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The impact of submission timing on students' final grades: Mindset as an academic predictor

El impacto del momento de entrega en las calificaciones finales de los estudiantes: El tipo de mentalidad como predictor académico

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ABSTRACT

The time students take to submit their exam may influence their final grades, as it reflects not only their prior preparation but also their underlying behavioral profiles. In this regard, literature highlights the role of mindset in shaping how individuals approach tasks. Students with a fixed mindset tend to exhibit slower responses due to fear of failure and avoidance of challenges, often delaying task completion and the moment of submission. In contrast, those with a growth mindset are more proactive, persistent, and focused on improvement, which may lead to faster and more efficient execution. In the world population, there is a predominance of people with a fixed mindset. Consistent with this, our data show that a majority of students submit their exams in the final time slots of the exam (around 60% of students). Likewise, both high- and low-performing students can hold either type of mindset, implying that high academic performers may deliver in the first time slots (when holding a growth mindset) and in the last ones (when holding a fixed mindset). Supporting this idea, our analysis reveals that the highest average grades are achieved both in the earliest (+12%) and latest (+4%) submission slots, whereas the lowest performance is observed in intermediate periods, following a U-shaped relationship. To deepen the analysis, we also examine the behavior followed by *the 'top 10'* best and *'top 10'* worst students in the class. Consistent with prior general submission pattern, both groups are mainly present in the final time slot. Therefore, it could be argued that students who take more time to complete their exams tend to obtain both the highest but also the lowest results of the class. Overall, our findings highlight the relevance of understanding submission patterns for educators, as they can better interpret students' needs during exams, anticipate peak workloads to increase invigilation, and avoid misinterpreting early or late submissions from potential high-performing students.

Keywords. Fixed mindset, growth mindset, response time, behavior pattern, educational system.

RESUMEN

El tiempo que los estudiantes tardan en entregar su examen puede influir en sus calificaciones finales, ya que refleja no solo su preparación previa, sino también su comportamiento subyacente. En este sentido, la literatura destaca el papel que tiene el tipo de mentalidad en la forma en que las personas abordan sus tareas. Los estudiantes con una mentalidad fija tienden a mostrar respuestas más lentas debido al miedo al fracaso y a la evitación de desafíos, retrasando con frecuencia la finalización de las tareas y el momento de entrega. Por el contrario, aquellos con una mentalidad de crecimiento son más proactivos, persistentes y orientados a la mejora, lo que puede traducirse en una ejecución más rápida y eficiente. A nivel global, existe un predominio de las personas con mentalidad fija. En esta línea, nuestros datos muestran que la mayoría de los estudiantes entregan sus exámenes en las últimas franjas temporales (alrededor del 60% de los estudiantes). Asimismo, tanto los estudiantes con buenas notas como los estudiantes con malas notas pueden presentar cualquiera de los dos tipos de mentalidad, lo cual implica que los alumnos con mejor desempeño académico pueden entregar tanto en las primeras franjas (cuando poseen una mentalidad de crecimiento) como en las últimas (cuando presentan una mentalidad fija). En esta línea, nuestro análisis revela que las calificaciones medias más altas se obtienen tanto en las primeras (+12%) como en las últimas (+4%) franjas de entrega, mientras que los peores resultados

se concentran en las franjas intermedias, siguiendo una relación en forma de U. Para profundizar en este análisis, también examinamos el comportamiento de los alumnos 'top 10' mejores y los 'top 10' peores de la clase. En línea con el patrón general de entrega observado previamente, ambos grupos se concentran principalmente en la última franja temporal. Por tanto, podría afirmarse que los estudiantes que tardan más en completar sus exámenes obtendrán tanto las mejores como las peores notas de la clase. En conjunto, estos hallazgos ponen de manifiesto la relevancia de comprender los patrones de entrega por parte del profesorado, ya que les permite interpretar mejor las necesidades de los estudiantes durante el examen, anticipar picos de sobrecarga para reforzar su vigilancia y evitar interpretaciones erróneas al observar que algunos estudiantes de alto rendimiento entregan su examen muy pronto o muy tarde.

Palabras clave. *Mentalidad fija, mentalidad de crecimiento, tiempo de respuesta, patrón de comportamiento, sistema educativo.*

INTRODUCTION

The literature identifies a clear positive link between student motivation and its academic performance (Ali et al., 2010; Huitt, 2001; Pinar-Pérez et al., 2021), understanding motivation as a mental state that stimulates the individual's activities and actions (Ali et al., 2010). Increasing student motivation is a complex task. However, it has been the subject of interest for numerous researchers over time (Huitt, 2001; Pintrich, 2003; Ryan & Deci, 2000) with the aim of identifying the factors that influence it. Among these factors, it is crucial to determine whether they foster what is known as intrinsic motivation or, on the contrary, they increase the extrinsic motivation. Extrinsic motivation refers to when students feel themselves motivated to learn with the purpose of achieving an external goal, receiving a reward, or avoiding punishment (Dev, 1997). In contrast, a student with intrinsic motivation participates in the learning process because of the interest and enjoyment it provides, without the need for external rewards or punishments. As Ali et al. (2010) stated, "students with intrinsic motivation will be more enthusiastic, independent and proactive, being able to feel pleasure for their studies, and (however) students with extrinsic motivation will drag themselves more when completing their academic tasks, will feel compelled to learn and will always dedicate minimal efforts to the learning process" (Ali et al., 2010, pp. 81). Consequently, as the literature shows, intrinsic motivation will positively influence academic performance, while extrinsic motivation will have a negative impact on it (Ali et al., 2010). Therefore, the goal of any professor and educational system should be to promote the intrinsic (and not extrinsic) motivation of the student (Villagrasa, 2024a).Previous research has focused on analyzing how these types of factors, as well as stress or time management, positively or negatively influence the academic performance of students (Crisp, 2007, Jami and Afzal, 2018) but none of them have delved into how the delivery time of an exam could influence the student's grades, since this would reflect, in part, the planning and prior preparation of the students for the subject, but also their internal characteristics. In this way, knowing what the students are like can lead to improve the teacher's understanding and treatment of them (Escribá-Esteve, et al., 2023, Villagrasa, 2024a).

The literature establishes a clear differentiation between those who hold a fixed mindset and a growth mindset (Dweck, 2006), which can be very useful in terms of analyzing their response time. People with a fixed mindset believe that their skills, intelligence, and talent are innate and immutable characteristics, that is why they try to avoid challenges, do not value constructive criticism considering it as a threat, and give up more easily (Dweck, 2006).

In contrast, people with a growth mindset believe that skills and intelligence can be developed with effort, strategy, and help, so they try to seek out challenges, are very persistent in trying, look for learning and improving from feedback, and are inspired by the success of others to achieve their own improvement (Dweck, 2006). This is why adopting a growth mindset can lead to greater

student motivation, better achievements, and a higher ability to face and overcome difficulties. Therefore, promoting this type of mentality in education, but also at a personal or professional level, would be very beneficial for the individual, who with their effort and interest in improvement, would increase their results obtained (Kroeper et al., 2022).

In this vein, literature has largely examined motivation, mindset, and time-related behaviors in isolation, relying predominantly on self-reported measures (Steel, 2007; Claessens et al., 2007; Dweck, 2006). As a result, limited attention has been paid to how observable behavioral indicators (such as the exact moment in which students submit their exams) relate to academic performance. Addressing this gap, the present study adopts a behavioral perspective by linking submission timing with exam outcomes, using mindset as a theoretical lens to interpret these patterns (Dweck, 2006; Dweck & Yeager, 2021). Specifically, this research aims to (1) overall analyze the distribution of submission timing among students, (2) examine its relationship with academic performance in order to identify potential patterns, (3) explore how these patterns may differ across extreme performers (top and low-performing students), (4) and provide practical insights for both institutions and educators by helping them to better identify students who may need support and understand how different submitting behaviors can be related to distinct academic results.

By doing so, this study contributes to the literature by providing an innovative behavior-based approach to understand academic performance and offering insights that bridge psychological theory and observable student behavior (Mofield & Parker-Peters, 2018).

In the following sections, the literature review, methodology used for data collection and analysis will be detailed, the key findings of the study will be presented and the implications of these results for educational practice will be discussed, ending with the potential limitations of the work and future lines of research.

LITERATURE REVIEW

Prior research has extensively examined the determinants of academic performance from different perspectives. A first stream of literature has focused on procrastination and delay behaviors, showing that students' tendency to postpone tasks is negatively associated with performance outcomes (Steel, 2007; Ferrari et al., 1995). Closely related, a second body of work has analyzed time management and study behaviors, highlighting the role of planning, time allocation, and task engagement in shaping academic results (Macan et al., 1990; Claessens et al., 2007). Finally, a well-established line of research has explored the role of psychological factors, particularly mindset, demonstrating how individuals' beliefs about the malleability of their abilities influence motivation, persistence, and performance (Dweck, 2006; Dweck and Yeager, 2021). However, despite these advances, prior studies have largely relied on self-reported measures and have examined these factors in isolation. To the best of our knowledge, little attention has been paid to how observable, real-time behavioral indicators (such as the exact moment in which students submit their exams) relate to academic performance, nor to how such behavior may be interpreted through a mindset lens. By linking actual submission timing with exam outcomes, this study aims to provide a novel behavioral perspective on student performance, bridging previously disconnected strands of the literature.

In this regard, the present study begins by drawing on the literature on mindset as a key theoretical approach to interpret student performance. Thus, despite the hypotheses deeply established by Dweck (2006), research has not found significant differences in this type of fixed or growth mindset between the most advanced students and those who obtain worse results (Mofield & Parker-Peters, 2018). That is to say, both good students and not-so-good students could develop both types of mindsets interchangeably. Or, in other words, these findings suggest that more capable students will not be more likely to develop growth mindsets than their peers (Mofield & Parker-Peters, 2018).

Nevertheless, the mindset with which a person addresses its tasks can significantly affect how quickly and efficiently he/she completes them. Thus, the growth mindset tends to favor greater speed and efficiency in completing tasks due to less procrastination, better acceptance of feedback received, and a marked focus on continuous progress. In contrast, the fixed mindset can lead to greater slowness due to the fear of failure and the avoidance of challenges associated with it, thus procrastinating their execution (Dweck, 2006). Consequently, both good and not-so-good students may be more or less quick in completing their tasks depending on the type of mindset they hold (Mofield & Parker-Peters, 2018).

On the other hand, if we analyse the distribution of people with a fixed mindset and a growth mindset in the world, we can establish that only 40% of people have a growth mindset, which indicates that the other 60% have a fixed mindset (Dweck, 2006). However, these percentages can vary significantly depending on factors such as education, culture, and social environment (Dweck & Yeager, 2021). The educational level tends to be associated with a growth mindset. According to Carol Dweck's theory (2006), education can play a significant role in promoting this type of mindset due to the exposure to new ideas, development of skills, the observation of educators as inspirational role models, etc.

It is important to note that not all educational contexts will necessarily promote a growth mindset. In fact, some educational environments may overemphasize achievement rather than effort and learning, which could encourage a fixed mindset within the students. Therefore, the way in which education is delivered and the values that are promoted within an educational system will be crucial in shaping the mindset of students (Dweck and Yeager, 2021).

In Spain, where culturally there is a high aversion to risk (Brooks and Williams, 2023), the fixed mindset seems to be even more widespread among the population, and also among the students (Zamarro et al., 2016). This phenomenon can be attributed to a traditional educational model based on more traditional or classic methodologies such as lecture-style teaching, concept repetition, and memorization (Izagirre-Olaizola et. al, 2020).

Therefore, although the prevalence of fixed and growth mindsets remains a complex and evolving field of study (Dweck & Yeager, 2021), the literature suggests that Spain shows a stronger inclination toward the fixed mindset, establishing in the same way that these mindsets are not static and could potentially change with the appropriate intervention. Thus, promoting a growth mindset across a variety of contexts could help increase the prevalence of this mindset over time, as well as its associated benefits.

Research questions

In this vein, this study aims to analyze the moment in which students hand in their exams, expecting to find a very high percentage in the last time slots, due to the predominance of the fixed mindset within the world population, which would be increased by the methodology implemented in the Spanish educational system. This type of mindset is linked in the educational field with a tendency to adopt avoidance-oriented behaviors, which would generate greater slowness on the part of the student due to the fear of failure and the avoidance of challenges associated with it, thus procrastinating the answering of questions until the end of the time established in the exam (Dweck, 2006, Mofield & Parker-Peters, 2018). In this sense, students with a fixed mindset are more likely to experience performance anxiety and to engage in self-protective strategies, such as delaying task completion, in order to avoid negative judgments about their abilities (Elliot and Church, 1997; Steel, 2007). This behavioral pattern reinforces procrastination tendencies and reduces task efficiency, particularly in evaluative contexts where performance is publicly exposed. Consequently, response delays may not only reflect a lack of preparation, but also an underlying psychological mechanism through which students seek to protect (or reinforce) how competent they perceive themselves to be.

It is important to clarify that this study does not directly measure students' mindset, but rather infers its potential presence through observable behavioral patterns, specifically the timing of exam submission. In this sense, mindset is treated as a theoretical lens to interpret behavior, rather than as an explicitly measured construct. Although prior research has developed validated scales to assess fixed and growth mindsets (Dweck, 2006; Dweck and Yeager, 2021), collecting such data for the full sample of students throughout the course would still present significant practical and methodological challenges, particularly when aiming to ensure consistent measurement across all students and to avoid potential response biases associated with self-reported constructs. Therefore, the absence of a direct measurement of mindset should be considered a limitation of this study, as the observed relationships rely on indirect inference rather than explicit psychometric assessment.

Secondly, due to the lack of significant differences between fixed or growth mindsets among the most advanced students (Mofield & Parker-Peters, 2018), it is expected to find good results on the part of the students both in the first time slots (due to the good students with a growth mindset) and in the last time slots (due in this case to the good students with a fixed mindset). In this case, for obvious reasons, continuous assessment grades should be excluded from the analysis in order to avoid possible distortions in the results due to the variability in the quality of the work groups[1] (Santos et al., 2018). Building on this reasoning, the study further explores whether the relationship between submission timing and academic performance follows a non-linear pattern, as well as whether these dynamics remain consistent across different cohorts (such as the first call versus second call).

In a third place, to deepen the analysis, this work also proposes analysing the specific results of the students who are in *the 'top 10'* best and in the *'top 10'* worst of the class. This perspective would allow a more fine-grained exploration of extreme performance patterns, offering additional insights to understand the factors that influence the student's final grade.

Someone could have argued, for example, a modification in this calculation, using the 'top 20' of the class instead of the 'top 10'. However, the reason behind using ten students or twenty students, would come determined by the sample size. Thus, in our case, where most of the classes have between 30 and 50 students, the use of 20 students to calculate the performance patterns of top students would eliminate the coherence of this calculation: to show the difference between the top students and the rest of the class (Villagrasa et al., 2024a). Indeed, this approach is consistent with prior research that recommends the use of extreme group comparisons or upper percentile thresholds to preserve differentiation and analytical clarity when examining performance distributions (Preacher et al., 2005).

Fourthly, this study aims to derive practical insights from the observed behavioral patterns, with the objective of informing both institutional decision-making and teaching practices. In particular, by identifying systematic relationships between submission timing and academic performance, this research seeks to provide actionable evidence that can help academic institutions anticipate peak workloads and allocate resources accordingly, as well as support educators in better understanding and guiding their students. In this regard, educators could better identify students who may require additional support during the exam process as well as better understand that the behavioral patterns followed by different types of students are potentially associated with distinct performance outcomes obtained by them.

[1] *It is important to note that the student's final exam grade is an individual mark obtained exclusively by the student through the final exam of the subject, so said grade would not be biased or conditioned in any case by the possible grades obtained within group works, included in this case within the final grade of the subject (but not in such final exam grade).*

METHODOLOGY

The methodology used for this research is based on the study of the final exam grades obtained by 454 students of *'EDEM-Business School'*[2], a Spanish academic institution considered as one of the leading and most dynamic entrepreneurial ecosystems in the Mediterranean region, and where apparently its students should have an embedded growth mindset to try to develop their ideas and future business projects. However, these institutional efforts may be partially offset by the broader country-level context, where a strong aversion to risk and a marked traditional educational model based on traditional methodologies (Izagirre-Olaizola et. al, 2020) could lead to a relatively higher prevalence of fixed mindset traits among students.

The sample consists of six different exams (three in the first call and three in the second call) developed by students enrolled in the two degree programs offered by the institution: Business Administration and Management, and Engineering and Business Management. One subject was selected in each degree, both of which share a similar business-oriented focus and content. Therefore, no substantive differences exist between the subjects in terms of content or approach, despite the fact that students' profiles differ across both degrees, with Business Administration students being more business-oriented and Engineering students exhibiting a more technical profile.

Additionally, all exams followed the same structure, combining a multiple-choice section with an open-answer part, aimed at assessing both theoretical and practical knowledge acquisition, with identical weighting assigned to each section across all exams. Besides, exams were able to reasonably be completed within the allotted time (with a maximum of 90 minutes), not being time pressure a deliberate feature. This distinction is important, as some exams are designed to allow completion without time constraints, while others explicitly assess students' speed.

The analysis is focused exclusively on the study of the students' final exam grades in order to provide an accurate assessment of their academic performance. As previously mentioned, this methodological decision aims to eliminate potential bias arising from variability in group-based continuous assessments. In this way, it is ensured that our results more objectively reflect the actual individual abilities of the students.

In addition, the study incorporates a detailed analysis of the time slots in which the students handed in their exams, thus relating the grades obtained by the students in such exams to these time slots. The time slots analysed are divided into five categories:

- < 49 minutes
- 50-59 minutes
- 60-69 minutes
- 70-79 minutes
- 80-90 minutes

To do so, we conducted a series of complementary statistical analyses. First, we performed a descriptive analysis of the data to provide an initial overview of grade distributions across our predefined time intervals. Subsequently, a one-way ANOVA was developed to assess whether mean grades significantly differ across these time slots. When overall differences were detected, post hoc comparisons using Tukey's test were employed to identify which specific time slots significantly diverge from each other. In addition, to improve the robustness of our analyses we

[2] *'EDEM-Business School' is a Spanish academic institution founded in 2002. Currently, the school is affiliated with the two main public universities in the city: the 'University of Valencia' and the 'Polytechnic University of Valencia'. Besides, the institution has an educational offer of more than 50 programs, including both university and management training, houses a total of 2,500 students and employs over 500 professors and researchers. It is also important to highlight that 'EDEM-Business School' is part of 'Marina de Empresas', a consolidated business ecosystem made up of a business accelerator, 'Lanzadera', an investment vehicle, 'Angels', and a training center, 'EDEM-Business School', concentrated in what has become one of the most important and successful entrepreneurial hubs in the Mediterranean area.*

estimated regression models including both linear and quadratic terms of submission timing to test for a potential U-shaped relationship, allowing us to assess whether performance is higher at the extremes. Finally, independent samples tests were conducted to explore whether these patterns differ across exam calls (i.e., first versus second call) and across degree programs (i.e., students enrolled in business administration and engineering degrees). Taken together, these analyses aim to determine whether certain submission time windows are associated with systematically higher academic performance, and whether such effects are consistent across different dimensions.

To enhance the analysis, the study also identifies the students with the *'top 10'* best and the *'top 10'* worst grades of the class. This segmentation allows to generate a more precise comparison between the time of delivery and the academic performance of the student, providing a clearer view of the characteristics that differentiate very high or very low performing students from the rest of students.

RESULTS

The results of the study are divided into two parts: the first refers to the students who took their exam in the first call, while the second corresponds to those who took it in the second call, whose total number was, understandably, lower than in the first.

First call results

In the first call, 332 students handed in their exam. Among them, 5% delivered it in the first time slot, 16% in the second, and 18% in the third. The majority of the deliveries, 61%, were concentrated between the fourth (25%) and fifth (36%) time slots. This indicates that most of the students handed in their exam almost at the end or at the end of the allotted time.

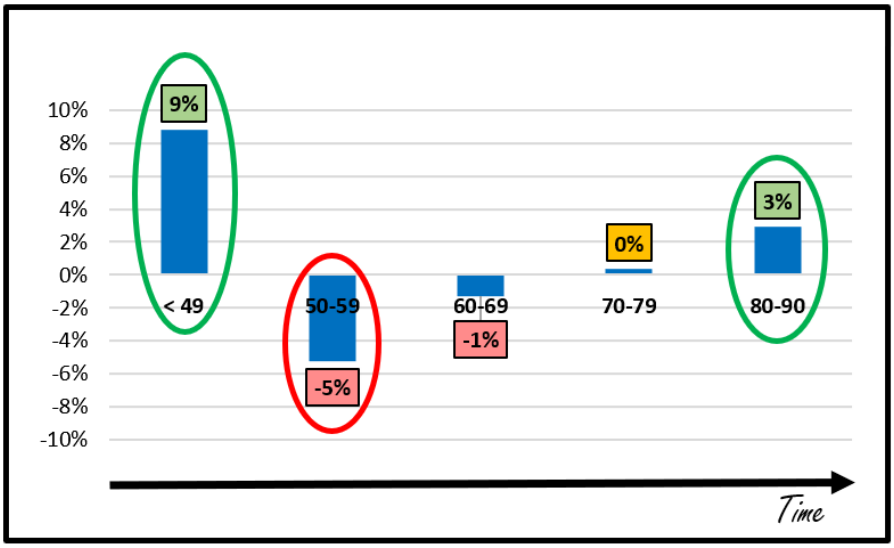
Table 1. Percentage of students who handed in their exam regarding each time slot in the first call.

TIME SLOT	% STUDENTS WHO HANDED IN	
< 49	5%	
50-59	16%	
60-69	18%	
70-79	25%	} 61%
80-90	36%	
	100%	

Source: Authors own elaboration

The average grade of the students in this first exam was 5.94 out of 10. The students who handed in the first time slot (in less than 49 minutes), obtained the best average grade, with 6.46; obtaining a performance 9% higher than the average. They were followed by those who handed in the last time slot (between 80-90 minutes), with an average grade of 6.11; performing 3% above the average. On the other hand, those who handed in the second time slot (between 50-59 minutes), that is, just behind the first ones, obtained the worst average grade, with 5.63; representing a -5% in their grade with respect to the average grade of the class.

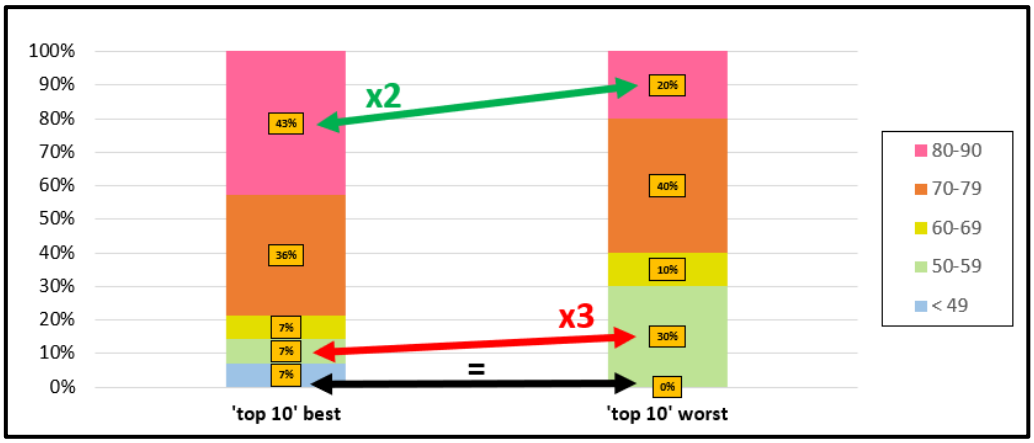
Figure 1. Percentage of grade higher or lower than the average grade of the class regarding each time slot in the first call.



Source: Authors own elaboration

For a more exhaustive analysis with which to obtain potential behavior patterns, the data from the *'top 10'* students with the best and the *'top 10'* students with the worst grades of the class were examined. To do this, we focused on analysing whether in the three time slots identified in the previous paragraph (where the best and worst average grades of the class were given), there was any significant difference between these types of students. Thus, in the first time slot (in less than 49 minutes), where the best average grade was obtained (+9%), there was hardly any representation of the *'top 10'* best students or the *'top 10'* worst ones. On the other hand, in the last time slot (between 80-90 minutes), where the second best average grade was obtained (+3%), there were twice as many *'top 10'* best students than *'top 10'* worst ones. Finally, in the second time slot (between 50-59 minutes), where the worst average grade was obtained (-5%), there were three times as many *'top 10'* worst students than *'top 10'* best ones.

Figure 2. Distribution of the *'top 10'* students with the best and the *'top 10'* students with worst grades regarding each time slot in the first call.



Source: Authors own elaboration

Second call results

Regarding the second call, it is worth mentioning that 122 students handed in their exam. Of this sample, 13% delivered it in the first time slot, 13% in the second, and 19% in the third. Again, the majority of the deliveries, 55%, were concentrated between the fourth (26%) and fifth (29%) time slots. This indicates that most students handed in their exam almost at the end or at the end of the allotted time, following the same pattern as in the first call.

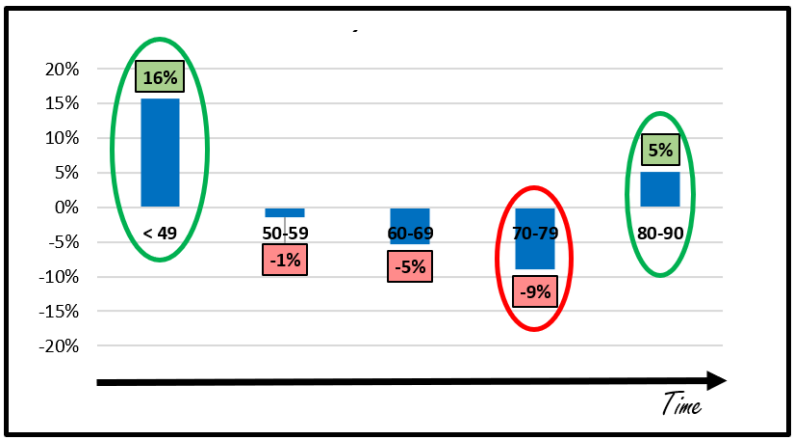
Table 2. Percentage of students who handed in their exam regarding each time slot in the second call.

TIME SLOT	% STUDENTS WHO HANDED IN	
< 49	13%	
50-59	13%	
60-69	19%	
70-79	26%	55%
80-90	29%	
	100%	

Source: Authors own elaboration

On this occasion, the average score of the exam was 5.46 out of 10, almost half a point lower than in the first call, or in other words, a 9.2% lower. The students who handed in the first time slot (in less than 49 minutes) again obtained the best average grade, with 6.31; obtaining a performance 16% higher than the average (much higher than the 9% obtained in the first call). They were followed by those who handed in the last time slot (between 80-90 minutes), with an average grade of 5.74, as occurred in the previous call; performing 5% above the average (much higher than the 3% obtained in the first call). On the other hand, those who handed in the fourth time slot (between 70-79 minutes), as opposed to the second time slot as occurred in the first call, that is, just before the last ones, obtained the worst average grade, with 4.97; representing a -9% in their grade with respect to the average grade of the class (much higher than the -5% obtained in the first call). It is therefore worth noting that individually, in each of these slots (as with the overall grade), the grades in absolute terms were lower in this second call compared to the grades obtained in the first call.

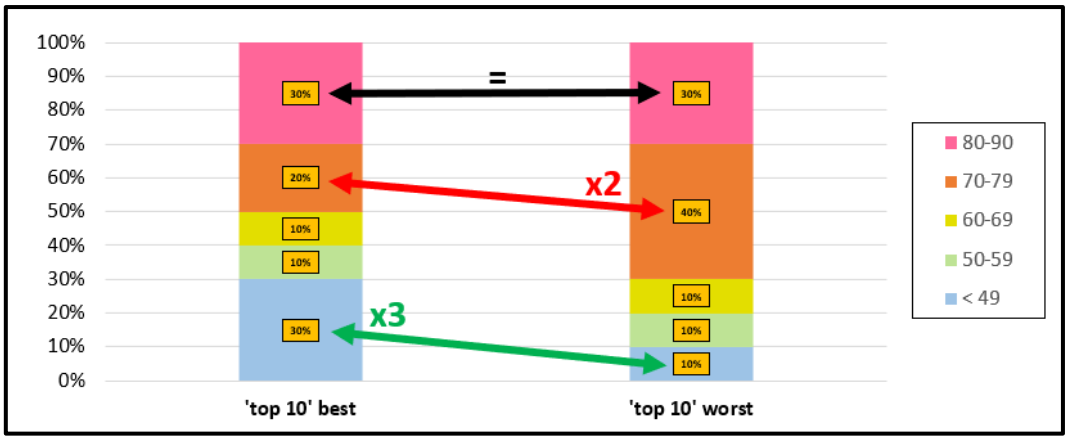
Figure 3. Percentage of grade higher or lower than the average grade of the class regarding each time slot in the second call.



Source: Authors own elaboration

Similarly to what was done in the first call, in order to obtain a more in-depth analysis of this second call, the data from the *'top 10'* students with the best and the *'top 10'* of the students with the worst grades of the class were analysed. To do this, we again focused on analysing whether in the three time slots identified in the previous paragraph (where the best and worst average grades of the class were given), there was any significant difference between these types of students. Thus, in the first time slot (in less than 49 minutes), where the best average grade was obtained (+16%), there were three times as many *'top 10'* best students than *'top 10'* worst ones (remember that in the first call there was hardly any representation of the *'top 10'* best students or the *'top 10'* worst ones in this time slot). On the other hand, in the last time slot (between 80-90 minutes), where the second best average grade was obtained (+5%), there was a very similar representation of the *'top 10'* best students and the *'top 10'* worst ones, with 30% of both (remember that in the first call there were twice as many *'top 10'* best students than *'top 10'* worst ones in this time slot). Finally, in the fourth time slot (between 70-79 minutes), where the worst average grade was obtained (-9%), there were twice as many *'top 10'* worst students than *'top 10'* best ones (remember that in the first call there were three times as many *'top 10'* worst students than *'top 10'* best ones, and that this also occurred in the second time slot, and not in the fourth).

Figure 4. Distribution of the *'top 10'* students with the best and the *'top 10'* students with worst grades regarding each time slot in the second call.



Source: Authors own elaboration

Descriptive analyses provided an initial overview of grade distributions across our predefined time intervals. However, with the aim of improving the implication of our results, an ANOVA test was conducted in order to examine differences in average grades across submission time slots. The results reveal statistically significant differences between groups ($F = 4.22$, $p < 0.01$), indicating that submission timing is associated with academic performance. Next, post-hoc Tukey HSD tests were conducted, indicating that students submitting their exams in the last time slot obtain significantly higher grades compared to those submitting in the time slot 2 (mean difference = 0.921, $p < 0.05$) and the time slot 4 (mean difference = 0.605, $p < 0.05$), similar to what our descriptive data showed for the first and the second call respectively. No other pairwise comparisons reached statistical significance. These results suggest that the observed differences in performance are primarily driven by higher outcomes among students submitting in last time period, rather than by a consistent advantage of early submission.

Table 3. Tukey HSD post hoc comparisons across submission time slots.

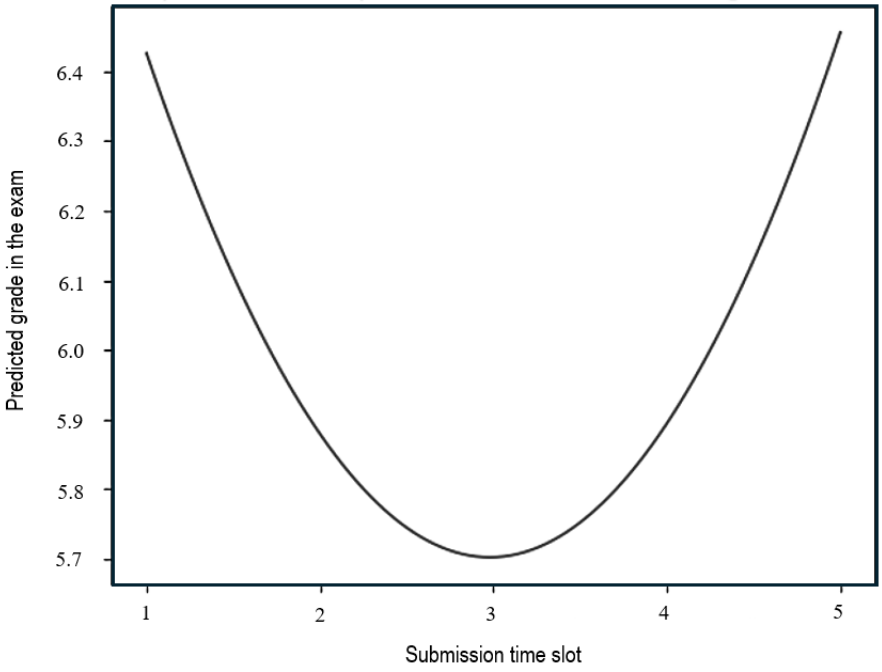
COMPARISON	MEAN DIFFERENCE	P-VALUE	SIGNIFICANCE
Slot 1 vs Slot 2	-1,160	0.139	No
Slot 1 vs Slot 3	-0.790	0.449	No
Slot 1 vs Slot 4	-0.840	0.342	No
Slot 1 vs Slot 5	-0.240	0.982	No
Slot 2 vs Slot 3	0.370	0.822	No
Slot 2 vs Slot 4	0.320	0.873	No
Slot 2 vs Slot 5	0.921	0.020	Yes
Slot 3 vs Slot 4	-0.060	0.999	No
Slot 3 vs Slot 5	0.550	0.178	No
Slot 4 vs Slot 5	0.605	0.048	Yes

Source: Authors own elaboration

However, to further explore the relationship between submission timing and academic performance and improve the robustness of our analyses, a quadratic regression model was performed. The overall model is statistically significant ($F = 6.95$, $p = 0.001$), indicating that the set of predictors jointly explains variation in academic performance beyond what would be expected by simple random variation (through our prior descriptive analysis). The results reveal a statistically significant U-shaped relationship between submission timing and grades, as indicated by a negative coefficient for the linear term ($\beta = -1.10$, $p < 0.05$) and a positive coefficient for the squared term ($\beta = 0.185$, $p < 0.01$). This suggests that students submitting their exams either very early or very late tend to achieve higher grades, as opposed to the previous test that only identified advantages for later submissions.

We also calculated the estimated turning point of the quadratic function, which lies around the intermediate time slot (slot 3, or more precisely, at the point 2.97, which corresponds to the point at which the marginal effect of submission timing on grades equals zero), reinforcing the idea that students submitting in the middle of the time distribution exhibit the lowest academic performance versus both extremes.

Figure 5. U-shaped relationship between submission timing and grades.



Source: Authors own elaboration

In this sense, it is important to underline that the regression-based approach offers a more powerful and nuanced test by modeling submission timing as a continuous variable. Therefore, although the ANOVA and Tukey HSD post hoc analyses did not identify statistically significant differences between the earliest and latest submission slots, the quadratic specification captures the underlying functional form of this relationship. This allows us to detect a U-shaped pattern that remains partially obscured in discrete group comparisons, highlighting the advantages of continuous modeling in uncovering non-linear effects.

Post-hoc analysis

To examine whether differences in academic performance exist between the first and second exam calls, an independent samples t-test was conducted. The results show no statistically significant differences in average grades between both groups ($t = -0.185$, $p = 0.854$), indicating that overall performance levels remain consistent across exam calls.

To further examine the robustness of the results and check whether the differences in submission timing keeps on being present in both calls, a two-way ANOVA was conducted (including both submission time slots and exam calls as factors). The results confirm a significant main effect of submission timing ($F = 4.20$, $p < 0.01$), while no significant effect is found for the exam calls ($F = 0.18$, $p = 0.671$). Besides, the interaction between submission timing and exam calls is not statistically significant either ($F = 0.37$, $p = 0.826$), indicating that the observed relationship between submission timing and academic performance remains stable across both calls. Thus, we can argue that this is not a context-dependent effect but reflects a consistent behavioral pattern.

In a similar vein, we also tested whether differences in academic performance exist between the students enrolled in business administration and engineering degrees. To do so an independent samples t-test was conducted. The results show no statistically significant differences in average

grades between both groups (t = -0.215, p = 0.830), indicating that overall performance levels remain consistent across degrees.

To further examine the robustness of the results and check whether the differences in submission timing keeps on being present in both degrees, a two-way ANOVA was conducted (including both submission time slots and degrees as factors). The results confirm a significant main effect of submission timing ($F = 4.22$, $p < 0.01$), while no significant effect is found for the degree ($F = 0.11$, $p = 0.742$). Besides, the interaction between submission timing and degree is not statistically significant either ($F = 0.86$, $p = 0.486$), indicating that the observed relationship between submission timing and academic performance remains stable across both academic programs. Thus, again, we can argue that this is not a context-dependent effect but driven by a stable behavioral pattern.

DISCUSSION

Students hand in their exams late due to the preponderance of a fixed mindset

The aim of this research is to analyse the moment in which students hand in their exams, in order to obtain a detailed understanding of the students' behavior at the different time slots assigned for delivery. As established in the literature, the mindset with which a person approaches their tasks can significantly affect the speed and efficiency with which they complete them (Dweck, 2006). In the world population, there is a predominance of people with a fixed mindset, who show a greater slowness due to the fear of failure and the avoidance of challenges, thus procrastinating their execution (Dweck, 2006). At the educational level, this would translate into a greater stickiness when answering the questions asked, postponing their answers and delaying the moment of delivery until the end of the established time (Dweck, 2006, Mofield & Parker-Peters, 2018). Something that in Spain would be reinforced by the effect that the educational system exerts on our marked aversion to risk and fear of failure (Brooks and Williams, 2023, Zamarro et al., 2016), accentuating this fixed mentality over students.

This situation can be easily corroborated when analysing our sample, where most of the deliveries of the students are made between the fourth and fifth time slots. Thus, in the first call, 61% of the students handed in their final exam between these time slots; a very similar figure to the 55% obtained in the second call. This would indicate that the majority of the students delivered their exam almost at the end or at the end of the allotted time, supporting what is established by the literature (see Table 1 and Table 2).

However, in contrast to the previous profile, people with a growth mindset believe that skills and intelligence are not something that can be developed without effort, that is why they seek to learn, improve, and are very persistent when looking for this improvement (Dweck, 2006). Consequently, adopting a growth mindset can lead to a greater motivation on the part of the student, better achievements, and a higher ability to face and overcome difficulties. In this way, the growth mindset tends to favour a greater speed and efficiency in the completion of tasks due to less procrastination, better acceptance of the feedback received, and a marked focus on continuous progress (Dweck, 2006).

Analysing our data, we can observe that a very small percentage of students deliver their exam in the first time slot. Only 5% of them in the first call; whereas 13% did so in the second call (see Table 1 and Table 2). This finding supports the notion that the vast majority of the population (and of our students) hold a fixed mindset.

Likewise, it would be logical to assume that if more students hand in their exams during these time slots, there would be also a greater chance that among them there is a high percentage of the best and worst students.

After analysing the data obtained, we can determine that in the first call, 79% of the *'top 10'* students with the best and 60% of the *'top 10'* students with the worst grades of the class handed in between the fourth and fifth time slots. On the other hand, in the second call, 50% of the *'top 10'* students with the best and 70% of the *'top 10'* students with the worst grades of the class handed in during these time slots.

These findings would suggest that, regardless of the call, students who take more time to complete their exams tend to obtain the best results of the class, but also the worst. In other words, the probability of a very good student handing his/her exam at the end of the time allotted is very high, but so it is the probability of finding a very bad student (see Figure 2 and Figure 4).

Good students with both types of mindsets: deliveries at the beginning and at the end

However, as previously noted, the literature has not identified significant differences between fixed and growth mindsets among the best and worst students (Mofield & Parker-Peters, 2018). That is, both good students and not-so-good students could develop the two types of mindsets indiscriminately. Or, in other words, there will be good students both in the first time slots (due to the good students with a growth mindset) and in the last time slots (due in this case to the good students with a fixed mindset).

If we analyse our sample, we may identify that in the first call, the students who handed in the first time slot obtained the best average grade (obtaining a performance 9% higher than the average). They were followed by those who handed in the last time slot (performing 3% above the average). And the same pattern was repeated in the second call, where the students who handed in the first time slot again obtained the best average grade (obtaining a performance 16% higher than the average). Besides, as it occurred in the previous call, they were followed by those who handed in the last time slot (performing 5% above the average) (see Figure 1 and Figure 3).

Nevertheless, although it is true that the time slots where the best average grades occur coincide in both calls (during the first and the last time slots), there are differences in the percentages obtained between both. Thus, in the first time slot, the performance in the first call was +9%, compared to the +16% in the second call (almost doubled). Similarly, in the last time slot, the performance in the first call was +3%, compared to the +5% in the second call (also almost doubled) (see Figure 1 and Figure 3).

The explanation is straightforward, since the average mark obtained by the students in the exam of this first call was 5.94 out of 10, compared to the 5.46 out of 10 in the second call, almost half a point lower, or what is the same, a 9.2% lower. This would mean that although in absolute terms grades are lower in this second call, the best marks obtained by the students would stand out more compared to the average, and therefore, the percentage with respect to the mean of the class would be increased.

As previously stated, to complement the descriptive evidence, we conducted a series of inferential analyses to formally test these patterns. The one-way ANOVA results indicate statistically significant differences between groups, indicating that submission timing is associated with academic performance. Likewise, post hoc comparisons were developed using Tukey's HSD test, which reveal that students submitting in the final time slot significantly outperform those in intermediate slots (e.g., time slot 2 and time slot 4), similar to what our descriptive data showed for the first and the second call respectively. No other pairwise comparisons reached statistical significance. These results suggest that the observed differences in performance are primarily driven by higher outcomes among students submitting in the last time period rather than in early ones.

However, when submission timing is modeled as a continuous variable, the quadratic regression analysis uncovers a statistically significant U-shaped relationship, indicating that higher performance is associated with both early and late submission behaviors, coinciding with our descriptive findings. Finally, independent samples t-tests showed no statistically significant

differences in academic performance between exam calls (or even across degree programs), suggesting that the observed relationship between submission timing and academic performance remains stable and is not a context-dependent effect, but driven by a constant behavioral pattern. In other words, they would not be affected by cohort-specific effects.

First vs second call: change in the patterns between the 'top 10' best and 'top 10' worst

As argued above, if in both the first and the second call a large number of students hand in their exams in the last time slots (see Table 1 and Table 2), the chances of finding a high percentage of the best and worst students among them would also be increased (see Figure 2 and Figure 4). But do these students always follow the same distribution or do they change their pattern of behavior between the first and second call?

They change. Specifically, in the second call the *'top 10'* students with the best grades increased in the first time slot (going from 7% to 30%), with a decrease in the fourth and last time slot (going from 79% to 50%). That is, it could be identified a transfer of these excellent students from the last time slots to the first ones (see Figure 2 and Figure 4).

The explanation is straightforward: high-potential students with a growth mindset who underperformed in the first call will tend to strive for improvement, will motivate themselves to increase their study hours and results, obtaining a much higher performance in the second call (and therefore, transferring the percentage of the *'top 10'* best students from the end to the beginning of the delivery time).

Conversely, in the second call it also happened that the *'top 10'* students with the worst grades decreased in the second time slot (going from 30% to 10%), with a rise in the fourth and last time slot (going from 60% to 70%). That is, it could be observed a transfer of these low-performing students from the second time slot to the last ones (see Figure 2 and Figure 4).

Its explanation is also very straightforward, and it will be caused due to a change in the distribution where the worst grades were obtained. Thus, in the first call, those who handed in the second time slot, that is, just behind the first, obtained the worst average grade (-5%). On the other hand, in the second call, those who handed in the fourth time slot, that is, just before the last, obtained the worst average grade (-9%). It is therefore logical that if the general results in the first call reached its lowest value in the second time slot, there would also be in that time slot a higher presence of *'top 10'* worst students, just as it would occur in the second call with the fourth time slot. Furthermore, this transfer of the worst students from the beginning to the end of the delivery time could be the natural consequence of concentrating together in this second call the less capable students who were not able to pass the subject in the first call, the students who did not study for the first exam and now experience greater difficulties by not clearly remembering the explanations of the subject, and the students who show a general lack of interest for the subject or the degree.

Consistent with the tests conducted on the full sample, no statistically significant differences are observed between time slots 4–5 and slot 1, nor between time slots 2 and 4. Likewise, no significant differences are found between the first and second exam calls. However, these results apply to the overall cohort and do not necessarily extend to top-performing and low-performing students, which are the ones analyzed currently.

Thus, to further examine whether the distribution of extreme performers varies across submission time slots, we conducted chi-square tests of independence. Given that the analysis focuses on the distribution of categorical outcomes (i.e., the presence of top- and low-performing students across time slots), chi-square tests are more appropriate than ANOVA, which is designed for comparing mean differences in continuous variables (and not categorical ones). The results show that the distribution of top-performing students does not significantly differ across time slots ($\chi^2 = 6.02$, $p = 0.198$), suggesting that high-performing students are relatively evenly distributed. In contrast, the distribution of low-performing students is significantly associated with submission timing ($\chi^2 = 13.28$, $p = 0.010$), indicating that these students tend to concentrate in specific time

slots (particularly, the ones placed in between time slot 2 and time slot 5). This asymmetry provides additional support for the coexistence of distinct behavioral patterns: while high-performing students appear more flexible and less constrained by submission timing, low-performing students exhibit a totally different behavior.

One possible explanation for the lack of statistically significant differences in the distribution of top-performing students could be the unequal distribution of observations across submission time slots. In particular, lower frequencies in early submission slots (5% delivered it in the first time slot in the first call and 13% in the second call) may reduce statistical power and limit the ability of chi-square tests to detect systematic patterns, even when descriptive differences are observed. Therefore, these findings should be interpreted with caution, as the absence of statistical significance does not necessarily imply the absence of meaningful behavioral differences.

CONCLUSIONS AND PRACTICAL IMPLICATIONS

This study offers several theoretical contributions. First, it advances the literature on academic performance by introducing submission timing as an objective, real-time behavioral indicator, moving beyond prior work predominantly based on self-reported measures and discussing how such behavior may be interpreted through a mindset lens (Steel, 2007; Macan et al., 1990). In doing so, it bridges research on procrastination, time management, and mindset by linking observable behavior with performance outcomes (Claessens et al., 2007; Dweck, 2006). In this regard, descriptive results show that a substantial proportion of students concentrate their submissions in the final time slots (61% in the first call and 55% in the second), suggesting a general tendency toward delayed task completion usually associated with fixed mindsets.

Second, the identification of a robust U-shaped relationship extends existing linear assumptions in the literature, highlighting the importance of modeling non-linear effects when examining student behavior (Cohen et al., 2003). In this sense, this study provides robust evidence indicating that both early and late submissions are associated with superior academic outcomes, whereas intermediate time slots correspond to lower performance. Therefore our findings empirically support prior theoretical arguments suggesting that, given the lack of significant differences between fixed and growth mindsets among advanced students (Mofield & Parker-Peters, 2018), it is expected to find good results on the part of the students both in the first time slots (due to the good students with a growth mindset) and in the last time slots (due to in this case to the good students with a fixed mindset). Besides, additional analyses show no significant differences across exam calls or degree programs, confirming that this relationship is stable across contexts and not cohort-dependent.

Third, by showing that top-performing students are distributed across time slots while low-performing students tend to cluster in the intermediate periods, the study reveals an asymmetry that enriches our understanding of performance heterogeneity not previously shown in the literature (Preacher et al., 2005).

Regarding the practical implications of this study, our findings provide several relevant insights for both academic institutions and professors. First, the strong concentration of submissions in the final time slots suggests that universities can anticipate peak workloads during these periods. This allows for better resource allocation, such as increasing invigilation, technical support, or administrative staff during the last minutes of exams, where both volume and pressure are highest.

Second, professors can use submission timing as a real-time behavioral signal to better understand and support their students. For instance, given that lower performance tends to concentrate in intermediate time slots, educators could proactively engage with students who are still working during these periods, offering encouragement or clarifications to help them improve their outcomes and persist in working on their exam for longer periods.

Third, the identification of a U-shaped relationship implies that professors should not be surprised to observe potential high-performing students submitting either very early or very late.

Early submissions may reflect well-prepared, confident students, characterized by a proactive learning orientation, persistence, and a focus on continuous improvement (connected with a growth mindset), while late submissions may correspond to students who invest additional time to refine their answers, often characterized by fear of failure, risk aversion, and a tendency to delay task completion (connected with a fixed mindset). Recognizing these patterns can help educators avoid misinterpreting submission timing as a direct proxy for effort or ability.

Finally, these findings suggest that submission timing could be incorporated as an additional behavioral indicator in learning analytics systems, allowing institutions to detect at-risk students more effectively and design targeted interventions aimed at improving academic performance.

LIMITATIONS AND FUTURE RESEARCH AVENUES

Despite the innovative nature of this study, not previously analysed in the literature, our research presents several limitations that in turn can lay the foundations for future research opportunities.

First, and although our study helps to understand the potential existing behavior models among students in order to avoid making decisions on mere subjective assumptions (Villagrasa et al., 2018; Villagrasa et al., 2024b), it only takes into consideration a specific academic institution, *'EDEM-Business School'*. Future research should therefore compare these results across different academic institutions, together with distinct countries where the distribution of students was different (Heffernan, 2022). This would provide much more precise data and more concrete solutions could be reached. However, it is important to emphasize the strength of this study, which lies in its comprehensive analysis of all participating students, both in the first and the second call. Likewise, it is important to underline the complexity of obtaining this type of information, where the teacher must note down the time of delivery of each student's exam, something that is made even more difficult if the students take their exam in different classrooms when it comes to ensuring proper supervision.

Second, it could be argued that the learning of the student could also be subjective, and that they themselves could establish their degree of satisfaction with the content taught and the knowledge acquired in the subject. This concept, referred to by Kalinowski and Toper (2007) as "student perception", could be examined by simply analyzing two of the specific survey questions that *'EDEM-Business School'* students and students from different other educational centres already answer through their periodic evaluations: *"I am satisfied with the teacher of this subject"* and *"I am satisfied with the teaching in this subject"*. Nevertheless, for a first level of analysis, in this work it has been considered more optimal to focus solely on objective variables such as the student's final exam grade. This, however, would not prevent expanding (and enriching) the horizon of this research in the future, making comparisons between both types of assessments.

In third place, future research could analyse the type of mindset that students really have through the ITIS scale (Implicit Theories of Intelligence Scale), developed and validated by Dweck and Legget (1988), and which is currently used throughout the world when carrying out mindset assessments. The scale has been implemented in a large number of studies, has been translated into several languages, and has even been used as a criterion to validate other mindset assessments (Burgoyne and Macnamara, 2021). Specifically, this scale captures students' agreement with a set of statements and consists of two versions, a six-item version for children (10 years and older) and an eight-item one for adults. With this, we would obtain much more precise information with which to make more concrete decisions, such as determining at what level of fixed or growth mindset your students would change their behavior patterns and start handing in their exam earlier or later. However, as a negative aspect, it is worth highlighting the difficulty of obtaining

a correct and honest response to this assessment from all the students, particularly when aiming to ensure consistent measurement across all students and to avoid default response sequences and potential response biases associated with self-reported constructs, which are typically exacerbated when students are not fully aware of the relevance or importance of the analysis (Burgoyne and Macnamara, 2021). On the other hand, to maximize the utility of this test, assessments should be conducted periodically, which would make it even more difficult to obtain trustworthy and high response rates from the students.

In any case, the absence of a direct measure of mindset should be acknowledged as a limitation, given that the observed relationships are inferred indirectly and not supported by formal psychometric assessment.

Fourth, and following on from the previous point, future studies could analyse the effect of the strategies implemented by educational institutions when it comes to modify the type of mindset of their students. According to the literature, students' mindset is malleable and can be changed over time through the implementation of "mindset interventions", which are brief activities or tasks that attempt to influence students' behavior and mentality (Dweck, 2006). However, there is considerable variability in the success of these interventions. In fact, a recent meta-analysis revealed that almost 50% of them failed to change the students' mindset, not being therefore always effective (Orosz et al., 2017). Thus, in order to be more persuasive and increase their success capacity, these activities would require a prior analysis of the typology of students that each institution has, with the aim of adapting the message and be more convincing to the students.

Finally, this work aims to provide information to better understand the students and their behavior patterns in the classroom. In this way, it could help the teacher to consider their specific needs during the course in order to improve their academic performance. However, and in a similar way, these conclusions could also be useful for the students, who could use them individually or in groups, to be aware of their characteristics and foresee the possible effects that they would have on their results. In this way, this better knowledge of their reality could affect their self-motivation towards study when it comes to increasing their attention in the classroom (with the aim of improving their final grades). Future research should further explore this issue, considering how Generation Z university students, current recipients of the teaching provided, actually behave, interact and socialize with each other (Hutton et al., 2020).

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