Do Remote Activities in Synchronous Mode Help to Improve the Students' Academic Performance? A Binary Logistic Regression Approach

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Abstract

The Covid pandemic prompted a significant move to online training, even within universities. Telematic universities, skilled in emergency response, became valuable models for creating inventive and personalized curricula. Despite the lack of consistent use of online platforms in teaching, the urgency to address the crisis frequently hindered reflective methodologies. Notably, the IUL Telematic University had the chance to consider these aspects since its inception in the 2000s, when discussions on quality standards for telematic universities were prevalent. The teaching model introduced by IUL is grounded in the theoretical framework of the Community of Inquiry (CoI), embodying a collaborative-constructivist approach to learning. Community of Inquiry framework is one of the most widespread in the field of online teaching and emphasizes the importance of interaction between students and teachers during the learning process. It is not only a pedagogical tool, but also research one. The educational success of university students can be assessed in various ways, through grades in exams, through the educational credits obtained, the drop-out of studies, the time elapsed between the end of studies and obtaining the first job. This study takes place in IUL Telematic University on first-year students of the bachelor's degree program in psychology of the academic year 2020/2021 (n=127). The aim of this work is to verify which variables have the greatest influence on students' educational success. To this end, a multiple binary logistic regression model was used to relate the event to take the exam of General Psychology within the first year, which can be considered as an event that heralds a drop out, with some explanatory variables such as gender, age, number of activities carried out in synchronous and asynchronous mode. The aim of this study is to demonstrate the importance of interactive activities also within telematic contexts. The results are presented and discussed.

Keywords: *Community of Inquiry, Learning Analytics, Educational Success, Binary Logistic Regression.*

1. Introduction

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The world of work is undergoing significant transformations, prompting a shift in the key competencies necessary for job performance. Simultaneously, the traditional concept of a linear career path is increasingly becoming obsolete [1]. In light of these developments, and in alignment with European policies such as the Bologna Process (1999), the university models are required to adapt, taking into account the complexity and ongoing evolution of knowledge. Universities are called upon to implement effective strategies to foster meaningful learning and the development of cross-disciplinary skills [2, 3].

The Dublin descriptors (2001) outline five types of learning expected at the end of various educational cycles, focusing on cross-disciplinary competencies such as knowledge and understanding, applied knowledge, and understanding, judgment autonomy, communication skills, and the ability to learn, and require that outcomes be expressed not only in terms of acquired knowledge but also skills and competencies.

Cross-disciplinary skills encompass various disciplinary knowledge and the multiple abilities required by professions, including a set of personal qualities (soft/character skills) that can be nurtured and enhanced through education, even at the university level [4]. In this sense, the university becomes a privileged place where these aspects can be cultivated, through the promotion of independent research, dialogue, and reinterpretation of meanings [4]. Furthermore, the need to innovate and revise the psycho-pedagogical paradigms under which educational courses are structured, even at the university level, is also tied to a reflection on new technologies and the possibility of these becoming

tools for innovation [5]. This is particularly relevant for an online university, where virtual spaces constitute the primary learning environment.
In this time of change, in the context of telematic universities, what are the factors that can improve the development of transversal competences and the educational success of students?
A previous study [6] has indicated that students who opted for a collaborative approach generally spent more time on their courses compared to peers who chose differently. This additional time investment was not in vain. All indicators point to high levels of satisfaction encompassing not just learning outcomes, but also heightened motivation, engagement, and social interaction within the course. Such collaborative activities helped make the course feel more vibrant and fulfilling, affirmatively enhancing both social and cognitive engagement [7]. However, the aspect of time is crucial as it may limit a student's decision to choose this mode (note that, to some degree, those solely focused on studying selected the collaborative option). Moreover, collaborative courses inherently face constraints related to the number of participants they can accommodate. Additionally, they demand more preparation and management time from instructors and tutors, not to mention the time needed for assessing students. Therefore, when designing online courses, the integration of collaborative elements should be a deliberate choice, well-considered in light of the context and goals, and not necessarily the sole or predominant method [8]. There is also a notable divide within the course between those who engage collaboratively and those who do not, which warrants careful management of classroom dynamics and attention to the overall student perceptions at the course's conclusion.
In another study, group work increases the examination grade on average by almost one point, but not in a statistically significant way [9]. This study supports the principles outlined in the Community of Inquiry (CoI) framework [10], which seeks to foster deep and meaningful learning experiences through the integrated development of three core 'presences' that interact continuously: Social Presence (social dimension), Cognitive Presence (cognitive dimension), and Teaching Presence (teaching dimension). A notable feature of the CoI is its ability to simplify the description of complex interactions by categorizing them into these specific dimensions. The framework not only aids research into online learning but also equips educators with the guidelines and tools necessary for designing collaborative online environments and making informed educational choices [11].
A more recent study investigated the relationship between synchronous and asynchronous activities and the development of students' soft skills [12]. In this sense, the development of transversal competences was strongly associated with participation in synchronous events, underlining the importance of the social dimension in the development of key competences. Within this line of research, this study investigates the importance of platform participation in synchronous and asynchronous activities with respect to the probability of taking the examination. Does following the proposed activities and also doing so by comparing oneself with others really improve the likelihood of taking the exam earlier? Also monitoring aspects such as these could increase the reduction of university drop-out [13].

2. Methodology

Data on (N=127) first-year students of the bachelor's degree program in psychology of the academic year 2020/2021 participating in the study was gathered from two distinct origins. Demographic and student career data were retrieved from Smart_Edu, an online platform serving as a student registry.
Information regarding the activities conducted by students in synchronous mode was directly sourced from the university's Learning Management System (LMS) platform, where students access teaching materials and engage in interactions with peers or instructors. The university utilizes Moodle (Modular Object-Oriented Dynamic Learning Environment, http://MOODLE.org/), a widely used e-learning platform known for its robust technical support and extensive customization options [12]. Moodle automatically generates and compiles log files of user connections, accessible to authorized personnel via the "Report" module, specifically the "Log" option. Each log file, corresponding to a single user action on the platform, includes details such as "Date/Time," "User's Full Name," "Engaged User" (if applicable), "Context of the Event," "Component," "Event," "Description," "Source," and "IP Address." To tally the number of synchronous activities undertaken by students, events labeled "Attended meeting" were considered, indicating user participation in synchronous sessions. Subsequently, the two datasets were merged into one using students' full names as the key identifier.

A logistic regression model was implemented to investigate the relationship between the possibility of passing the General Psychology exam within the first academic year and a vector of independent variables.

$$log\left(\frac{\pi(X)}{1-\pi(X)}\right) = \sum_{i=1}^{p} \beta_i X_i \quad (1)$$

Where:
p is the number of independent variables.
The vector $\beta = (\beta_0, \ldots, \beta_p)$ is an unknown vector of p + 1 regression coefficients.
π is the probability of success P(Y = 1|X)
X is the vector of independent variables.

Model (1) enables the analysis of how the independent variables in vector X influence the probability of passing the General Psychology exam.

The X vector consists of:

X_1: dummy variable for male vs. female.
$X_2, \ldots, X_5$: dummy variables for the age class (except for the baseline category “19-25”).
$X_6, \ldots, X_9$: dummy variables for the types of high school diploma (except for the baseline category “Scientific”).
$X_{10}, \ldots, X_{14}$: dummy variables for the area of residence (except for the baseline category “Northwest”).
X_{15}: number of synchronous activities.
X_{16}: number of asynchronous activities (divided into ten classes of equal amplitude).

Age represents an intriguing variable of focus within an online university environment, particularly given the prevalence of working students. Enrolment patterns often differ from the conventional norm, with many students entering university at ages divergent from the typical 19/20 years seen in Italy. Recognizing a potential non-linear relationship between age and academic performance, the "Age group" variable was treated categorically, featuring classes such as "19-25," "26-35," "36-45," and "over 45."
As for high school diploma, the most general classification of Italian high schools was used: “Scientific”; “Humanistic”; “Technical”; “Vocational”.
Residential location also holds significance in the context of an online university, as student origins are unrelated to the university's physical location. For this reason, the Eurostat classification (https://ec.europa.eu/eurostat/web/nuts/overview) was adopted, delineating five macro-regions that are socio-economically homogeneous: The Northwest consists of Liguria, Lombardia, Piemonte, and Valle d’Aosta; The Northeast consists of Emilia-Romagna, Friuli-Venezia Giulia, Provincia Autonoma di Trento e Bolzano, and Veneto; The Centre consists of Lazio, Marche, Toscana, and Umbria; The South consists of Abruzzo, Campania, Molise, Puglia, Basilicata, and Calabria; and the Islands consists of Sardegna and Sicilia.
Due to the high range of the variable “Number of asynchronous activities”, for an easier and more meaningful interpretation of the results, it has been divided into ten classes of amplitude equal to 122.
All analyses were carried out using the statistical software STATA18.

3. Results

The frequency distributions of the categorical variables are summarized in Table 1.

Table 1. Frequency distributions of categorical variables: first-year students of the bachelor's degree program in psychology of the academic year 2020/2021, IUL University.

Variable		N	%
Gender			
	Males	31	24,4
	Females	96	75,6
Age class			
	19-25	44	34,6

	26-35	32	25,2
	36-45	27	21,3
	Over 45	24	18,9
High school diploma			
	Scientific	20	15,7
	Humanistic	42	33,1
	Technical	47	37,0
	Vocational	18	14,2
Area of residence			
	Northwest	38	29,9
	Northeast	27	21,3
	Centre	37	29,1
	South	18	14,2
	Islands	7	5,5
Exam passed within the first year			
	Yes	40	31,5
	No	87	68,5
Total		127	100

The quantitative variables are summarized by the following indices of position and variability.
Number of synchronous activities: Min: 0; Max: 5; Mean: 0,8; Standard Deviation: 1,4.
Number of asynchronous activities: Min: 0; Max: 1222; Mean: 211,4; Standard Deviation: 221,7.
Age: Min: 19; Max: 64; Mean: 33,7; Standard Deviation: 11,4.

The results of the logistic regression model for the probability of taking the general psychology exam within the first year are reported in Table 2.
To facilitate result interpretation, odds ratios are provided in place of β coefficients. The odds ratio (OR) reflects the ratio of the probability of a specific category of the independent variable resulting in a positive outcome of the dichotomous dependent variable, compared to the probability of the reference category of the independent variable leading to a positive outcome of the dichotomous dependent variable. Essentially, an OR > 1 indicates a higher likelihood of the category being associated with a positive outcome; in this case, passing the General Psychology exam within the first year.

Table 2. Logistic regression model (Odds Ratios estimates) for the probability of passing the General Psychology exam within the first year.

Variable		Odds Ratio	Standard Error	P-Value
Gender				
	Females	0,729	0,423	0,586
Age class				
	26-35	1,301	0,784	0,663
	36-45	0,531	0,396	0,396
	Over 45	0,138	0,128	0,033
High school diploma				
	Humanistic	0,595	0,433	0,476
	Technical	0,209	0,167	0,050
	Vocational	1,002	0,893	0,997
Area of residence				
	Northeast	0,720	0,542	0,663
	Centre	2,426	1,601	0,179
	South	2,253	1,716	0,286
	Islands	0,982	1,449	0,990
Number of synchronous activities		2,219	0,456	0,001
Number of asynchronous activities (in classes)		1,707	0,299	0,002
Intercept		0,151	0,147	0,052

Baseline student: Male, from 19 to 25 years old, Scientific High school diploma, from Northwest Italy, 0 synchronous activities, 0 asynchronous activities.

As measures of fit goodness of the model were calculated the Likelihood ratio χ^2 (13) = 51,3 (P-Value < 0,001), The Pseudo R^2 = 0,324, and the Wald test to compare this model to the null model resulting 23,9 (P-Value < 0,001).
All these measures indicate a good fit of the model.

The results show that the most significant effects on the odds of the probability of passing the General Psychology exam within the first year were those of the variables of the number of synchronous and asynchronous activities. By doing an extra synchronous activity, the probability of taking the exam increases by 70,7% on average. In addition, by increasing the variable number of asynchronous activities in classes by one, thus increasing by about 122 activities, the probability of passing the exam increases by an average of 121,9%.
The effects of age for the over 45s vs. 18-25s, and of the technical vs. scientific diploma, are also significant and negative.

4. Conclusions

Based on the results presented in this article and the existing literature, it can be concluded that engaging students in both synchronous and asynchronous activities significantly enhances their chances of academic success in an online learning environment. The research conducted at the IUL Telematic University demonstrates that an increase in the number of these activities correlates with a higher likelihood of students taking and passing their exams within the first year [13]. This finding aligns with the Community of Inquiry framework, which underscores the value of integrating social, cognitive, and teaching presences to enrich the learning experience [10]. The increased engagement through synchronous activities, in particular, plays a crucial role in reducing dropout rates and improving educational outcomes, reflecting the importance of real-time interaction for fostering a supportive and responsive learning community [11, 13]. Moreover, this study highlights the significance of adapting educational strategies to the unique demands of an online format. The differentiation in impact between various demographic groups, such as age and educational background, suggests that personalized approaches may be necessary to maximize the effectiveness of online education platforms [9]. The integration of collaborative and interactive elements within online courses should be strategically planned, keeping in mind the context, objectives, and specific characteristics of the student population. Educators and course designers are encouraged to leverage both synchronous and asynchronous activities to create a dynamic and engaging learning environment that not only addresses the educational needs but also promotes social interaction and cognitive development among students.

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