Gamification: a methodology to motivate engagement and participation in a higher education environment

Dr. Lauro André Ribeiro[1] (corresponding author)
Dr. Thaísa Leal da Silva[2]
Dr. Andréa Quadrado Mussi[3]

[1] Stricto Sensu Postgraduate Program in Architecture and Urbanism (PPGARQ), Faculdade Meridional (IMED), Rua Senador Pinheiro, 304, Passo Fundo/RS, 99070-220, Brazil and INESCC, Portugal. E-mail: lauro.ribeiro@imed.edu.br; Phone: (+55) 54-3045.6100.

[2] Stricto Sensu Postgraduate Program in Architecture and Urbanism (PPGARQ), Faculdade Meridional (IMED), Passo Fundo/RS, 99070-220, Brazil. E-mail: thaisa.silva@imed.edu.br.

[3] Stricto Sensu Postgraduate Program in Architecture and Urbanism (PPGARQ), Faculdade Meridional (IMED), Passo Fundo/RS, 99070-220, Brazil. E-mail: andrea.mussi@imed.edu.br.

Abstract

Due to technological evolution and the advent of mobile computing, it has become increasingly challenging to engage students in the classroom, gain their attention and involve them in some activities. In this context, the objective of this work is to stimulate students' engagement in class through the use of gamification, creating metrics to evaluate their participation and informing their progress during the semester. In order to carry out such evaluation, a spreadsheet was developed in which students were awarded with points for attendance and participation in each class throughout the semester. A survey was conducted with students to evaluate such method. As results it is possible to perceive a greater interest of the students to participate in the classes, a significant increase in the presence, and a fun and healthy competition among the students.

Keywords: Gamification; Higher Education; Student Engagement; Motivation; Spreadsheet;

1. Introduction

Nowadays, with technology advances, available communication networks and new skills developed by the new generations, there is a need to adapt teaching methodologies, making them much more interactive and attractive to attain students' attention.

According to Prensky (2001), this new generation can be called "digital natives", since today's students are native speakers of the digital language of computers, video games, and the Internet. They are the first generation to grow up with these technologies combined. In this way, computer games, smartphones and instant messaging are integral parts of their lives (Prensky, 2001).

This overwhelmingly interesting surrounding, with lots of gigabytes of information changes when students enter a classroom. There they normally need to sit and pay attention to an older person that is giving a lecture. Generally, teachers and professors are not as keen in technology as they are, and many classes could be quite boring for this type of students, and they end up losing interest very rapidly. This is a problem that many professors are facing nowadays, in which students prefer to navigate on the internet rather than pay attention or participate in the class.

Therefore, this work is focused in an active learning methodology, called Gamification, which combines content, game and technology aiming to motivate the learning experience in a classroom. This methodology aims to enhance the student learning experience, introducing an alternative to class management and traditional evaluation methods, getting students' attention through gamified activities with goals and rankings in a collaborative environment.

Furthermore, this research attempts to contribute with the investigation of the effect of active learning methodologies in higher education based on the student's perception. This work intends be replicable for all areas and to contribute in measuring the impact of gamification in students' behavior.

Regarding the importance of this work, an evaluation about teaching methodologies is important to encourage new actions of implementation and diffusion of active learning.

Understanding how some actions of active methodologies impact students will contribute for the dissemination of good practices among professors and universities.

In the next section, a brief literature review will be presented. Afterwards, a proposed gamification method and a survey methodology to assess this method will be described. By the end, results will be analyzed and conclusions are drawn.

2. Literature review

The Education field is in evolution, pursuing to adapt to the technology evolution in order to improve learning and make classes more attractive through the use of active learning methodologies in a student-centered learning environment. According to Tsay, Kofinas, & Luo (2018) this environment is focused on "understanding user/learner needs as part of determining the system's effectiveness".

Active learning methodologies are based in the decentralization of the professor function in classroom. A transition for a student-centered learning is expected whereas professors could plan different approaches for learning effectiveness. To reach this goal, professors use new tools and methodologies that consider the student background. Gamification is a good strategy, because considers the student daily environment, immerse in technologies and digital tools.

There are many experiences of active learning methodologies use reported in the literature, applied as a resource to decrease course evasion or to decrease the number of students that are recurrently reproved in disciplines, resulting in an increase in student satisfaction and a decrease in over mentioned rates. The application of active learning methodologies contributes in an increase of the student motivation, decrease of evasion and reproval (Kereki & Adorjan, 2017; Lourenço Jr. & Veraldo Jr., 2017). Delphino, Oliveira, Felisbino, Sgorbissa, & Souza (2017) present experiences of active learning methodologies applied in three different undergraduate courses: human management, pedagogy and physical education, highlighting the student's satisfaction of 90% and relating an increase in motivation to participate in classes, to study and to learn. In this context, an experience that is gaining strength is gamification.

According to Deterding, Dixon, Khaled, & Nacke (2011) and Deterding, Sicart, Nacke, O'Hara, & Dixon (2011), gamification method can be summarized as the use of game design elements in non-games contexts. Its positive, motivating and playful experiences are drawing attention to higher educational contexts as a possible solution for student engagement (Huotari & Hamari, 2012; de Sousa Borges, Durelli, Reis, & Isotani, 2014; Dicheva, Dichev, Agre, & Angelova, 2015).

For Kapp (2012), gamification can be understand as the use of game elements, game mechanics, and game thinking aiming to make learning activity more compelling. In addition, Kapp (2012) affirms that gamification is applied in motivating, promoting learning, solving problems and engaging people. This engagement characteristic makes gamification relevant to higher education context, in which it can be considered as a potential solution to foster the engagement of students through more interesting and easier to follow learning activities (de Sousa Borges et al., 2014;

Dicheva et al., 2015). In order to exemplify some cases in the literature regarding the use of gamification in higher education scenario, some gamified experiences are presented as follows.

Sprint & Cook (2015) presented a turn-based active methodology gaming experience to engage and enjoy students in an introductory programming course. Students and educators provided positive feedback due to high participation, interaction, and successful team programming efforts.

Also related to programming, Barnes, Powell, Chaffin, & Lipford (2008) developed a game to teach introductory computer science concepts. They found out that students can have fun programming within a game and can improve their attitudes and engagement. They also highlighted that feedback is a very important instrument in gaming design for learning purposes.

Tsay et al. (2018) designed a gamified course using a wide variety of game mechanics to engage students and satisfy the needs of a diverse class. They found that course design based on gamification could contribute to student-centered learning and enable the use of a flipped classroom. The authors say that the students showed high level of engagement and improved course performance compared to the nongamified one.

Many other examples could be presented since this is an emerging and prominent area of research. However, most studies still lack to describe all the mechanisms and how the points of the gamified experience work. Therefore, in the next section, a proposition of a gamification method will be presented and all the points' awarding mechanics will be explained.

3. Proposed Gamification Method

In order to gamify part of the grade in a university class, the method proposed in this study had to be developed before the beginning of the semester. On the first day of class, the professor presented himself and the schedule for the upcoming classes of the semester. Furthermore, he explained that 25% of the students' grades would be gamified. The other portion of the grade (75%) would be given using normal evaluation methods such as exams and assignments. Thus, it is important to highlight that this is not just a game of a one-day class, the entire course is gamified.

The semester was divided in two different grades. In the first part of the semester, students would make an individual exam to define the 75% portion of their grades. And in the second, a group assignment and presentation was done. In both portions of the semester, 25% of the grade was gamified, in which presence, participation and tasks were evaluated as it will be described subsequently. Professors are free to change these percentages according to their needs if they are replicating this method.

The method was applied in three different classes with different students and courses. The total number of students that participated in this study was 66, and they were majoring in Architecture and Urbanism and Engineering. The majority of the students' age range from 20 to 25 years old.

In order to keep the scores and record student day to day points, an Excel spreadsheet was used. The points were divided into presence and participation/tasks and were given by the end of each class for the students depending on how the students performed. Thus, if the student was present from the beginning until the end of the class he would be granted 10 points. If the student

participated and/or made the assignments given in class, he would receive 10 points. Therefore, an excellent expected score for each class would be 20 points (10 for presence + 10 for participation).

The class is divided into 4 periods (4 credits). Thus, if the student fails to show in one of these periods he does not get the full 10 points for presence. For example, if he attends the first two periods and then do not return, he earns 5 points for presence. He could still get participation points depending on his performance in the periods he was in class. It is up to the professor to grade him. The same way, a student that was present all class but was not even listening to the class or participating in the activities would get only the 10 points regarding presence; and zero for participation.

If one or more students stand out in a particular class, the professor could grant more 5 or 10 points depending on performance. Therefore, a very good grade on a given class would be 20, and an excellent one could be 25 or even 30. Furthermore, professors are free to use different active methodologies techniques throughout the semester, but always making it clear that their performance would count in the overall ranking. An example of this day-to-day points' awarding is shown in Figure 1.

	Univ. Number	STUDENT	1st	2nd	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11
1	1109123	Student 1	140	0	20	20	10	0	20	20	25	25			
2	2107321	Student 2	155	0	20	20	15	15	20	25	10	30			
3	1104421	Student 3	160	0	20	25	20	0	20	20	25	30			
4	3107010	Student 4	150	0	20	20	20	25	20	20	0	25			
5	1106712	Student 5	85	0	10	20	0	15	20	0	0	20			
6	1107543	Student 6	165	0	20	20	20	15	20	20	25	25			
7	1106984	Student 7	165	0	20	20	20	15	20	15	25	30			
8	1507473	Student 8	165	0	20	20	20	15	20	25	20	25			
9	1607115	Student 9	155	0	20	20	20	15	20	20	20	20			
10	1807172	Student 10	175	0	20	20	15	15	20	20	25	40			
11	2107114	Student 11	145	0	20	20	15	15	20	15	20	20			
12	3106972	Student 12	145	0	20	10	15	15	20	20	25	20			
13	2106988	Student 13	120	0	20	0	10	0	20	25	25	20			
14	3106969	Student 14	150	0	20	10	15	0	20	20	25	40			
15	3107371	Student 15	100	0	0	15	20	25	20	20	0	0			
16	2108222	Student 16	160	0	0	20	20	20	20	15	25	40			
17	3107490	Student 17	175	0	20	20	15	15	20	20	25	40			
18	2127359	Student 18	100	0	20	20	0	0	20	20	20	0			
19	3107571	Student 19	155	0	10	20	15	15	20	20	25	30			
					23-Feb	01-Mar	08-Mar	15-Mar	22-Mar	05-Apr	12-Apr	19-Apr	26-Apr	03-May	10-May
													Review	Exam	

Figure 1: Spreadsheet example of day-to-day students' points awarding.

Source: Authors.

As can be seen in Figure 1, there are different points given for different students in each day, depending on the evaluation that was already presented. It is important to notice that an overall sum of the 1st portion of the semester is presented (Figure 1 - 1st), so that it is possible to rank the students from the most to the least points earned. In relation to that, it is possible to classify the students using a simple function in any spreadsheet and present it in a different way, as shown in Figure 2.

	Univ. Number	STUDENT	1st	2nd	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11
1	1807172	Student 10	175	0	20	20	15	15	20	20	25	40			
2	3107490	Student 17	175	0	20	20	15	15	20	20	25	40			
3	1107543	Student 6	165	0	20	20	20	15	20	20	25	25			
4	1106984	Student 7	165	0	20	20	20	15	20	15	25	30			
5	1507473	Student 8	165	0	20	20	20	15	20	25	20	25			
6	1104421	Student 3	160	0	20	25	20	0	20	20	25	30			
7	2108222	Student 16	160	0	0	20	20	20	20	15	25	40			
8	3107571	Student 19	155	0	10	20	15	15	20	20	25	30			
9	2107321	Student 2	155	0	20	20	15	15	20	25	10	30			
10	1607115	Student 9	155	0	20	20	20	15	20	20	20	20			
11	3106969	Student 14	150	0	20	10	15	0	20	20	25	40			
12	3107010	Student 4	150	0	20	20	20	25	20	20	0	25			
13	3106972	Student 12	145	0	20	10	15	15	20	20	25	20			
14	2107114	Student 11	145	0	20	20	15	15	20	15	20	20			
15	1109123	Student 1	140	0	20	20	10	0	20	20	25	25			
16	2106988	Student 13	120	0	20	0	10	0	20	25	25	20			
17	2127359	Student 18	100	0	20	20	0	0	20	20	20	0			
18	3107371	Student 15	100	0	0	15	20	25	20	20	0	0			
19	1106712	Student 5	85	0	10	20	0	15	20	0	0	20			
					23-Feb	01-Mar	08-Mar	15-Mar	22-Mar	05-Apr	12-Apr	19-Apr	26-Apr	03-May	10-May
													Review	Exam	

Figure 2: Spreadsheet example of day-to-day students' points awarding after using the classify function to order by overall points.
Source: Authors.

In addition to that, a new spreadsheet tab was created to show the students their rankings. The idea of presenting a different ranking came with the objective to present a cleaner ranking, with fewer numbers for the students to understand. Another important motivation to do it in this way is that it is possible to hide students' names when desired. A first experimental attempt showing all students' names could cause embarrassment for students that were in the last positions of the rank. As shown in Figure 3, from the middle to the table onwards, student names are hidden and their university student number appears instead (Univ. Number). This ranking was updated weekly and shown every two weeks in the beginning of the class for the students so that they could follow their performance. Figure 3 was presented to students with a colorful design to call their attention.

RANKING OF THE WEEK		
Position	**STUDENT**	**1st**
1	**Student 10**	175
2	**Student 17**	175
3	**Student 6**	165
4	**Student 7**	165
5	**Student 8**	165
6	**Student 3**	160
7	**Student 16**	160
8	**Student 2**	155
9	**Student 9**	155
10	**Student 19**	155
11	3107010	150
12	3106969	150
13	2107114	145
14	3106972	145
15	1109123	140
16	2106988	120
17	3107371	100
18	2127359	100
19	1106712	85

Figure 3: Spreadsheet example of overall ranking to present for students.

Source: Authors.

In the first day of class, it was also told that it was expected for the students to reach 20 points on average in each class if they wanted to reach the 25% mark regarding presence and participation in a given portion of semester. So, for example, if half of a semester had eight classes, at the end it would be expected 160 points (20 x 8) to reach a perfect grade of presence and participation. Keeping this in mind, intervals were presented to the students so that they knew how many points it was needed to achieve each goal (Table 1).

Table 1: Intervals of final overall points versus the grade the students will receive.

GOAL	
1st Stage	
160 or more	**2.5**
140-159	**2.0**
120-139	**1.5**
100-119	**1.0**
99 or Below	**0.5**

Source: Authors.

As presented in Table 1, intervals were developed beforehand and presented to students. The professor is free to adapt these intervals depending on how many classes are given to each class. Furthermore, he can adjust for narrower or wider intervals if desired. However, it is important

to notice that this has to be done in the beginning of the "game" so that the rules are not changed in the middle, causing frustration or displeasure among students.

When the end of the first part of the semester comes, the final ranking is presented and some prizes could be given to the best students. Depending on the class size, the professor is free to acknowledge the number of students he wants. For example, in a class of ten students, a feasible number of prizes could be three, whereas in a class of thirty it could be five. The professor can also give special prizes for specific accomplishments. For example, the best presentation, the most beautiful work of art, the most interested student, etc. A suitable and non-expensive prize could be a chocolate candy or something else that the students would like.

To end this step, the professor adds up the grade earned from each student to the other assignment. In this case, the grade of the final exam was added to the presence and participation score to build the final score. So, if a student reached 160 points (taking into account Figure 3), he would have earned 2.5 points over ten (25%). If in the exam the same student scored 6.0 out of 10 (75%), he would get 4.5 (6 x 0.75). The final grade of this student would be 7.0 (2.5 + 4.5).

After this point, the scores are reset and the second half of the semester begins. It is important to highlight to the students that the game restarts and everyone has the chance to win again. It is also fundamental to notice that the students do not need to win the game to reach the maximum points earned. Many times, depending on the number of the students in the class, several students reach the 2.5 points related to presence and participation.

In the next chapter, a survey methodology is presented do identify and analyze the effectiveness of this method on students presence and participation in classes.

4. Methodology

The key objective of the survey was to assess the efficacy of the proposed method regarding student participation and presence. Thus, a questionnaire survey was planned and applied. According to De Leeuw, Hox, & Dillman (2008, p. 1), a survey "involves identifying a specific group or category of people and collecting information from some of them in order to gain insight into what the entire group does or thinks."

Therefore, an online survey was developed and sent to the students e-mail to answer. 151 e-mails were sent to all students attending four different courses that used the same gamification method explained beforehand. Ten obligatory closed questions were made using a Likert-scale ranging from 1 to 5, meaning totally disagree to totally agree. An open optional question at the end asked for suggestions or criticism about the proposed method. All the answers were taken between November 20th and December 5th, 2017. Survey responses are presented and analyzed in the next section.

5. Results and Discussion

In this section, the results of the conducted survey will be presented. Students from four different classes answered the survey. All the students were majoring in Architecture and Urbanism

and Engineering. As it can be seen in Table 2, 66 out of 151 students answered the survey, reaching a response rate of 43.7%. The courses and day-shift are also presented.

Table 2: Total number of students in each class and how many answered the survey.

Course	Day-shift	Total Number of Students	Answered
Business & Entrepreneurship (8th Semester)	Morning	26	10
Environmental Impacts (9th Semester)	Morning	16	12
Business & Entrepreneurship (8th Semester)	Evening	55	21
Environmental Impacts (9th Semester)	Evening	54	23
TOTAL		**151**	**66**

Source: Authors.

The first question was made in order to evaluate if due to the introduction of the gamification method, students paid more attention in class. All 66 students answered all the questions, thus the sample of all subsequent figures presented in this section is the same. Figure 4 shows the results of the first questions whereas more than 60% of the students believe they have paid more attention due to gamification. Percentage of students that disagree to such statement was around 10%.
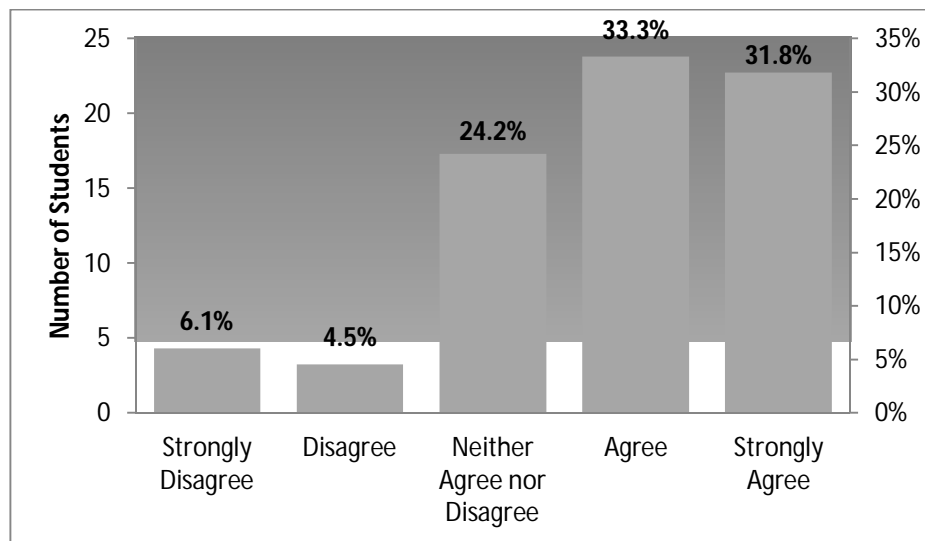
Figure 4: Statement 1 - Due to gamification I paid more attention in class.
Source: Authors.

Afterwards, the next question was aimed to assess if students, beyond paying more attention, also tried to improve their participation in class. Figure 5 presents data collected regarding this question. In this graph it is possible to witness that around 70% of the students state that changed their normal behavior in participating in class due to gamification. This was one of the key objectives prior to the development of the gamification method, and based on this survey, it seems this method accomplished this goal.
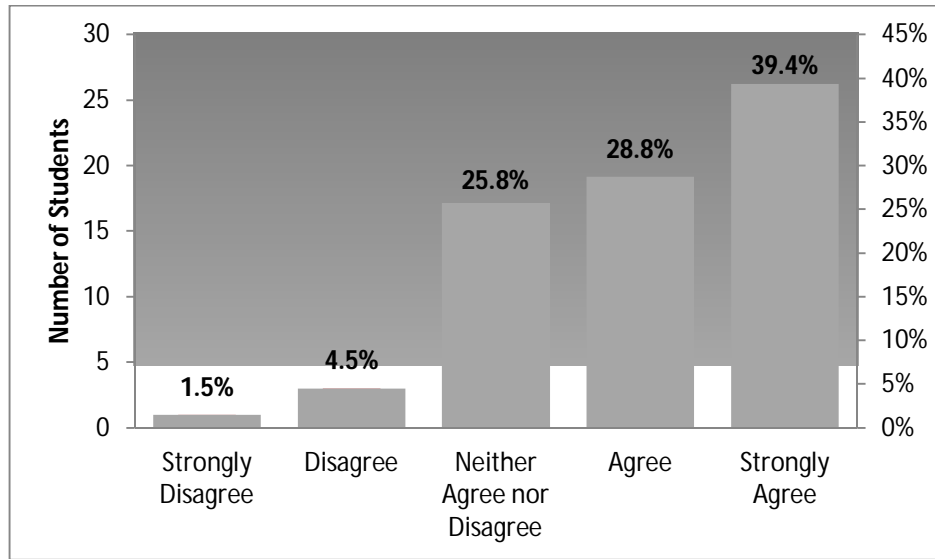
Figure 5: Statement 2 - Due to gamification I tried to participate more.
Source: Authors.

Another issue that was of interest of the researchers, was whether or not the students were less absent in classes. Thus, the third question asked if because of the gamification, they tried not to miss classes. Figure 6 shows the results that demonstrate that around 70% of the students made an effort to be present more often.
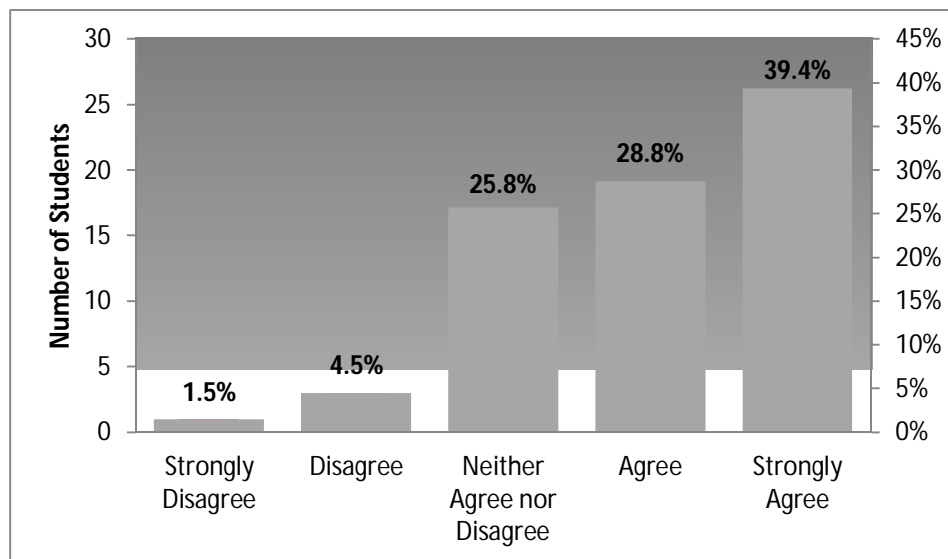

Figure 6: Statement 3 - Due to gamification I tried not to miss classes.
Source: Authors.

A similar issue was whether or not the students tried not to leave before the classes were over. Figure 7 presents the results that demonstrate that around 65% of the students tried to stay I class until it was over because of the gamification method.
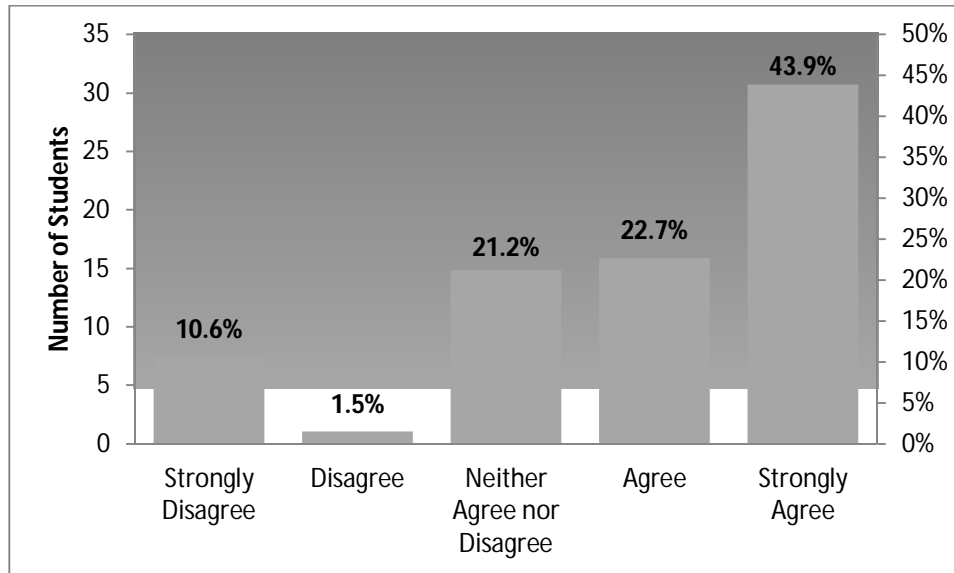
Figure 7: Statement 4 - Gamification made me try not to leave before class was over.

Source: Authors.

Another key goal of the development of this method was the improvement of students' socialization with the professor and colleagues. Therefore, the fifth question asked if the students communicated more with colleagues and/or professor because of the utilization of the gamification method. Figure 8 shows that around 60% of the students believe they have communicated more.
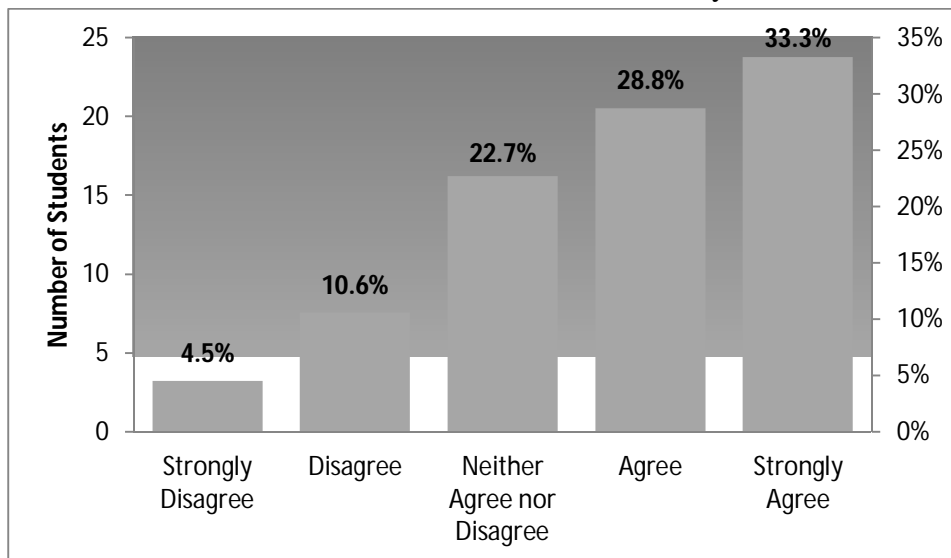

Figure 8: Statement 5 - Due to gamification I communicated more with my colleagues and/or professor.

Source: Authors.

The next question was similar to the first one and enquired if students felt more focused and attentive because of the gamification. In Figure 9 it is possible to verify that around 65% of the sample believes they have been more focused. Percentage of students that disagree to such statement was around 15%.
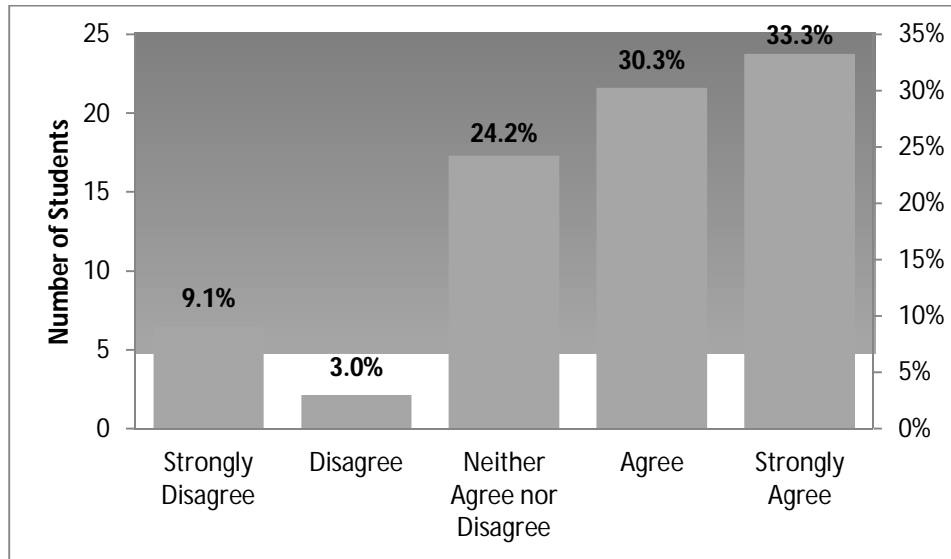
Figure 9: Statement 6 - I was more focused and attentive due to gamification.

Source: Authors.

Subsequently, there was a concern if the students enjoyed the ranking presentation since when the ranking was presented some students complained that they deserved to be in a better position. To answer to this uncertainty, students were asked if they enjoyed seeing the overall ranking in the beginning of the classes. Figure 10 presents the results in which the majority of the students (around 65%) enjoyed it. However, a considerable portion of the students (around 20%) did not enjoy such moment. Probably the students that did not enjoy were the ones on the bottom portion of the ranking, but since the survey was anonymously, it is not possible to evidence it.
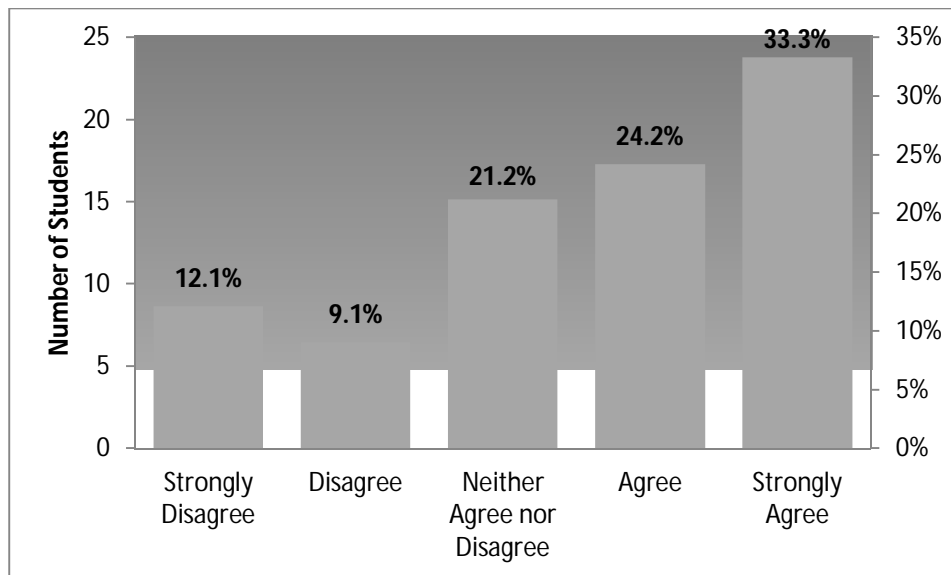

Figure 10: Statement 7 - I enjoyed seeing the overall ranking at the beginning of class.

Source: Authors.

Strongly linked with the prior question, it was interesting to evaluate if apart from enjoying or not the ranking presentation, if some students felt uncomfortable during this moment of class.

Figure 11 presents the results of this question and although the majority of the class did not feel uncomfortable, still informs that almost 20% did felt uncomfortable. This is could be a weakness of this method since the ranking is used to motivate, but also can lead to undesired effects on some students.
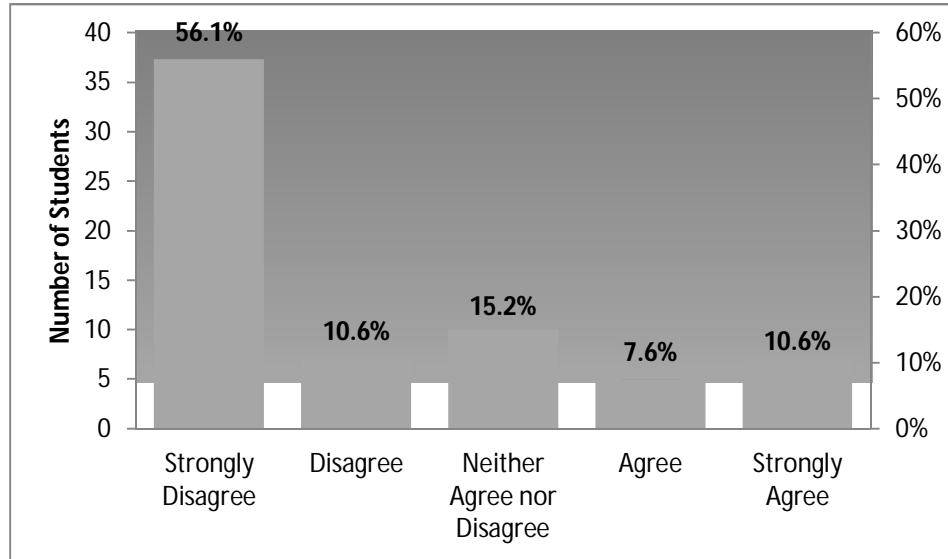

Figure 11: Statement 8 - The presentation of the overall ranking made me uncomfortable.
Source: Authors.

The last two questions had similar goals and wanted to assess if students felt that being evaluated for participation as presence was fair. These questions were made because traditional methods like exams and final assignments are largely used in this university; and students are not used to it at all. Figure 12 results' indicates that the majority of the students (around 65%) think it is fair to be evaluated for participation and presence. Still, around 15% disagree, what is sound since most of the students are not used to evaluations of this nature.
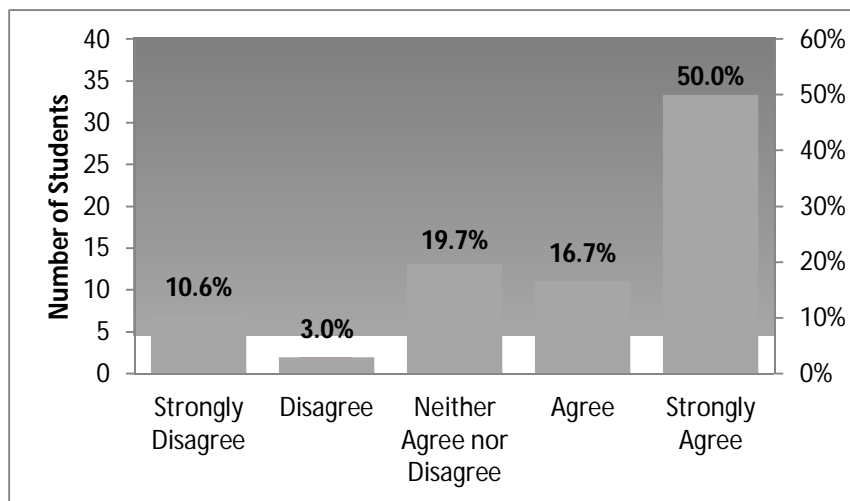

Figure 12: Statement 9 - I think it is fair to be e valuated for participation and presence and not just with evaluations (exams and assignments).
Source: Authors.

The final question pondered to appraise if students liked to be evaluated for participation and presence. This question differs from the previous one because it is different to think something is fair, and in fact like it. Lower agreement was expected in this question in relation to the previous one, and that was what was seen in Figure 13 (around 60%). Likewise, disagreement also showed slightly more adepts (around 20%).
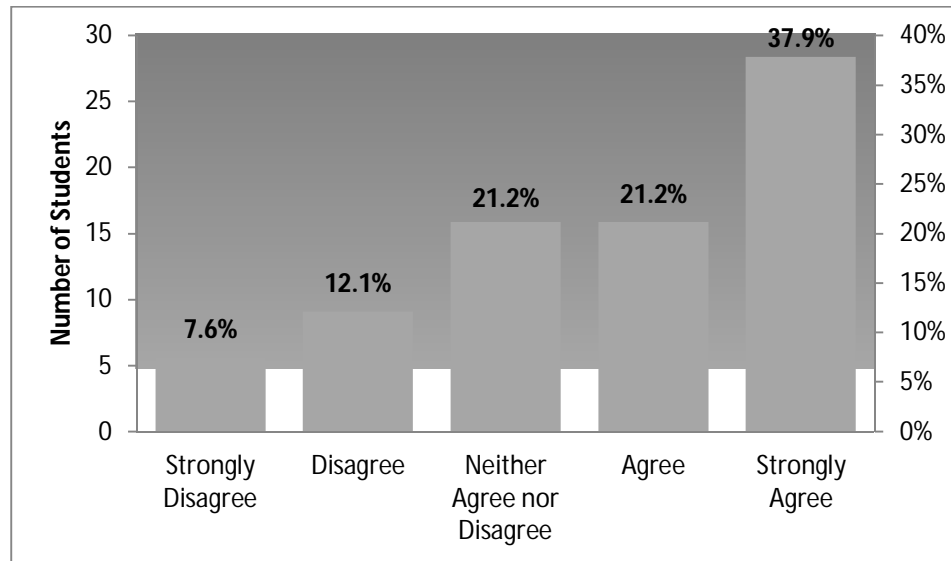

Figure 13: Statement 10 - I like to be evaluated for participation and presence.
Source: Authors.

Regarding the open ended question, students gave some testimonials about the method used. The majority pointed out that they enjoyed the method, for example "I liked the method, I'm shy and I did not participate much, but encouraged me to participate more"; "Very good system, in which there is more interaction among students"; "I found the tasks gamification great. I found it very interesting"; "Very good, this makes everyone pay attention, even those who do not want... So they do not disturb those who want to pay attention."

Others exposed dissatisfaction with the gamified method, for example "I find it unfair to discount notes from absences, knowing that we are entitled to be absent in 25% of the classes"; "I think that we can be evaluated for the participation, as for presence I think it is not necessary"; "I think it would have to be just exams."

As a final remark, it is possible to perceive a greater overall interest of the students to participate in the classes, a significant increase in the presence, and a healthy competition among the students. With this method, it is possible to perform tasks and games in the classroom that are worth points in the gamification classification without the need to give points directly in the final course grade. All tasks given could be gamified using the same spreadsheet and awarding points.

However, professors are advised to be aware if the students get over competitive. It is interesting to inform them that they do not need to be in the top of the ranking to earn the maximum grade. All students that reach the predetermined points earn the grade as already shown in Figure 3.

6. Conclusion

The world is changing rapidly and the teaching methodologies must follow a similar path. Many students find some classes boring and rapidly lose interest in paying attention and participating. This is a problem that many professors are facing nowadays, in which students prefer to navigate on the internet rather than pay attention or participate in the class.

Therefore, this work focused in an active learning methodology, called Gamification, which combines content, game and technology aiming to motivate the learning experience in a classroom. The development of this method aimed to enhance the student learning experience, introducing an alternative to class management and traditional evaluation methods, getting students' attention through gamified activities with goals and rankings.

Thus, based on the presented results, this method has proved to be very useful for a better management and conduction of classes by the professor, as well as a stimulus for students to participate, providing a clear and visual evaluation of their performance in relation to participation and tasks in the course.

This method continues to be used in classes by the authors and small modifications are made in each semester in order to improve it. As this study was conducted in a university environment and therefore with adults, the authors cannot assess how would younger students react to such ranking presentations. More studies are recommended to answer this issue and to foster incremental modifications to enhance this method.

REFERENCES

Barnes, T., Powell, E., Chaffin, A., & Lipford, H. (2008). Game2Learn: Improving the motivation of CS1 students. In *Proceedings of the 3rd international conference on Game development in computer science education - GDCSE '08* (pp. 1–5). https://doi.org/10.1145/1463673.1463674

De Leeuw, E. D., Hox, J. J., & Dillman, D. A. (2008). *International Handbook of Survey Methodology*. *International Handbook of Survey Methodology*. https://doi.org/10.4324/9780203843123

de Sousa Borges, S., Durelli, V. H. S., Reis, H. M., & Isotani, S. (2014). A systematic mapping on gamification applied to education. In *Proceedings of the 29th Annual ACM Symposium on Applied Computing - SAC '14* (pp. 216–222). https://doi.org/10.1145/2554850.2554956

Delphino, F. B. B., Oliveira, E., Felisbino, A. M., Sgorbissa, M. L., & Souza, D. R. (2017). A utilização de metodologias ativas em cursos superiores para uma aprendizagem significativa. In O. Jerez & C. Silva (Eds.), *Innovando en Educación Superior: Experiencias clave en Latinoamérica y el Caribe 2016-2017 (Volumen 3: Integración de TIC's)* (1st ed., Vol. 3, pp. 67–77). Santiago, Chile: Facultad de Economía y Negocios, Universidad de Chile.

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining gamification. In *Proceedings of the 15th International Academic MindTrek Conference on Envisioning Future Media Environments - MindTrek '11*. https://doi.org/10.1145/2181037.2181040

Deterding, S., Sicart, M., Nacke, L., O'Hara, K., & Dixon, D. (2011). Gamification: Using Game
Design Elements in Non-Gaming Contexts. In *Proceedings of the International Conference on
Human Factors in Computing Systems* (pp. 5–8). https://doi.org/10.1145/1979742.1979575

Dicheva, D., Dichev, C., Agre, G., & Angelova, G. (2015). Gamification in Education: A
Systematic Mapping Study. *Educational Technology & Society*, *18*(3), 75–88.
https://doi.org/10.1109/EDUCON.2014.6826129.

Huotari, K., & Hamari, J. (2012). *Defining gamification - A Service Marketing Perspective*.
Proceeding of the 16th International Academic MindTrek Conference on - MindTrek '12.
https://doi.org/10.1145/2393132.2393137

Kapp, K. M. (2012). *K. M. Kapp, The Gamification of Learning and Instruction: Game based
Methods and Strategies for Training and Education, 1 edition. San Francisco, CA: Pfeiffer,
2012.* (1st Editio). San Francisco, USA: Pfeiffer.

Kereki, I. F., & Adorjan, A. (2017). Innovación en la Enseñanza Inicial de la Programación. In O.
Jerez & C. Silva (Eds.), *Innovando en Educación Superior: Experiencias clave en
Latinoamérica y el Caribe 2016-2017 (Volumen 3: Integración de TIC's)* (1st ed., Vol. 3, pp.
55–66). Santiago, Chile: Facultad de Economía y Negocios, Universidad de Chile. Retrieved
from https://creativecommons.org/%0D

Lourenço Jr., J., & Veraldo Jr., L. G. (2017). Flipped Classroom e PBL no curso de engenharia:
uma experiência bem-sucedida na disciplina mecânica dos fluidos. In O. Jerez & C. Silva
(Eds.), *Innovando en Educación Superior: Experiencias clave en Latinoamérica y el Caribe
2016-2017 (Volumen 3: Integración de TIC's)* (1st ed., Vol. 3, pp. 31–41). Santiago, Chile:
Facultad de Economía y Negocios, Universidad de Chile.

Prensky, M. (2001). Digital Natives,Digital Immigrants. *On the Horizon*, *9*(5), 1–6.
https://doi.org/10.1108/10748120110424816

Sprint, G., & Cook, D. (2015). Enhancing the CS1 student experience with gamification. In *ISEC
2015 - 5th IEEE Integrated STEM Education Conference* (pp. 94–99).
https://doi.org/10.1109/ISECon.2015.7119953

Tsay, C. H. H., Kofinas, A., & Luo, J. (2018). Enhancing student learning experience with
technology-mediated gamification: An empirical study. *Computers and Education*, *121*, 1–17.
https://doi.org/10.1016/j.compedu.2018.01.009