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Relationship between Motivation, Self-Regulation, and Procrastination in Entering Computer Science Students of Generation Z: The Phenomenon of Regulatory Shock

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Abstract

The study analyzes the relationships between motivation, self-regulation, and procrastination among incoming university students belonging to Generation Z. The aim of this study was to quantify the levels of the monitored factors and analyze their relationship to academic performance. The research reflects the specifics of Generation Z and the fact that the development of self-regulatory mechanisms in the examined cohort was historically affected by the non-standard lower-to-upper secondary school transition (at age 15 in 2020) due to the COVID-19 pandemic. The research sample consisted of first-year Bachelor's degree students majoring in Computer Science, monitoring the impact of regulatory mechanisms on their study behavior. The results revealed a high level of declared intrinsic motivation (90 %) but a heterogeneous level of self-regulation (only 43 % with a high level). Procrastination was confirmed as the dominant negative predictor of academic success, with digital distraction also playing a significant role. The findings point to the presence of a "regulatory shock" upon entering university, where initial enthusiasm masks deficits in autonomous learning management. The study emphasizes the need for targeted university interventions focused on time management and procrastination reduction, which are crucial for the successful adaptation of students to a demanding higher education environment and the transformation of their motivation into stable academic habits.

Keywords: motivation, self-regulation, academic performance, procrastination.

1. Introduction

Because of the COVID-19 pandemic, pupils and students were forced to switch to distance learning, which represented a significant disruption to their learning process. This transition

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brought increased time flexibility but also heightened demands for independence and responsibility for one's own learning (Bylieva et al., 2021). Several studies indicate that changes associated with the move to online learning substantially influenced students' motivation, self-regulation, and study habits (e.g., Broadbent, Fuller-Tyszkiewicz, 2018; Flanigan et al., 2025; Xu et al., 2022). The increased self-regulatory demands can be compared to those typical of the transition from secondary to higher education. This sudden shift to distance learning affected a large portion of Generation Z precisely at the time of entering secondary school. The reduced level, or even absence, of external regulation led to significantly higher demands on self-regulation for part of this population. This increase in demands was caused by the need to take control over time management and by heightened digital distraction in the online environment. Limited direct interaction with teachers in the classroom reduced the immediacy of feedback (Biwer et al., 2021), making it more difficult for students to evaluate their progress and adjust their learning processes (Bylieva et al., 2021).

Entering university represents a similarly challenging situation for this segment of Generation Z, as it requires adaptation to a new academic environment and the simultaneous management of increased demands for independence. University study places significantly higher expectations on active planning, monitoring, and evaluating the learning process, with a high degree of autonomy and self-regulation expected from students (Liu, Zhang, 2023; Simón-Grábalos et al., 2025). Currently, there is a lack of empirical studies examining how the experience of digitally skilled Generation Z students with pandemic distance learning translates into their motivation, procrastination, and self-regulation upon entering university.

The aim of this study is to quantify the levels of motivation, procrastination, and self-regulation among incoming university students and to analyze the relationship of these variables to academic performance, with special regard to the specifics of Generation Z and the historical context of their transition to upper secondary school (at age 15) during the outbreak of the COVID-19 pandemic in 2020.

Based on this aim, we formulated the following research questions:

RQ1: What is the current state of motivation, procrastination, and self-regulation among Generation Z students entering university?

RQ2: Does prior academic achievement among Generation Z students differ depending on their levels of motivation, procrastination, and self-regulation?

2. Literature Review

Motivation is one of the key determinants influencing students' academic performance. According to Schunk et al. (2014), motivation is defined as a process through which goal-directed activity is initiated and sustained. Nakonečný (2004) defines motivation as the process that ensures the activation, direction, and maintenance of an individual's behavior depending on their needs, goals, and environmental conditions. Pincus (2023) understands motivation as a state resulting from unmet needs that gain motivational relevance and guide the individual's effort toward their fulfilment through cognitive, affective, and behavioral mechanisms.

From a scientific perspective, motivation is differentiated by its quality and origin. The most frequent distinction (Ryan, Deci, 2000) is between intrinsic motivation, in which individuals engage in an activity due to inherent satisfaction, curiosity, and interest without external rewards (Ryan, Deci, 2017), and extrinsic motivation, in which behavior is driven by external rewards or pressure such as grades, recognition, or social expectations. These theoretical approaches (Urhahne, Wijnia, 2023) emphasize that the quality of motivation influences learning engagement, the use of self-regulation strategies, and persistence. Empirical research further highlights the relationship between motivation and academic performance, especially in higher education contexts.

Although both intrinsic and extrinsic motivation correlate with positive academic outcomes, higher intrinsic motivation is associated with deeper academic integration (Clark et al., 2014). The transition to university imposes substantial demands on autonomy, planning, and time regulation, making motivation not only an internal evaluation of the importance of study but also a predictor of engagement and performance (Wild et al., 2024; González-Arias et al., 2025). Recent studies show that students' motivation levels often change during their first year, and higher engagement helps reduce the risk of dropping out (Almulla et al., 2025).

De Vincenzo and Carpi (2024) identified three motivational profiles among university students: "autonomously motivated deep learners," "externally motivated balanced strategists,"

and "externally motivated task performers." Intrinsically motivated students with autonomous strategies tend to achieve better results and greater well-being than those with predominantly extrinsic orientations.

Self-regulated learning (SRL) is an autonomous, proactive process in which students plan, monitor, and evaluate their learning (Zimmerman, 2000; Schunk, Zimmerman, 2012). Panadero (2017) provides an overview of major SRL models, noting differences across educational levels. Zimmerman and Moylan (2009) describe a cyclical model including forethought, performance, and reflection phases, each with specific strategies.

Accurate monitoring depends on appropriate cues (David et al., 2024). Their findings indicate that higher perceived mental effort reduces judgments of learning, which correlates with poorer learning outcomes. Hawrot et al. (2025) show that accurate performance monitoring is a key metacognitive component linked to long-term academic success.

A major issue in higher education is early dropout, especially in the first year. Evidence suggests that higher motivation and improved curricula enhance SRL (Simón-Grábalos et al., 2025). Their review stresses the importance of tailoring interventions to specific contexts and ensuring continuity.

Other studies (Liu, Zhang, 2023) show that SRL practices among first-year students are influenced by negative learning experiences during academic transitions. In online learning environments, SRL becomes even more challenging, with the learning environment and teacher preparedness playing crucial roles (Baars, Viberg, 2023; Scherer et al., 2021). Many first-year students struggle to develop learning strategies aligned with course expectations (Rakhunwana et al., 2025). Pandemic-related online learning exacerbated these issues.

Procrastination is seen as a maladaptive behavior involving the voluntary delay of tasks despite expected negative consequences. Early research (Solomon, Rothblum, 1984) emphasized the emotional component – guilt, anxiety, or frustration – accompanying task delay. Steel's (2007) meta-analysis identified low self-control, weak discipline, poor organization, and low goal-related motivation as main predictors of passive procrastination.

Awashreh and Ghunaimi (2025) noted that students often prioritize grades over meaningful learning, weakening intrinsic motivation and contributing to procrastination and academic dishonesty. Mechanisms explaining the negative link between procrastination and performance include weak self-regulation, poor planning, increased stress, and digital distractions (García-Ros et al., 2023; Yuan et al., 2024). Excessive social media use is a strong predictor of academic procrastination (Çiftçi et al., 2025). Digital literacy, however, can act as a protective factor (Yuan et al., 2024).

Recent research (Knof et al., 2024) shows a discrepancy between students' self-assessment and actual performance, demonstrating a clear Dunning-Kruger effect among both men and women. Limited collaborative learning during the pandemic may have reduced opportunities for realistic comparison. Students tend to overestimate their performance; accuracy is influenced by competence and feedback availability. In metacognition research, performance judgments are key for SRL (Hawrot et al., 2025). Similar overestimation patterns were observed among primary and secondary school students, with secondary students being slightly more accurate.

However, alternative analyses (Lebuda et al., 2024) challenge the consistency of Dunning-Kruger findings. Feedback does not necessarily improve self-assessment accuracy (Grinschgl et al., 2025), while practice and experience do.

Skorbakk and Gamlem (2025) examined self-assessment practices among 1002 secondary science students. Students reported high engagement in self-reflection and internal feedback but low engagement in seeking external feedback. Self-assessment positively correlated with deep learning strategies.

Other studies (Checa-Domene et al., 2022; Taylor, Brown, 1988) show that self-assessment is influenced by optimism, overconfidence, or pessimism. Emotional competencies are important predictors of academic performance (Checa-Domene et al., 2022).

Purpose of the Study

The aim of the study is to quantify the levels of motivation, procrastination, and self-regulation among incoming university students and to examine the relationship of these factors to their prior academic achievement (measured by high school GPA), with regard to the specifics of Generation Z and the context of their transition to upper secondary school (at age 15), which took place during the COVID-19 pandemic in 2020. The findings aim to provide empirically grounded insights for

designing support strategies that facilitate student adaptation to the university environment, strengthen effective self-regulation, and support successful adjustment to higher education.

3. Methodology

Instruments and Measures

In accordance with the aim of our study, we created our own questionnaire consisting of two logical parts. The first contained identification questions; the second focused directly on the examined areas of motivation, procrastination, self-regulation, and academic performance.

Control Variables

The first part of the questionnaire consisted of classification questions that allowed us to categorize our respondents. We asked students about the type of secondary school they completed, their most frequent grade on their final high-school report card, whether they live in a dormitory, and their study program.

Instruments

The core of the questionnaire consisted of questions related to factors influencing students' academic performance. We focused on three key areas: procrastination (PRO), self-regulation (SREG), and motivation (MOT).

Following Araya-Castillo et al. (2023), we defined six items related to procrastination. These items addressed whether the student completes tasks according to priority (PRO1), spends time justifying why tasks were not completed (PRO2), becomes distracted by other matters while working on academic tasks (PRO3), works at the last minute (PRO4), postpones tasks aimed at understanding until just before the exam (PRO5), and engages in non-academic activities instead of studying (PRO6).

We developed six items for the area of self-regulation, four of which were adapted from the Spanish Short Self-Regulation Questionnaire (SSSRQ). The SSSRQ was originally developed by Pichardo et al. (2014) and is available through the appendix of Garzón Umerenkova et al. (2017). These questions addressed goal-setting (SREG1 – "When I have a goal, I can usually plan how to achieve it."; SREG2 – "I get distracted from my plans easily.") and decision-making (SREG3 – "I postpone decisions."; SREG4 – "I have so many goals that it is difficult for me to focus on any of them."). Two additional items addressing insufficient self-regulation were taken from Whelan et al. (2020), originally based on LaRose et al. (2003): SREG5 – "It's hard for me to keep my internet use under control."; SREG6 – "I have unsuccessfully tried to reduce the time I spend online."

The questionnaire contained seven items in the area of motivation, based on the Situational Motivation Scale (Guay et al., 2000). Focusing on intrinsic motivation, we created items related to spending time on interesting activities (MOT1), beliefs about the usefulness of studying (MOT2), studying as a personal choice (MOT3), the experience of continuous learning (MOT4), studying despite uncertainty about its usefulness (MOT5), recognizing the benefits of regular preparation (MOT6), and using a mobile phone during class while doubting whether it is appropriate (MOT7).

Responses for all three areas – PRO, SREG, and MOT – were measured using a 7-point Likert scale ranging from 1 ("strongly disagree") to 7 ("strongly agree").

The questionnaire also included a question regarding respondents' academic results in the final year of secondary school (LAST_GPA). Responses to this question served as values of the dependent variable in the subsequent analysis.

Participants

The sample consisted of university students studying at a technical university in Slovakia. Data collection took place during the fall of 2024. For the purposes of this study, we created a subset consisting exclusively of first-year bachelor's students. The rationale behind this choice was to focus on the specific transition period from high school to university. We also concentrated on students enrolled in computer science programs. This more homogeneous group allowed us to obtain more personalized insights and draw practical implications for students within these study programs. The final sample consisted of 199 students.

Data Preprocessing

Before conducting the analysis, it was necessary to preprocess and clean the data obtained from the 199 student responses. Preprocessing consisted of several steps: renaming columns, recoding response values into a shortened format, and converting the variable LAST_GPA into a numerical form. We also performed reverse coding of certain items related to motivation (MOT5,

MOT6, MOT7), procrastination (PRO1), and self-regulation (SREG2, SREG3, SREG4, SREG5, SREG6), which unified the orientation of the items within each scale.

The dataset was then cleaned of erroneous data. We excluded students who had attended secondary school abroad and removed four responses with incorrect or invalid values for LAST_GPA. To ensure accuracy in the analysis, categorical variables were correctly transformed into factor data types.

Data Analysis

To address the research questions we defined, several statistical methods were applied. To determine levels of procrastination, motivation, and self-regulation, we used contingency tables. When examining the influence of composite indices of procrastination, motivation, and self-regulation, selected statistical tests were conducted. A linear regression model was used to examine the dependence of the logarithmic transformation of academic performance on the level of procrastination and on the category of self-regulation. Statistical data processing was carried out using the R programming language.

RQ1: What is the current state of motivation, procrastination, and self-regulation among Generation Z students entering university?

Our sample consisted of 199 students from informatics-related fields, whom we analyzed based on three composite indices: intrinsic motivation (MOT), procrastination (PRO), and self-regulation (SREG). Our initial goal was to determine the distribution of first-year students, mostly coming from secondary schools, with respect to these three indices.

The composite indices were calculated as the arithmetic mean of individual items representing the respective domain. Since the individual items within each index were measured on a 7-point Likert scale (1 to 7), the composite index values were also within this range. Categorization was based on thresholds, where the first threshold, less than 3.5, represented the low index category (low self-regulation, low procrastination, low motivation). Students with index values above the threshold of 4.5 belonged to the high index category (high motivation, high procrastination, high self-regulation).

Table 1 presents the distribution of students across categories according to the three composite indices of our student sample.

Table 1. Frequency table of student distribution according to composite index values of procrastination (PRO), motivation (MOT), and self-regulation (SREG) – relative and absolute frequencies

Composite index	Low	Medium	High
Motivation (MOT)	0	10.6 % (21)	89.4 % (178)
Procrastination (PRO)	36.7 % (73)	46.2 % (92)	17.1 % (34)
Self-regulation (SREG)	17.6 % (35)	39.7 % (79)	42.7 % (85)

Notes: Significance: *** p-value < 0.001, ** p-value < 0.01, * p-value < 0.05, p-value < 0.10

As shown in Table 1, none of the students exhibited low motivation, and more than 89 % of the students demonstrated high levels of motivation. The level of self-regulation among students was skewed towards higher values. Nearly 43 percent of students had a high degree of self-regulation, almost 40 % exhibited moderate self-regulation, and only approximately 18 % showed low self-regulation. In contrast to motivation and self-regulation, procrastination was more evenly distributed among the students in the dataset.

RQ2: Does prior academic achievement among Generation Z students differ depending on their levels of motivation, procrastination, and self-regulation?

In the second research question, we aimed to test whether the levels of the three composite indices (PRO, SREG, MOT) relate to students' prior academic achievement upon entering university. Therefore, in this section, we tested hypotheses regarding the statistical significance of the impact of each composite index on the final high school grade point average (LAST_GPA,

representing their prior academic performance). To test these hypotheses, we conducted statistical hypothesis testing.

No statistical test was performed for motivation since the number of students with low motivation was zero. Prior to testing for differences in LAST_GPA between students with low and high procrastination and low and high self-regulation, the LAST_GPA variable was log-transformed. The results of the parametric tests are presented in Table 2.

Table 2. Comparison of differences in academic performance measured by LAST_GPA based on the levels of procrastination (PRO), motivation (MOT), and self-regulation (SREG)

Categories	p-value	Cohen d	Significance
Low Motivation vs High Motivation	-	-	-
Low Procrastination vs High Procrastination	<0.001	-1.128	***
Low Self-regulation vs High Self-regulation	0.0507	0.396	.

Notes: Significance: *** p-value < 0.001, ** p-value < 0.01, * p-value < 0.05, p-value < 0.10

As shown in Table 2, the Welch's t-test examining differences between students with low and high procrastination revealed statistically significant differences ($t = -4.503$, $p < 0.001$). The effect size measured by Glass's delta, due to unequal variances, was -1.128 (95 % CI = <-1.567; -0.689>), indicating a large effect between the groups with low and high procrastination. Although the sample size was greater than 30, analysis of histograms and Q-Q plots showed that the data did not perfectly follow a normal distribution even after log-transformation. Therefore, to ensure robustness of the results, we performed nonparametric tests in addition to parametric ones. Applying the two-sample Wilcoxon test on the log-transformed LAST_GPA variable (LAST_GPA_log) again confirmed statistically significant differences between the low and high procrastination groups ($W = 683$, $p < 0.001$). The effect size measured by rank-biserial correlation was -0.362, indicating a moderate (i.e., practically significant) effect.

Additionally, we fitted a linear regression model to examine the dependency of LAST_GPA_log on procrastination level (considering only low and high procrastination). The model showed a statistically significant effect of the procrastination category on the dependent variable ($b1 = 0.206$, $p < 0.001$). Since the Breusch-Pagan test indicated heteroskedasticity of residuals ($BP = 6.2594$, $p = 0.012$), we used robust standard errors (White-Huber) to improve result reliability. The coefficient for the high procrastination category remained 0.206 and was strongly statistically significant ($p < 0.001$). These results imply that students with high procrastination had a 0.206 higher value of log-transformed GPA compared to students with low procrastination, which in the original scale corresponds to approximately a 23 % worse academic average (note that in Slovakia, a higher GPA value indicates worse academic performance).

Next, we examined differences in academic performance between students with low and high self-regulation. The t-test showed no statistically significant difference at the alpha = 0.05 level ($t = 1.974$, $p = 0.051$). Cohen's d indicated a small effect size ($d = 0.397$). For robustness, we also conducted a nonparametric Wilcoxon test, which revealed a statistically significant difference between the groups at the alpha = 0.05 level ($W = 1844.5$, $p = 0.039$). The effect size measured by rank-biserial correlation was 0.188, indicating a small effect size. Although the t-test result was borderline non-significant, the Wilcoxon test confirmed statistically significant differences in academic performance between the low and high self-regulation groups.

We also created a simple linear regression model to assess the effect of self-regulation category (low vs. high) on the log-transformed academic performance (LAST_GPA_log). Since the Breusch-Pagan test did not indicate heteroskedasticity ($BP = 0.984$, $p = 0.321$), we used classical standard errors. The coefficient for the high self-regulation category was -0.108, which was not statistically significant at the alpha = 0.05 level ($p = 0.051$).

4. Discussion

Our study identified a specific psychological profile of incoming computer science students, characterized by high self-reported intrinsic motivation and relatively stable but heterogeneous self-regulation. Nearly 90 % of students showed high motivation (MOT), which supports the assumption that STEM fields attract students with clear professional goals and a purposeful approach to learning (Markman, Du, 2025; Wolter et al., 2019; Chen et al., 2024). However, this figure must be interpreted critically high motivation may be temporary and partly influenced by the emotional excitement of the new academic status, the so-called "honeymoon phase" (Camacho-Morles et al., 2021). In this initial phase, subjectively perceived motivation may mask deficits in long-term perseverance and the ability to autonomously manage one's own learning.

Self-regulation (SREG) in our sample was distributed more heterogeneously: approximately 43 % of students reached a high level, while the remainder showed moderate values. This disparity suggests that many students continue to rely on external regulatory mechanisms – such as parents, a structured schedule, or regular feedback from high-school teachers. This "regulatory shock" (Zimmerman, 2002) may explain the paradox that even highly motivated students may fail later in their studies if they are unable to adapt effectively to the more autonomous learning environment.

The most prominent finding regarding the impact of psychological factors on academic performance (RQ2) is the unequivocal role of procrastination as a dominant negative predictor. The approximately 23 % difference in high-school GPA between low- and high-procrastination students is not only statistically significant but also pedagogically meaningful. This result supports the view that procrastination is not merely a "bad habit," but a complex failure of emotional and time regulation that seriously threatens academic achievement (Steel, 2007; Kim, Seo, 2015). In the context of higher education, eliminating dysfunctional behaviors, particularly procrastination – during the initial stages is more critical than the presence of advanced self-regulatory strategies (Elizondo et al., 2024; Valenzuela et al., 2020; Chen, Chung, 2025). This highlights the need for intervention measures aimed at reducing procrastination from the very beginning of university studies, thereby increasing the likelihood of sustainable academic success.

The relationship between self-regulation and academic performance proved to be weaker and less consistent than in the case of procrastination. Although non-parametric tests indicated small but statistically significant differences between low- and high-self-regulation groups, the overall effect size was low. This may reflect the fact that autonomous self-regulatory abilities among first-year Generation Z students are still developing. This pattern supports the argument that high motivation alone is insufficient. To achieve long-term academic success, initial enthusiasm must be transformed into stable self-regulatory processes, which also serve as a protective mechanism against procrastination and failure (Caixia et al., 2025; Wolters et al., 2023).

Based on these findings, it can be concluded that higher education planning should simultaneously support motivation and the development of self-regulation, with particular emphasis on mechanisms for preventing and managing procrastination. Intervention programs focused on time management, planning, and gradually increasing student autonomy may be crucial for reducing the negative effects of procrastination and supporting long-term academic achievement.

5. Conclusion

Our study shows that incoming Generation Z students exhibit high intrinsic motivation, but their self-regulation is heterogeneous, and procrastination represents a significant negative factor influencing academic performance. The findings suggest that in the initial stages of university study, it is more effective to focus on eliminating procrastination than solely on developing self-regulation.

In practice, this means that universities should support planning, time management, and autonomous learning strategies, so that initial motivation can be transformed into sustainable motivational and self-regulatory processes. These measures may reduce the risk of academic failure and help students successfully adapt to the demands of the university environment.

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