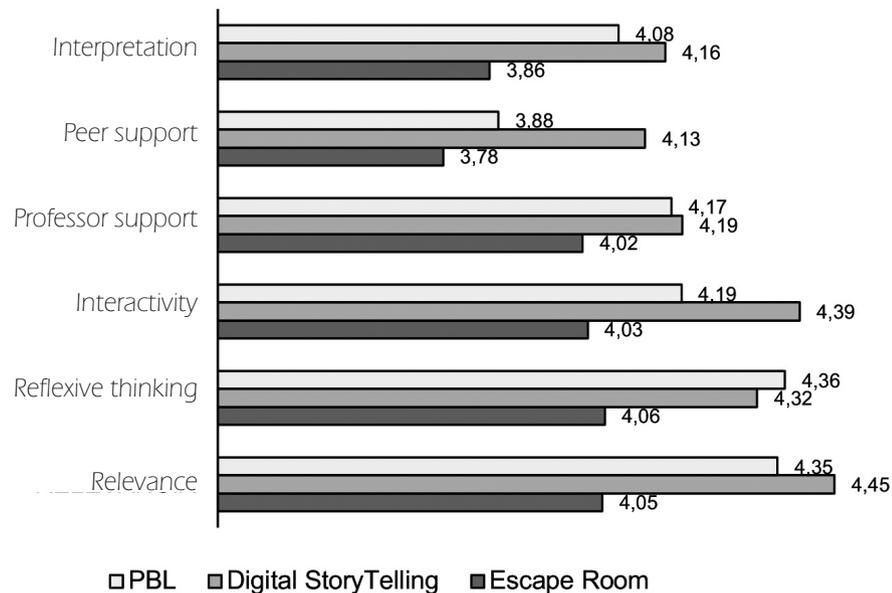
### 3.1. Levels of Collaborative Learning

When scoring each strategy, it was found that the PBL triad averaged ( $M= 4.17$ ,  $D.S.=0.59$ ), Digital Storytelling ( $M= 4.27$ ,  $D.S.=0.56$ ), and Escape Room ( $M= 3.97$ ,  $D.S.=0.61$ ).

When performing data processing, the averages for each scale that make up Collaborative Learning were obtained, the scores of which are represented in Figure 2 as follows:



Figure 2. Comparison of the scales that make up Collaborative Learning between the three main gamification strategies used in the distance learning course



Source: Own elaboration

The Digital Storytelling strategy on most scales obtained the highest scores, especially in interactivity and relevance,  $M=4.39$  and  $M=4.45$  respectively; on the other hand, the Escape Room strategy had the lowest scores on all the scales analyzed. In addition, it was found that, at both collaborative learning levels and their scales, all strategies scored above the criteria established in the methodology.

### 3.2. Differences in collaborative learning levels

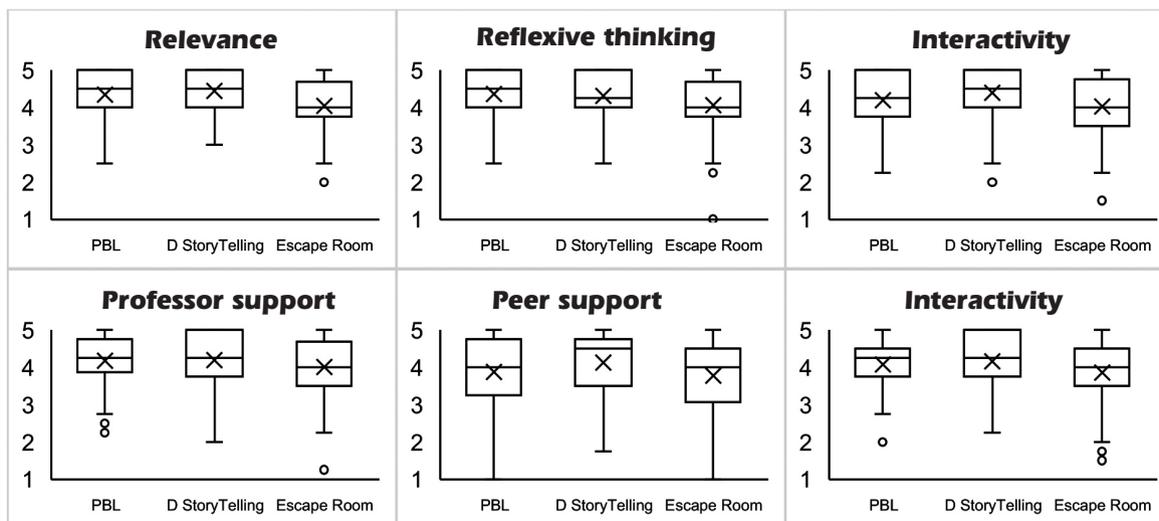
When checking whether there were significant differences in the collaborative learning level

between the three gamification strategies used in the distance course, the values obtained between the Collaborative Learning level with the strategy type had a value of  $F=4.008$ ,  $p=.021$  and  $\eta^2p=.065$ , which indicates that there are differences between the strategies employed; but when performing the Bonferroni post-hoc test, the differences were between the Escape Room and Digital Storytelling ( $p=.031$ ,  $\eta^2p=.077$ ).

Regarding the scales, Figure 3 represents the differences between the strategies used.



Figure 3. Differences between the scores obtained on the scales that make up Collaborative Learning



Source: Own elaboration

Significant differences were found in three scales: Relevance ( $F=5.680$ ,  $p=0.04$ ,  $\eta^2p=.082$ ), reflexive thinking ( $F=3.610$ ,  $p=0.029$ ,  $\eta^2p=.071$ ) and interactivity ( $F=3.490$ ,  $p=0.033$ ,  $\eta^2p=.060$ ). When performing Tukey post-hoc tests, the Relevance scale presented significant differences between Escape Room and Digital Storytelling strategies ( $dif=-.39$ ,  $p=.004$ ) and Escape Room with PBL ( $dif=-.29$ ,  $p=.040$ ); the Reflexive Thought presented differences in Escape Room with PBL ( $dif=-.30$ ,  $p=.035$ ) and the Interactivity scale in Escape Room with Digital Storytelling ( $dif=-.36$ ,  $p=.025$ ).

#### 4. Discussion and conclusions

Initially the distance course was designed for students to perform all group activities; then, the use of gamification strategies also took into account team work and support among members in achieving the competencies stated in the curriculum. The above resulted in high levels of Collaborative Learning; however, differences were found in the analysis of the scales as in the case of the scales of relevance and interactivity

whose scores were higher in Digital Storytelling, a strategy that is widely used in gamification by teachers, especially in language learning and in the social sciences (Silva et al., 2019) because it “allows a fictional world to deal more effectively with the challenges of the real world” (Gambocar & Dabagian, 2016, p. 242) and that favored the professional theory-practice in online learning as well as the establishment of a rich educational dialog (Taylor & Maor, 2000).

On the other hand, the PBL triad presented the greatest scores and significant differences in the scale of reflexive thinking, which is the critical analysis that students have about the contents studied during the unit (Dougiamas & Taylor, 2002). It also encouraged the competitive spirit of students to obtain a better position in the ranking of the teams, as happened in the study of Uz and Gul (2020) when using this strategy. In the case of the Escape Room, it also influenced Distance Collaborative Learning; however, by conducting statistical tests and comparing their scores with the other strategies, it obtained the best results, probably because this strategy is oriented to develop in a physical environment, using a classroom and real objects (Bartlet & Anderson,



2019), although there are virtual designs for the escape room whose results have been satisfactory (Jiménez et al., 2020; Hunt et al., 2020). Because of the latter, it is concluded that the gamification strategies used in the distance course had an impact on Online Collaborative Learning, with Digital Storytelling's strategy being the one with the highest score, possibly because of the characteristics of each strategy that would be determining factors in the scales of Online Collaborative Learning, mainly in relevance, interactivity and reflexive thinking.

There are two recommendations from these results: the first, when using gamification strategies, it is necessary to combine the type of learning sought and the mechanics or strategies to be used for the course; although there is a wide variety of mechanics and strategies that can be used and that researchers have documented in their studies, it is advisable to start with those that are considered basic and have had the most analysis, specifically regarding points, badges, leaderboards and narratives. In the case of using strategies that would be considered more complex such as the Escape Room, teachers should be familiar with their characteristics and anticipate their possible effects on the students, as more preparation is required in the design of the activities, mainly by working online. The second recommendation is to make measurements with validated instruments to have reliable indicators and monitor the group before, during and at the end of the distance course. Using COLLES instrument is reliable and valid to identify the collaborative learning of students, it allows teachers to make timely decisions to improve the design of distance courses, and it also improves the experience of students with activities that foster motivation and interest toward the subjects. In this way, it is possible to achieve better indicators on school dropout and society's acceptance of distance education, regardless of whether current and future generations need to study in this way, since the most

important thing is to combine technology and good educational practices.

#### 4.1. Limitations and Constraints

There was no sample procedure because students voluntarily enrolled in the course in accordance with procedures set by the institution; gender or the school group they belonged to were not considered as study variables. On the other hand, the instrument was applied at the end of each unit in order to identify the level of collaborative learning achieved by each strategy, unlike other studies where it was provided at the beginning and end of each unit to compare both scores. This procedure is known as a "preferred and real survey" (Rivero, 2018, p. 179; Azhari et al., 2020, p. 274; Syed-Mohamad et al., 2006, p. 187; Sthapornnanon et al., 2009, p. 5).

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