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Blockchain-Based Badge Award to encourage participation in Tutoring and Comprehensive Wellbeing classes

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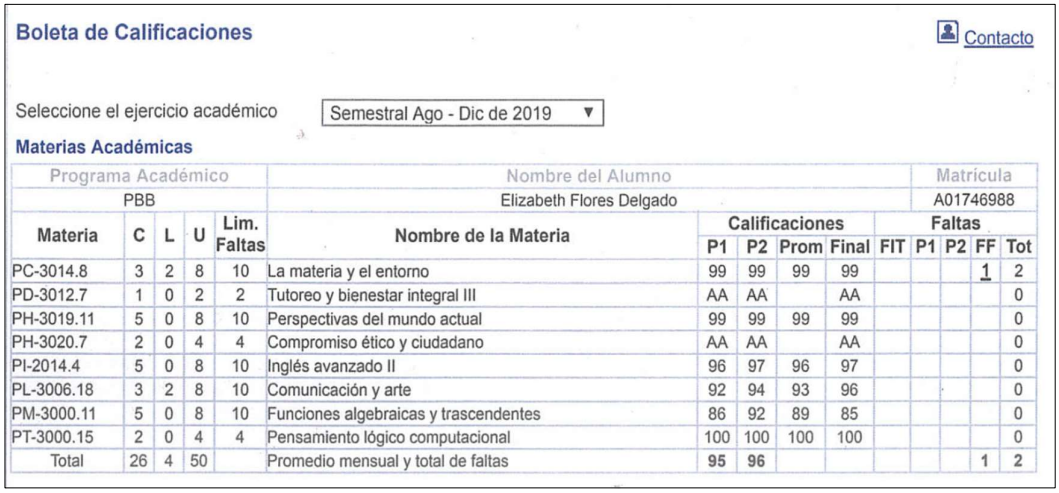
ABSTRACT
PrepaTec Morelia students take Tutoring and Comprehensive Wellbeing classes each semester, the objective of these classes is for the students to achieve personal and academic success, however, given the low importance that students give to these classes due to the fact that these classes are not graded numerical, but letter graded and don't sum up to calculate the students grade point average like the other academic classes, students do not participate fully. The principal problem observed is that students do not carry out all their class activities, surveys, homework, etc. Gamification strategies were sought to increase participation using Blockchain-Based Badge technology. The intervention consisted of creating badges using Badgr application in LMS CANVAS platform and awarding badges to the students completing all the requirements of each class module, with 100 participating students from August 2020 to May 2022. After the statistical analysis of the results, student grades and number of assignment submissions were the most relevant variables to measure the impact of the implementation; 50% of the students who belong to the groups with digital badges obtain a better grade than the 50% of the students in the control group, 75% of the class grades of digital badge group are above 85, while the 75% of the control group's scores are above 75. The results showed an increase of 9.66% in the general average of the grades of the groups that used badges; in terms of assignments not submitted, they decreased to 6.7% when the digital badges were implemented. This represents a substantial improvement in the digital badge group and suggests a favourable impact on the implementation.

Keywords: Blockchain-Based Badge, Students Participation, Innovative Technologies in Education, Gamification, Tec21.

INTRODUCTION

One of the most important roles of a teacher is to motivate students to participate in class and to achieve academic success , teachers should encourages students to learn, to participate and to integrate into the learning process [1] likewise, active participation is essential to learn and to advance in achieving the desired competencies and skills, hence the importance of this topic and how active student participation plays a very important role in academic success [2]. In the study carried out in 2018 by Seçil Bal-Taştan and his team, on the effect of motivation and active participation in science subjects in high school in Russia, showed that there is a close relationship between active participation and academic performance of students in science classes [3]. In order to motivate active participation of PrepaTec Morelia Highschool students in their Comprehensive Wellbeing and Tutoring classes, in which they have low performance as well as low participation due to the number of missing activities and late submissions. Comprehensive Wellbeing and Tutoring classes in PrepaTec Morelia are the only courses not being graded numerically but with letter grading; meaning that the grades from these classes do not sum up or affect the students' grade point average. It was observed a drop in the performance and participation of the students in the subject since they began to consider it a “worthless” subject.

Analyzing the participation of Baccalaureate students in Tutoring and Comprehensive Wellbeing classes during the semesters of August – December 2021 and January – May 2022. The study questions being: To what extent does the Blockchain-Based Badge Award gamification strategy impact in participation in high school students? What effects will the use of the Blockchain-Based Badge Award have on the participation of high school students in their Comprehensive Wellness class VI, as shown in Figure 1.



Boleta de Calificaciones Contacto

Seleccione el ejercicio académico: Semestral Ago - Dic de 2019

Materias Académicas

Programa Académico					Nombre del Alumno								Matrícula
PBB					Elizabeth Flores Delgado								A01746988
Materia	C	L	U	Lim. Faltas	Nombre de la Materia	Calificaciones				Faltas			
						P1	P2	Prom	Final	FIT	P1	P2	FF	Tot
PC-3014.8	3	2	8	10	La materia y el entorno	99	99	99	99				1	2
PD-3012.7	1	0	2	2	Tutoreo y bienestar integral III	AA	AA		AA					0
PH-3019.11	5	0	8	10	Perspectivas del mundo actual	99	99	99	99					0
PH-3020.7	2	0	4	4	Compromiso ético y ciudadano	AA	AA		AA					0
PI-2014.4	5	0	8	10	Inglés avanzado II	96	97	96	97					0
PL-3006.18	3	2	8	10	Comunicación y arte	92	94	93	96					0
PM-3000.11	5	0	8	10	Funciones algebraicas y trascendentes	86	92	89	85					0
PT-3000.15	2	0	4	4	Pensamiento lógico computacional	100	100	100	100					0
Total	26	4	50		Promedio mensual y total de faltas	95	96						1	2

Figure 1: *Report card of a student taking Tutoring and Comprehensive Wellbeing VI. School Banner DR © Instituto Tecnológico y de Estudios Superiores de Monterrey, México*

Gamification is already widely used to motivate adolescents, since it is a recreational activity in which the game has certain specific objectives that the student must achieve and is usually very well accepted by students, one of the main benefits being student motivation [4]. According to Marqués and Supervia 2019, to obtain the greatest possible motivation from students, teachers widely use gamification activities in the classroom [5].

There are multiple reasons to explain why some high school students have a negative attitude towards classes, it seems to be the obligation, which provokes counter reactions. One of the strategies to find a solution to the problems of motivation and lack of participation is gamification, thus enhancing intrinsic motivation [6].

Gamification has an important power to motivate and increase participation, since it is a set of tools to encourage people to interact with others just for the pleasure of playing and the possibility of winning. Although gamification is gaining ground in many areas of our society, its application in education continues to be an emerging trend. Using game design elements in non-game contexts is one of the good ways to motivate and encourage students to learn.

To evaluate how gamification impacted the learning experience, we compared data from a gamified and non-gamified year as part of our study report. In general, the results show significant improvements in terms of class attendance, participation, and proactivity [7].

The problem observed is that the students of PrepaTec a Private High School in the City of Morelia do not carry out all their activities and are not actively involved in the Tutoring and Comprehensive Wellbeing classes, which is a mandatory subject within the curriculum of this High School, and they must enrol and past in their 6th semesters of high school. A high percentage of students' hand in only a little more than half of the class activities and do not worry about complying; It is worth mentioning that the class is evaluated with letters AA, AB, AC and AD unlike the rest of the subjects which are evaluated with a numerical scale from 1 to 100 as shown in Table 1.

AA	AB	AC	AD
Achieve exceptional performance in your self-management	Obtains expected performance in self-management	Achieves intermediate performance in self-management	Has elementary performance in self-management

Table 1: Letter Grading Scale for the Tutoring and Comprehensive Wellbeing Classes. School CANVAS PrepaTec | Tecnológico de Monterrey (May 19, 2022) DR© Instituto Tecnológico y de Estudios Superiores de Monterrey, México

The Tutoring and Comprehensive Wellbeing subjects are not averaged with the rest of the academic subjects, below is a report card of a student in figure 1 where the average of the first partial is 78 in academic subjects, however, the student has a grade of AD in the Tutoring and Comprehensive Wellbeing class, which means an elementary performance of his self-management, however this does not affect his partial average in any way. This is believed to be one of the main causes of the lack of student participation in their Tutoring classes.

The general objective of this research was: To quantify the impact that the use of gamification with the granting of the Blockchain-Based Badge Award will have on participation in its Comprehensive Wellness and Tutoring classes.

The specific objectives of the project are the following:

- Evaluate participation of students in Tutoring and Comprehensive Wellbeing classes.
- Within the framework of the work, design the electronic badges of the training and disciplinary competencies of the Institution.
- In the process Implement the badges throughout the semester.
- Evaluate final performance results.

Hypothesis: To what extent does the Blockchain-Based Badge Award gamification strategy impact in participation in high school students? What effects will the use of the Blockchain-Based Badge Award have on the participation of high school students in their Comprehensive Wellness classes?

1) Methods and Methodology

The intervention in this study, consisted of using the Badgr Blockchain program for digital badges using the LMS CANVAS educational platform in the Tutoring and Comprehensive Wellbeing classes of Morelia High School, a total of 4 groups, in a total of approximately 100 students of the three years of high school in the January - May 2022 semester and compare the participation results of this semester with the previous ones in which the badges were not used. Badges created in CANVAS LMS and Badgr Blockchain to encourage participation of the students of PrepaTec Campus Morelia for the subjects of Tutoring and Comprehensive Wellbeing. These Badges will be awarded once the student has met the requirements of a training module. The badges to be awarded would be related to the training competencies and the values and transversal competencies of the training model of the High School of study. Badges function as micro-credentials for students to have evidence of the achievement of these skills and can share on their social networks and to be able to incorporate them into their academic development plan.

The intervention project was carried out in a private preparatory school in southern central Mexico, in a private preparatory school in southern central Mexico in the state of Michoacán with 4 groups of 25 students taking the Tutoring and Comprehensive Wellbeing class in the semester August December 2022 with the authorization of the director of the institution and the support of the director of the Development and Tutoring department. All students belonging to the 2019-2022 generation.

There was support from the institution, as well as from the leader of the high school tutors. The institution has 387 students distributed over six semesters, in each of these semesters they must take the subject of Tutoring and Comprehensive [8]. The students who participated were the entire generation made up of 100 distributed in 4 groups of 25 students to whom the Comprehensive Development and Wellbeing class is taught in the August - December 2022 semester, which are the total of the students of the generation 2019-2022. In the first and second year of high school, the students took their Tutoring and Comprehensive Wellbeing classes regularly, that is, without the use of digital badges, and in their last year of high school they took it with the format of using digital badges.

Semester	ID	Period	Year	Group
3ro	PD3012	August December	2020	Without Badges
4to	PD4011	January June	2021	Without Badges
5to	PD5016	August December	2021	With Badges
6to	PD6018	January June	2022	With Badges

Table 2: *Population and Sample PrepaTec Generation 2019-2022: The table shows the population of students who were followed up one year and the intervention project was carried out with the use of badges a second year. CANVAS PrepaTec | Tecnológico de Monterrey (May 19, 2022) DR © Instituto Tecnológico y de Estudios Superiores de Monterrey, México*

To find out if the problem really reflected a situation to be addressed, information was collected on the participation of the students in different surveys that they must answer in their Tutoring and Wellness classes each week in class and for which a specific time is designated for it. as well as the percentages of student performance shown by the platform, they use to upload their LMS CANVAS activities. In addition, the percentage of participation in the class and the number of tasks delivered and not delivered per student were recorded, as seen in Figure 2.

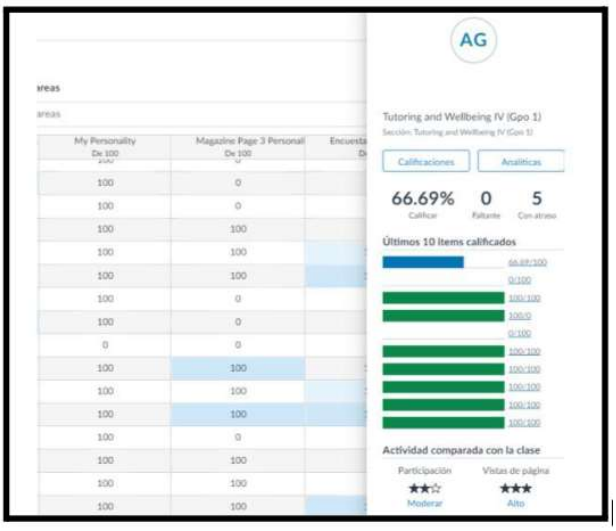


Figure 2. *Low and low moderate participation performance of students in the subject of Tutoring and Comprehensive Wellbeing Student CANVAS PrepaTec | Tecnológico de Monterrey (May 19, 2022) DR © Instituto Tecnológico y de Estudios Superiores de Monterrey, México.*

At the same time, a survey was carried out using a Likert scale in Google Forms, which was answered by 83 of the 100 students in our total sample who were taking the Tutoring and Comprehensive Wellbeing class. The survey included the following questions/statements shown in Table 3.

Age and Sex
Tutoring class to take this semester
What grade do they usually get in their tutoring classes?
From 1 to 5, 1 being totally disagree and 5 being totally agree, rate the following statement: I give the same performance to the tutoring classes as to my other classes.
From 1 to 5, with 1 totally disagreeing and 5 totally agreeing, rate the following statement. I consider that tutoring classes are of equal importance to other academic classes.
From 1 to 5, 1 totally disagree and 5 totally agree, rate the following statement. I do not take tutoring classes seriously since they do not affect my midterm or final average of the semester.
From 1 to 5, 1 being totally disagree and 5 totally agreeing, rate the following statement: I like my tutoring classes.

Table 3: *Survey questions applied to students. PrepaTec | Tecnológico de Monterrey (May 19, 2022). DR © Instituto Tecnológico y de Estudios Superiores de Monterrey, México*

2) RESULTS

A survey was applied on the Tutoring and Comprehensive Wellbeing classes from which we obtained 84 responses out of 100 students in different semesters taking the classes to know some general data of the group as well as their feelings about these classes, see Figure 3 and Figure 4.

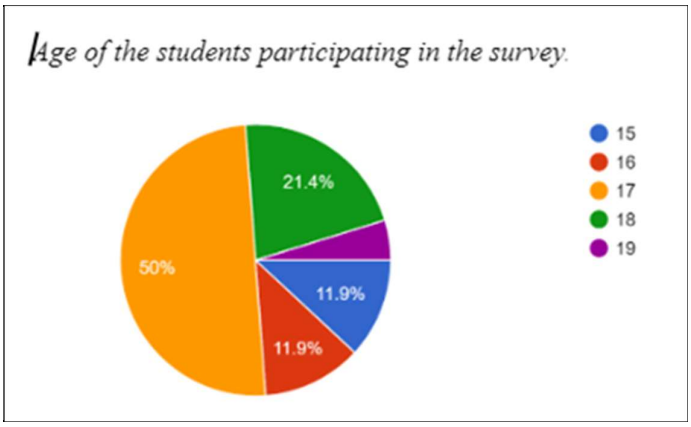


Figure 3: *Age of the students participating in the survey.*

Survey applied to the students participating in the intervention.

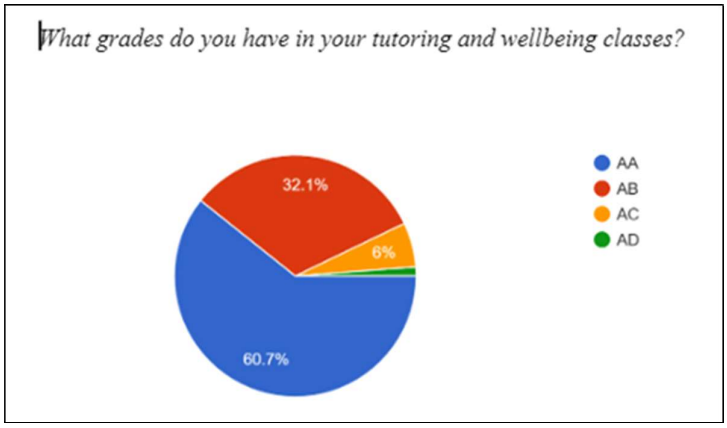


Figure 4 *Survey applied to the students participating in the intervention.*

Figure 5 shows the results of whether the students consider that they make the same effort into their tutoring classes as into their academic ones, 42% of the students assured that they do input the same effort, while the remaining 38% indicate that They do not strive in the same way as in their other academic subjects.

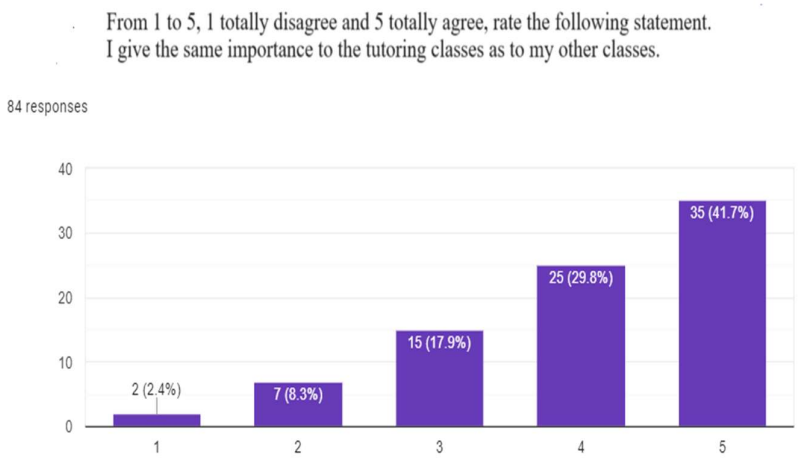


Figure 5 *Comprehensive Wellness class survey*. Results of the survey applied to the students of the Tutoring and Comprehensive Wellbeing classes,

The students were also asked if the fact that the tutoring classes will be graded with letters instead of numerically affected the participation into these classes, to which almost 60% of the students surveyed answered that they did not agree. this statement as shown in Figure 6.

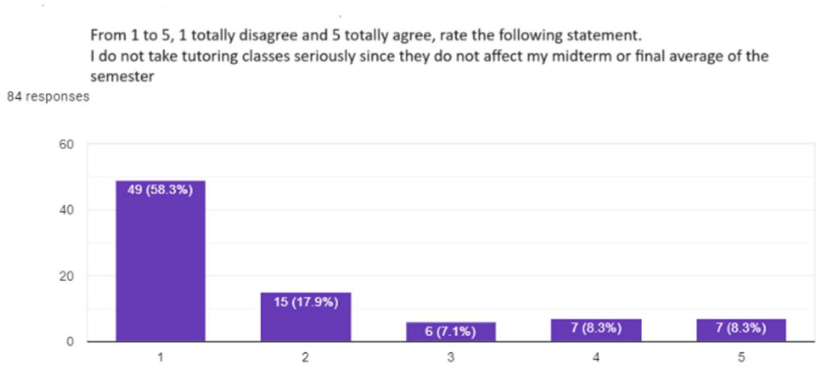


Figure 6 *Comprehensive Wellness class survey*: Results of the survey applied to the students of the Tutoring and Comprehensive Wellbeing classes.

The students were monitored for two years in their Tutoring and Comprehensive Wellbeing classes that they take each semester, during the first year the digital badges were not used, and the second year the badges were implemented through LMS CANVAS using the Bdgr platform. The variables that were compared are: Students Grade, Class Participation, Number of Submissions, Activities turn in in time and activities turn out late. All this DATA obtained from the LMS CANVAS analytics. The result of the statistical analysis is shown in Table 4 average scores and variability in both groups the control and experimental group.

Variable		Group	Mean	StDev
Student Grade		badges	89	12
		control group	83	17
Participations		badges	50	10
		control group	36	8
Submissions		badges	56	8
		control group	43	2
On Time		badges	37	10
		control group	32	8
Late		badges	11	5
		control group	3	3

Table 4 *Statistics Descriptive Analysis DATA obtained from the LMS CANVAS analytics.*

From the results shown in the previous table, we can suggest that the groups that intervened with educational innovation improved their average score in each of the variables that we are analysing in this research. It can be seen how by implementing the use of digital badges in the groups there is an improvement in student performance by obtaining a grade of 89. The increase in the number of activities delivered is also significant, going from an average of 43 deliveries in the control groups to 56 in the groups where digital badges are awarded to students, from which we can infer the use of digital badges motivates students to complete their deliveries. The rest of the variables behave in a similar way. An interesting finding of this descriptive analysis is that the number of activities delivered late increased in the groups with educational innovation.

We consider that this is due to the students' intention to complete their delivery and obtain a digital badge even if the delivery is extemporaneous, this finding is positive because it suggests that the use of digital badges motivates students to complete all the activities designed for this course. Below are the histograms of the variables Student Grade and Submissions, which are variables that in this study we consider to be the most relevant to measure the impact of the implementation of digital badges. Figure 7 shows the comparison between the frequency of submissions in both control and experimental group.

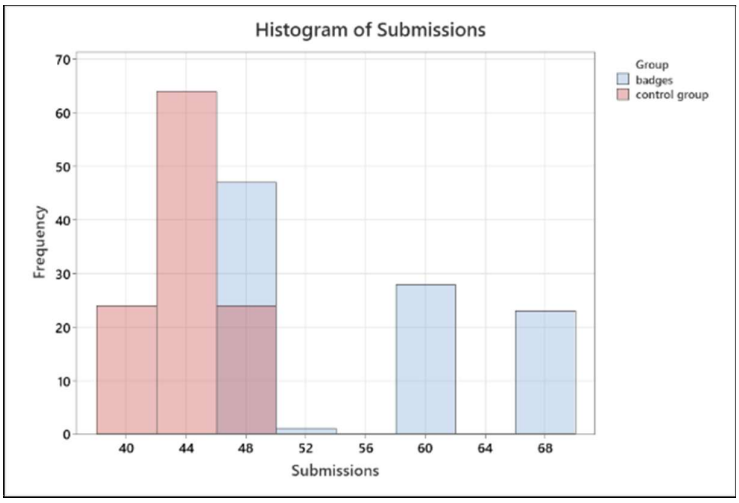


Figure 7 *shows the comparison between the frequency of submissions in both control and experimental group. LMS CANVAS Analytics in Figure 8 The grade of the students were compared in both groups, the grades incremented in the group with the use of badges.*

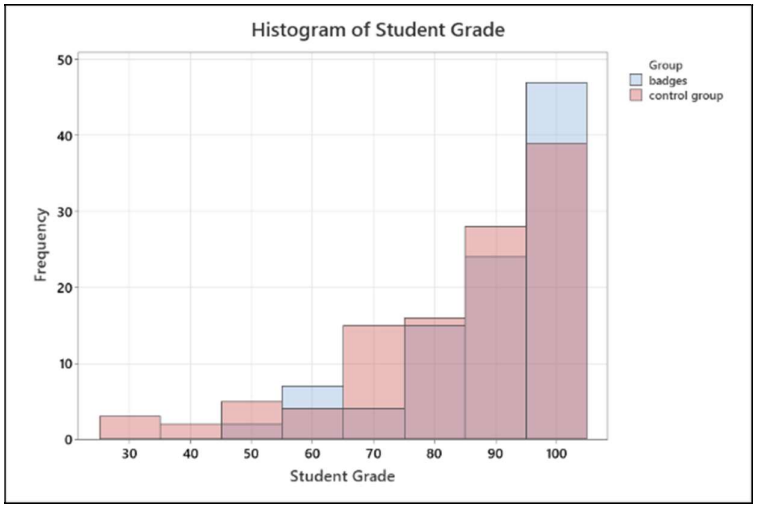


Figure 8 *Histogram of Students Grades. LMS CANVAS Analytics*

Figure 9 shows the participation and frequency of the student participation in the CANVAS LMS Platform.

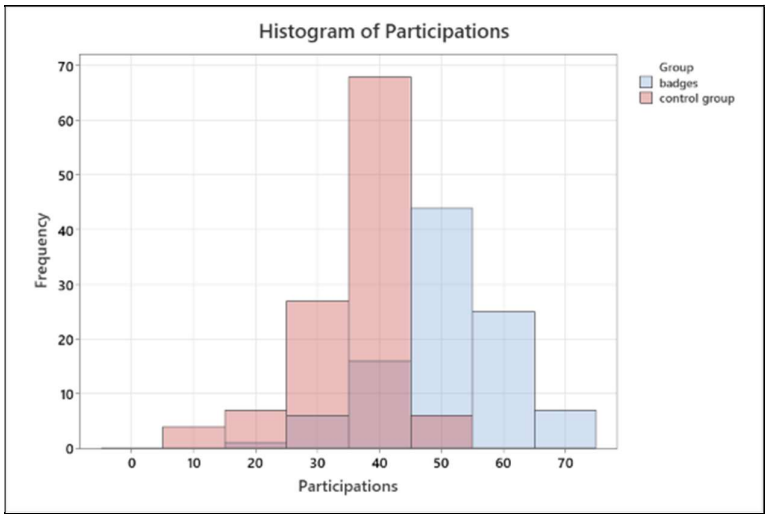


Figure 9 *Histogram of Students Participation LMS CANVAS Analytics*

To complete this first statistical analysis, we present the box plots for the variables Student Grade and Submissions, which are variables that in this study we consider to be the most relevant to measure the impact of the implementation of digital badges.

In Figure 10 Box plot Score Students, the red line joins the medians of the "Student Score" variable of the 2 groups of this research, it can be seen that 50% of the students who belong to the groups with digital badges obtain a better grade than the 50% of the students who took classes in a control group, it can also be observed that the box of the digital badge group is smaller than that of the control group, which indicates that the digital badge group has less variability. It is also observed how the graph of the badge group is located more towards the top than the graph of the control group, this indicates that 75% of the qualifications of the digital badge group are above 85, while the 75% of the control group's scores are above 75. This represents a substantial improvement in the digital badge group and suggests a favourable impact on the implementation of this methodology.

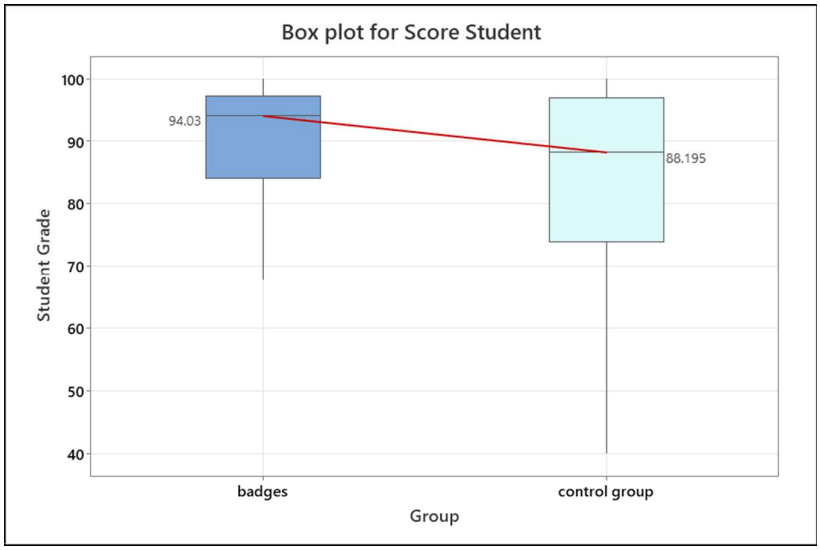


Figure 10 Box Plot for Students Grades *LMS CANVAS Analytics*

Figure 11 clearly shows how the groups that were encouraged through the delivery of digital badges have greater participation, as well as a greater number of activities delivered by the students than the control groups. Also, the graft allowed to propose the following hypothesis: The use of digital badges is a factor that favourably impacts student performance through greater participation and delivery of activities by students. This is a hypothesis that we can prove statistically using T-test. T tests are the most used statistical analysis tools to analyse the difference between means, they are easy to interpret and resistant to deviations from normality. To correctly use the t test, we verify the conditions of independence, normality, and equality of variances.

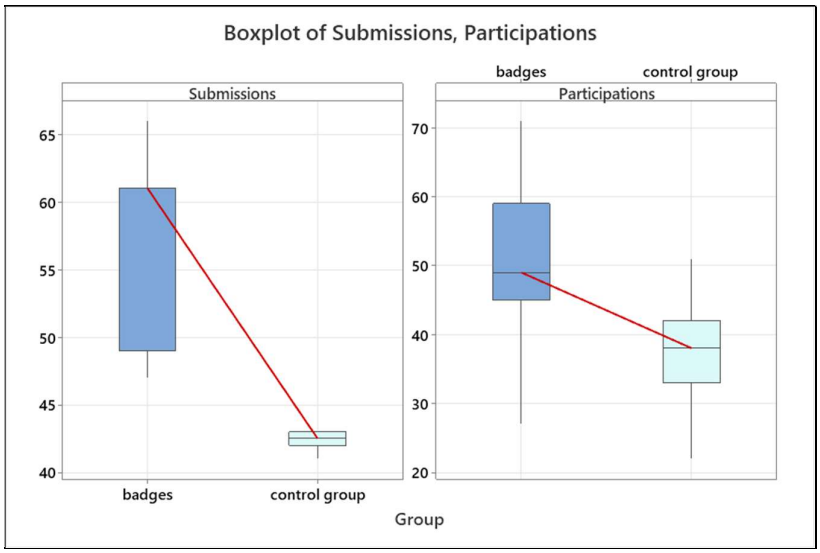


Figure 11 *Box plot of Submissions shows the number of activities delivered by both groups. LMS CANVAS Analytics*

The results of the hypothesis tests that were carried out to see if there is a statistically significant difference between the groups with educational innovation with badges and the control groups, contrasting the average scores for the Score

Grade variables, Submissions and Participations, a significance level of 5% was used and it is assumed that the variances are not equal shown in Table 5.

Variables	**Hypothesis Test. α=0.05**		**p-value**
Score Grade	HO: innovation≤ control H1: innovation>control		0.004
Submissions			0.000
Participations			0.000

Table 5 *Hypothesis Test for each variable LMS CANVAS Analytics*

In the hypothesis tests carried out for each of the variables, the p-value is less than 0.05, which is the value that corresponds to the level of significance, that is, with a significance level of 5%, there is statistically significant evidence that the Score Grade , Submissions and Participations of students who received digital badges is higher than the average obtained by students who did not have the incentive of digital badges in their course.

3) DISCUSSIONS

For some students, the improvement in grades is very clear once the badges began to be used, as is the case with other students who maintained the same grades with or without the use of badges, however, the group grade average improved. In short, the use of badges through the gamification technique is a good resource to motivate students in the academic area as a powerful pedagogical tool [9]. However, tasks delivered late rose to almost more than double a phenomenon that is attributed to the fact that given Since it was extremely important to submit the activities and assignments, the students decided to submit them late although this means a penalty on their grade if they do not submit them and have a zero grade on submission.

Through this project, it was possible to verify the effectiveness of gamification with the use of digital badges as a pedagogical tool to achieve student participation. However, it is very important to plan these types of strategies in advance, indicating very specifically what will be the path through which the student will earn these badges. If the student finds that earning a badge is extremely easy, they will soon lose motivation and the novelty of these, on the other hand if the student is challenged and realizes that earning a badge is a difficult work, but not impossible and that not everyone can obtain them, the student will maintain his motivation to be a recipient of a badge. It is also extremely important to explain in detail to the student what the badges are, what they represent and how they can earn them, so that they can set a goal to achieve it and make the project their own.

The students liked this dynamic, since they are competitive, they also liked the way in which every time they obtained a badge, they received the notification in their institutional email and could share it on social networks, in addition to being able to save these badges in a portfolio electronic where you can keep a record of each of the badges. It was also observed that at a given moment during the second semester of application of the badges, the novelty is lost, so it would be advisable to set higher requirements to be able to qualify for these badges using higher parameters to maintain the motivation of the students and not lose your interest.

4) CONCLUSIONS

From the results obtained in this research we can conclude that the use of gamification methodologies favourably impacts the teaching-learning process. There is statistical evidence that the use of digital badges motivates the student to comply with the deliveries of their learning activities, on the other hand, the statistical evidence shows that in the groups where the use of digital badges is implemented there is more participation of the students, which is a clear indicator of the greater interest that students have in these courses.

In future research, we propose the use of artificial intelligence to measure students' opinions regarding the use of digital badges in their courses. Specifically, we use a machine learning technique known as sentiment analysis to know the opinion that students have, in addition to this we propose a multiple linear regression to decide if some of the variables we are analysing are statistically significant to predict the performance of the students.

5) ACKNOWLEDGMENT

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