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# Engagement And Solidarity While Learning

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# ENGAGEMENT and SOLIDARITY WHILE LEARNING (RESEARCH-PRACTICE)

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**ABSTRACT**
2020 and 2021 were difficult years for students attending higher education and secondary education especially if they were preparing to enter higher education. Teaching was adapted, and assessments were the possible ones according to what we lived and experienced. Thus, students need innovative and stimulating teaching and learning practices that motivate and involve them in the teaching/learning processes. Information and Communication Technologies (ICT) and digital platforms have seen their indiscriminate use, not without sometimes, teachers and students questioning whether they were being used in the best conceivable way or taken full advantage of. Face-to-face group work and involvement with the needs of colleagues lost some space for achievement and effectiveness. The preference for individual work and the visible reduction in solidarity among colleagues was an issue/question posed at the beginning of this study. An activity was proposed over a semester to students of Statistical Methods from Informatics Engineering. This curricular unit enrols 533 students, 85 on an after-work basis. The objective of this proposal was to create a collaborative learning platform where students could interact with each other within the scope of the curricular unit. Cumulatively, it was an objective that students deepen the topics taught in class, including references provided, and reviewing exercises conducted by their colleagues. Regularly professors corrected the materials proposed by the students. All students who participated had access to all the work developed. The evaluation of students' involvement, collaboration, and solidarity in addition to the results will be discussed and presented.

## 1 INTRODUCTION

### 1.1 Activity Contextualization

The process of learning Mathematics in Engineering courses is the target of varied and deep studies and research by the teachers who teach and develop it (Babo, L. et al., 2023 [1]). The pandemic caused widespread disruption to educational systems, with schools and universities around the world having to rapidly transition to remote learning to comply with social distancing guidelines and reduce the spread of the virus. This sudden shift to online learning posed significant challenges for both students and educators, as they had to adapt to innovative technologies and modes of instruction while dealing with the social and emotional stresses of the pandemic. For students preparing to enter higher education, the pandemic created additional challenges. College and university campuses were also closed or operating at reduced capacity, which limited opportunities for campus visits and extracurricular activities that allow students to engage on group studying contents and socializing. The pandemic also had significant economic impacts, with many families facing job losses or financial strain, which could affect their ability to afford higher education. Overall, the pandemic created a difficult and uncertain environment for students, particularly those preparing for higher education, and required them to be resilient and adapt to significant changes in their learning environments and plans. Teaching was adapted, and assessments were the possible ones according to what we lived and experienced. Thus, students need innovative and stimulating teaching and learning practices that motivate and involve them in the teaching/learning processes (Viberg, Olga, 2023 [5]). Information and communication technologies (ICT) and digital platforms have seen their

indiscriminate use, not without sometimes, teachers and students questioning whether they were being used in the best feasible way or taken full advantage of. Face-to-face group work and involvement with the needs of colleagues lost some space for achievement and effectiveness. The preference for individual work and the visible reduction in solidarity among colleagues was an issue/question posed at the beginning of this study. Within this education scenario, the authors looked for a solution that could engage their students and provide help between them. Due to all developments induced using digital platforms during pandemic times, we were looking for a platform where students initiative, interaction and visualisation was easy to achieve. According to several authors (e.g., Fisher, C. D., 2017, [2], Mehta K. J., Miletich I., & Detyna M., 2021, [3] and QiaoZhi, MuSu, 2015, [4]), « *Padlet is an excellent online collaboration tools which can help the students in the collaborative knowledge building in classroom and after class. It is convenient to use, powerful, and a good assistant of both the teaching and learning.* », therefore Padlet, [5], was chosen to experience a collaborative activity to engage students. Nevertheless, there are other platforms where similar activities may be proposed, *e.g.* Google Jamboard, Miro, Moodle, etc.

K. Lee (K. Lee, 2014 [6]) states that "*It may be advisable for teachers to develop students' learning processes in the face-to-face context without technology before engaging them in technology-supported learning*."

With this activity proposal authors wanted to have a clear perception of several aspects, namely:

1. Do students really engage into collaborative platforms?
2. Do these platforms help students to obtain better results?
3. Do students prefer individual help given by a teacher, for example office hours, when they need to clarify some questions?
4. Are students willing to help they fellow colleagues in the learning process?

## 2 METHODOLOGY

### 2.1 Padlet Activity Proposal

An activity was proposed over a semester to students of Statistical Methods from Informatics Engineering. This curricular unit enrols 533 students, 85 on an after-work basis. The objective of this proposal was to create a collaborative learning platform, as described above, where students could interact with each other within the scope of the curricular unit. Cumulatively, it was an objective that students deepen the topics taught in class, including references provided, and reviewing exercises conducted by their colleagues.

Questions from previous exams were regularly proposed in a Padlet where students who register to participate, duly identified (Name and number of student) can publish their resolutions, comment (constructively) on the resolutions published by colleagues.

The proposed questions were taken out from all previous exams of the curricular unit since one of the aims was to support students on their learning path. The typical study path followed by our students is 1) To study theoretical concepts (definitions, applied

theorems, examples given in class); 2) Solve the exercises proposed at Exercises Curricular Unit booklet; 3) Solve previous exams. With this activity teachers were aiming to help on steps 1 and 2, since step 1 is discussed inside class. One example of questions proposed in the Padlet activity is provided in Appendix I.

Student ratings are a calculated proportion of the number of participations in different content. Of all the participations made by the student, the one(s) that has the highest number of correct participations in the largest number of different contents, has the highest rating. Example: From X distinct contents, the student correctly solves 1 exercise of content A and 1 exercise of content B - will have in the final classification (2/X) * 2 bonus values. The student correctly solves 2 exercises of content A and 0 exercises of content B - will have in the final classification (1/X) * 2 bonus values. Participation in exercises of the same content, despite not having bonuses in the final classification, has the goodness of cementing the personal study of the student and collaborating in the study of the group involved.

Professors corrected the materials published by the students providing feedback either if the students' resolution needed to be redone or if it was correct.

All students who participated had access to all the work developed. At the end of the activity, the students involved could obtain at most 2 points that were added to their final classification mark. The evaluation of students' involvement, collaboration, and solidarity in addition to the results will be discussed and presented in the results' section. Figure 1 shows the Padlet activity proposed.

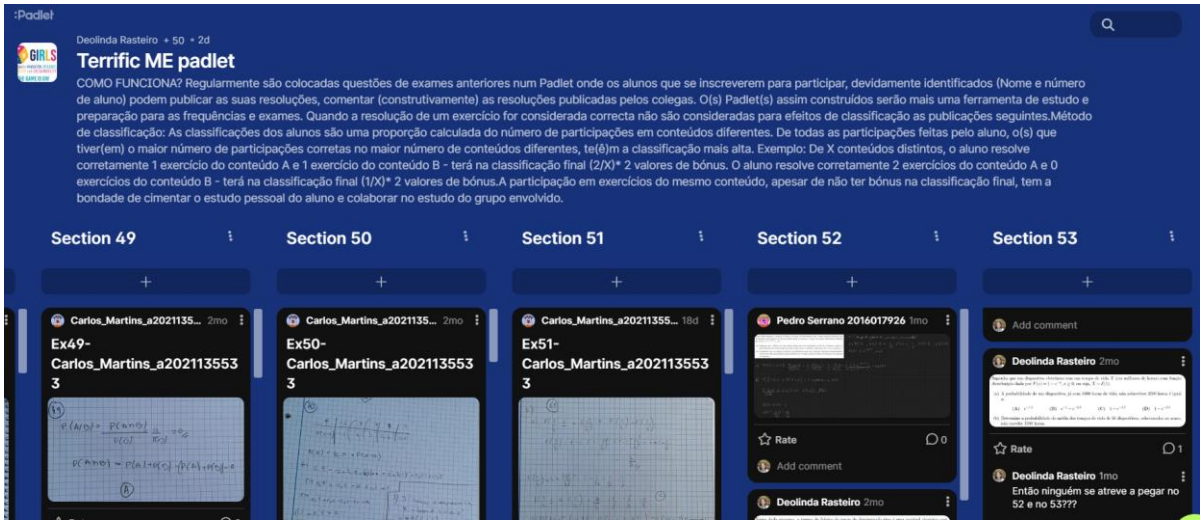


*Fig. 1. Padlet activty.*

The period of observation of the activity was from 18/03/2023 to 28/04/2023. After the activity a *GoogleForms,* [6], questionnaire was filled by the students in order to gather their opinion about it.

The questions made are within table 1 below, possible answers were yes/no.

*Table 1. Satisfaction Questionnaire*

| Questions |
|---|
| Have you ever used Padlet before? |
| Do you consider that, in addition to the Bonus, which you may have in your classification, this activity helps you to study? |
| Do you consider that, in addition to the Bonus, which you may have in your ranking, this activity helped you to obtain a better ranking in the written assessment? |
| Was the feedback given by teachers sufficient? |
| Was the feedback given by your colleagues sufficient? |
| Would you like there to be more interaction with and from your colleagues? (comments and questions to your resolutions) |
| You agree to share the published resolutions with all your colleagues registered in the curricular unit? |

## 2.2 Working Sample

Registered to Statistical Methods curricular unit were 533 students (85 of them on a after work basis). To all students an invitation to inscribe themselves on the Padlet activity was sent by e-mail and available at the Moodle curricular unit page during a period of two weeks at the beginning of the semester. From the 533 students, 137 showed intentions to participate, 28 of which from the after-work course. Thus, approximately 24.3% of regular the students and 33% of after work students engaged on this activity (≅ 25.7% of the total students registered on the curricular unit). Although 137 showed intentions of participating, only 50 indeed posted and interacted with their fellow colleagues.

# 3 RESULTS

## 3.1 Padlet posts, satisfaction questionnaire and written assessment

The first result that was indeed not encouraging was the starting index of engagement, only 25.7% of the students responded to the activity invitation, even though 2 bonus points could be achieved in the end.

Considering the period of observation (from 18/03/2023 to 28/04/2023) we had 448 posts and their distribution by day may be observed in Figure 2 below.

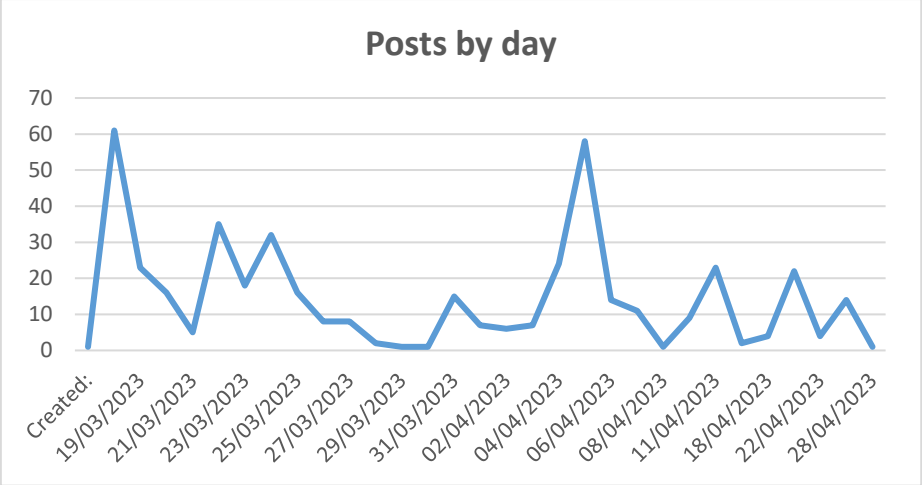


*Fig. 2. Distribution of posts by day*

The distribution of posts by Exercise entrance is depicted on Figure 3, below. As we may observe, in the beginning there was a higher response rate that may be attributed to two different reasons: one is natural curiosity, the other is because initial exercises were simpler that the following ones.

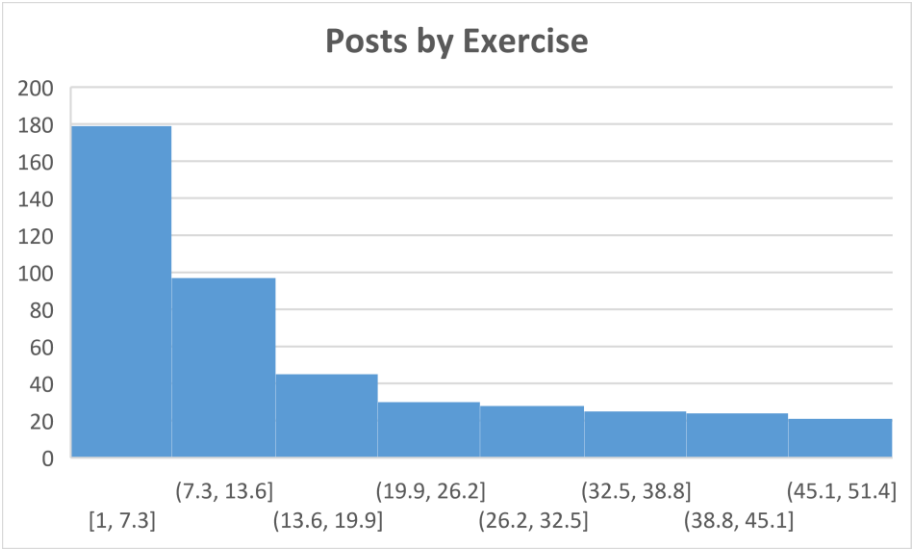


*Fig. 3. Posts by Exercise*

Since the response rate stabilized during the period of observation and the exercises difficulty were regularly improving, the authors tend to justify the initial index of response as curiosity.

The questionnaire using *Googleforms*, Figure 4., that was proposed to the students allowed teachers to obtain their opinion about satisfaction and utility of the Padlet activity.

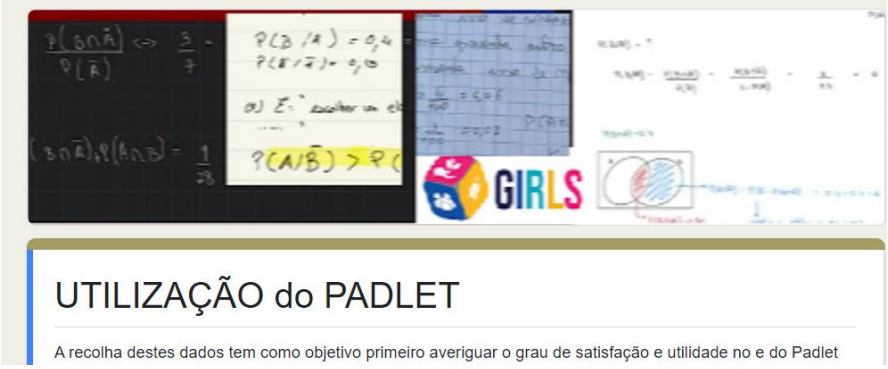


*Fig. 4. Posts by Exercise*

From the data collected and resumed we conclude that 60% of the engaged students had never used Padlet. Since the activity engagement in the beginning was only approximately 25.7%, the authors questioned if the students were only involved because of the 2-points bonus proposed. All 100% students agreed that this activity helped them to study besides the 2-points bonus proposed. When asked «*Do you consider that, in addition to the bonus, which you may have in your mark, this activity helped you to obtain a better classification in the written assessment?* », *the* obtained answers indicate, as shown in Figure 5., that 73.33% of the students consider the activity has helped them to prepare to the written assessment.

To corroborate these received answers, we compared the number of students approved in the written assessment to the number of those students that participated in the activity.

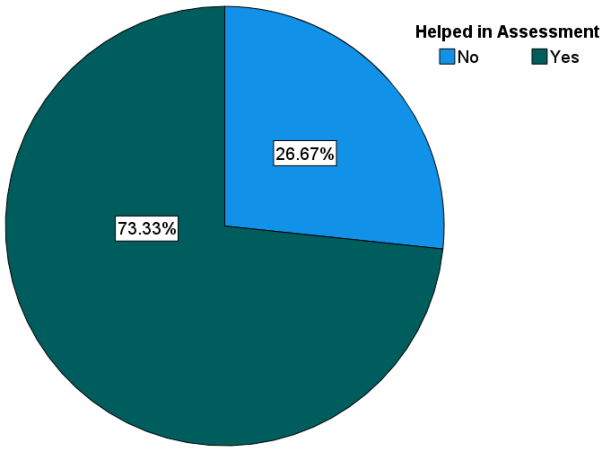


*Fig. 5. Positive activity influence in the assessment*

In fact, in case of after work students, from the 44.71% of the ones that were assessed, 60.53% approved, and from those 60.78% participated in the activity. Regarding regular students, from the 43.90% of the ones that were assessed, 70.09% approved, and from those 37.80% participated in the activity.

*Table 2. Statistics from the written assessment*

| | | |
|---|---|---|
| **After Work Students Total** | 85 | |
| **Assessed** | 38 | 44.71% |

| | | |
|---|---|---|
| **Approved** | 23 | 60.53% |
| **In_Activity** | 14 | 60.87% |
| **Regular Students Total** | 533 | |
| **Assessed** | 234 | 43.90% |
| **Approved** | 164 | 70.09% |
| **In_Activity** | 62 | 37.80% |

Regarding the feedback given by professors, 100% of the students considered that it was enough, while 13.3% of them wished that colleagues gave more feedback. All 100% considered the materials posted by their fellow colleagues were of help to complement their own study.

When asked «*Would you like there to be more interaction with and from your colleagues? (Comments and questions to your resolutions)?* », 40% of the students wished more interaction from their colleagues.

Finally, professors, to be able to conclude whether students' solidarity was only towards the colleagues participating in the activity or in general, asked the students «*Do you agree with the sharing of the published resolutions with all your colleagues enrolled in the course?* » and all 100% agreed.

## 4 CONCLUSIONS

From this activity a couple of conclusions may be redrawn. The first conclusion is that the percentage of students engaged in this activity was below professors' expectation and the percentage of students that undertaken the written assessment was also surprising (≅51%). Students prefer to clarify their questions about contents and exercises resolution at office hours or by e-mail where the only intervenient are the professor and themselves. Therefore, individual study is preferred by the student's majority. Other conclusion is that, even though we have faced times where ICT was widely used, Padlet, which is a very know collaborative platform was an unknown tool for 60% of the students. All 100% students agreed that this activity helped them to study, and the feedback provided by professors was enough. A small percentage, 13.3%, of the students wished that colleagues gave more feedback.

To share their collaborative work with all the other students is, for the students engaged in the Padlet activity, not a problem. Therefore, we may conclude that although a small percentage of students wishes to work in collaboration, those who want are 100% solidary with all the others.

Regarding future work with Padlet, authors intend to continue with this resource but using a different approach. It will be also used as a tool inside and outside the classroom. We believe that this approach will involve more students in the collaborative learning process.

## 5 ACKNOWLEDGMENTS

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## APPENDIX I

This appendix contains some figures with examples from the exercises proposed to students in the Padlet activity

Let $\Omega$ be the space results associated to a random experience. Consider that $A$ and $B$ are two events ($A \subset \Omega$ and $B \subset \Omega$) such that $\mathrm{P}(A) = 0.6$, $\mathrm{P}(\overline{B}) = 0.6$ and $\mathrm{P}(A \cap B) = 0.4$. The value of $\mathrm{P}(B/\overline{A})$ is

**(A)** 0 **(B)** $\frac{1}{3}$ **(C)** $\frac{2}{3}$ **(D)** 1

A student will take 3 exams. The probability of having a positive grade in each exam is 0.6 and the exam results are independent. Calculate the probability of the student having a positive grade:

(a) in the maximum of two exams;

(b) in the first and third exams only.

The number of defects per article produced in a certain production line follows a *Poisson* distribution with an expected value of 0.01. To be sold, these articles are packed in boxes of 10 units.

(a) The probability of any article not being defective is

**(A)** 0.9900 **(B)** 0.9048 **(C)** 0.0952 **(D)** 0.0100

(b) The probability that, in a box, the total number of defects found is greater than 2 is

**(A)** 0.0001 **(B)** 0.0013 **(C)** 0.0002 **(D)** 0.9957

In a factory, there are two production lines for an article ($X$), and the article is classified regarding its final quality ($Y$), according to the following table:

| Y \ X | 1 | 2 | Total |
|---|---|---|---|
| 1 | 0.06 | b | 0.25 |
| 2 | 0.04 | c | e |
| 3 | a | d | 0.4 |

(a) Knowing that $P(X = 2 \cap Y = 3) = 0.25$, complete the table missing values.

(b) Knowing that an article was rated 3 regarding its final quality, determine the probability that it was produced by production line 2.

(c) From the sentences below choose the one that is true

**(I)** The higher the number of the production line, the lower will tend to be the classification in terms of final quality;

**(II)** The higher the number of the production line, the higher the classification will tend to be in terms of final quality;

**(III)** The final quality classification is independent of the production line number.

**(Although this question is a multiple choice, please indicate all the calculations you performed.)**

The time that an employee, a hypermarket cashier, takes to serve a customer follows an exponential distribution of an average of 5 minutes.

(a) The probability of a customer takes less than 4 minutes to be served is

**(A)** 0.7135 **(B)** 0.7769 **(C)** 1 **(D)** 0.5507

**Observation:** If needed, $\int_a^b f'(x)\, e^{f(x)}\, dx = e^{f(b)} - e^{f(a)}$

(b) Assume that 50 customers paid for their purchases in this hypermarket cashier. What is the probability of the average service time is less than 5 minutes?

. Consider that there are four consecutive steps of processing and analyzing images for further integration into *apps*. The average time spent in each of these steps by algorithm A is, respectively, 10.5, 10.8, 10.4 and 10.7 milliseconds. It is assumed that the times spent in each step are independent and have normal distributions whose standard deviations are, respectively, 0.2, 0.4, 0.4 and 0.6.

(a) Set a maximum limit on the time spent by algorithm A in 95% of cases.

(b) If the total time spent in the 4 steps by algorithm B follows a normal distribution of mean 42.6 milliseconds and variance 0.9, the probability of this algorithm being faster than algorithm A is, using 4 decimal places,

**(A)** 0.3187 **(B)** 0.4376 **(C)** 0.5624 **(D)** 0.6813

. An investor is interested in a financial asset and needs help to make the decision. The investor will only invest if the average financial return (expressed as a percentage) is greater than 3.4%. To help him make the decision, a sample corresponding to the financial return of 41 transactions was collected, whose average is 3.9% and the standard deviation is 1.3%.

(a) With 98% confidence, what would you indicate to the investor?

(b) Subsequently, the standard deviation was questioned by business partners who claimed not to support the decision if the standard deviation was greater than 1.2%. At the significance level of 5%, and assuming that the financial return follows a normal distribution, find out if the investor will have the support of its partners in the decision taken.

. In a given curricular unit, the time in hours that a student spends to study for an exam is associated with a random variable $X$, with the probability density function given by $f_\alpha(x) = e^{-x+2\alpha}$, $x > 2\alpha$, where $\alpha$ ís an unknown parameter related to the minimum study time to approve in the exam. It is also known that $\mathrm{E}(X) = 1 + 2\alpha$.

(a) A random sample of $X$, $X_1\, X_2\, , \cdots , X_n$ with $n > 2$ was collected. An unbiased estimator of $\alpha > 0$ is

**(A)** $\dfrac{\overline{X} - 1}{2}$ **(B)** $\overline{X}$ **(C)** $\dfrac{\overline{X}}{2} - 1$

(b) A sample of $X$, of size 200, whose average is 50 hours, was collected. From this sample an unbiased estimate of $\alpha$ is

**(A)** 24hours **(B)** 50hours **(C)** 49hours **(D)** $24,5$hours