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Students' adaptive behaviors to Covid-19 impacts: a multidimensional analysis

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Abstract

This investigation had three objectives: (i) to evaluate the impact of the Covid-19 pandemic on the emotional state and behavior of Higher Education students; (ii) to clarify the condition of students at the beginning of the pandemic; and (iii) to understand how they assess the impact and engage in adaptive behaviors. The sample involved 804 students in Brazil and Portugal. The results corroborate the hypotheses: the impact of the pandemic forced the emergence of energy dissipative structures; and student behavior stems not only from the negative emotional impact of Covid-19, but also from internal and external positive motivational factors. Online classes indicate three groups of students: enthusiasts, positive thinkers, and skeptics, with statistical differences between countries, gender, and professional status. The implementation of hybrid teaching should be considered to enhance student learning.

Keywords: Higher Education; Students' Motivation; Online Learning; Covid-19.

1 Introduction

The pandemic caused by the global spread of Sars-CoV-2 created structural and behavioral problems in all countries, triggering a research effort directed towards their solution. Whilst the focus has largely been the medical area, there has been

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interest also within the fields of Education and Social Sciences (FEBRIANTO; MAS'UDAH; MEGASARI, 2020). This article investigates the impact of the pandemic on the lives of Portuguese and Brazilian Higher Education students. On-site teaching was suspended in many schools and universities, which fostered the growth of online activities, seeking to avoid a potentially dangerous break in Education (DIAS, 2021). Online Education was seen as the best method for both students and educators, especially during the isolation period imposed by governments (BASKARAN, 2018; YUSUF; AHMAD, 2020), as well as a platform that could transform the traditional teacher-center model to a more student-centered, creative, and flexible (SINGH; THURMAN, 2019; ZALAT; HAMED; BOLBOL, 2021). Despite a lot of research on online Education related to Covid-19, studies on the impact on the lives of Higher Education students are scarce. Thus, our first objective is to clarify the influence of the pandemic on the emotions and behavior of students and the immediate changes in their lives, studies, and work. Our second objective is to identify the adaptive behaviors of students to the new conditions created by Covid-19. A third objective is to understand the students' evaluation of the changes faced in the present and their predictions about which educational characteristics would be maintained in the future.

To achieve these objectives, an empirical study was conducted using a questionnaire specifically designed for this purpose. The results are interpreted in the light of a composed model, chosen for their special relevance to provide a reasonable explanation of the two problems defined in the study: the changes promoted by the pandemic, as an event strongly enough to force the emergence of energy dissipative structures and bifurcations (PRIGOGINE; STENGERS, 1979) in educational context; and the students' responses to these changes, interpreted in the light of a motivation model, as motivations are the core explanation of intentional behaviour (PARREIRA, 2021).

Section 2 explains the complex interpretive models to understand the impacts of Covid-19. In section 3, the research design describes the data collection and analysis methods. In section 4, a presentation of quantitative and qualitative results is made. Finally, the conclusion and future directions are described.

2 Interpretive models: the understanding Covid-19 impacts

The Covid-19 pandemic was a factor of sudden change in all areas of life. The way it happened affected different societies to a greater or lesser extent,

arising disturbing and seemingly insoluble dilemmas: “the crisis caused by Covid-19 has resulted in the closure of classes in schools and universities, affecting more than 90% of students worldwide” (UNESCO, quoted in DIAS; PINTO, 2020, p. 545).

The pandemic's effects are complex, in their variety and in the abruptness of the enforced changes. This high complexity created an urgent need for unforeseen responses to the threat of the virus. At the societal level, these changes can be explained by the concepts of Prigogine and Stengers (1979):

- the concept of energy-dissipating structures, arisen by the necessity to face the energy accumulated by an event at the edge of chaos - the coronavirus challenge that triggered personal and social tensions - which forced the need for dissipative structures;
- the idea of bifurcation that is a way by which the system can adopt new and more complex structures more adequate to control entropy, by the use of a higher level information.

This is the first model that will guide the authors' analysis of the Covid-19 impacts on university students; MCA¹ (PARREIRA, 2021) is the second model, explaining the intentional choice of behavior.

2.1 Prigogine and Stengers contribution: dissipative structures and bifurcations

The dissipative structures allow order to emerge from chaos, from entropic movements, through the entrance of the system in one of the possible bifurcations open to the future². In the succession of bifurcations, deterministic zones alternate (between bifurcations) with points of probabilistic behavior, the bifurcation points; in these bifurcations, there are generally many possibilities open to the system. The appearance of the new structures is rooted in the energy-dissipating structures. This emergency implies time in a defined direction, that is, the activity of dissipative structures is defined as history and not just as a balance

¹ MCA are the initials of the words *Motivação Complexa da Ação*, the designation of the model in Portuguese, its original publication language (“Complex Motivation of Action”, in English).

² “The drop in learning could last “more than a decade if public policies are not created that invest in improvements in infrastructure, technologies, training, methodologies, and salaries” (DIAS; PINTO, 2020, p. 545).

of energies. The result is a breakdown of determinism, even on the macroscopic scale (PRIGOGINE; STENGERS, 1979).

The multiple possibilities open to the system cannot be reduced to a single scheme:

The system can never be explained based on the simplicity of a single time path: it became complex, as it is constituted by a plurality of times in which past, present and future are interwoven. Any state of the system is not something that can be deduced, because others were also possible. We need to describe the path that constitutes the system's past, enumerate the bifurcations crossed and the fluctuations that decided the real history, among all possible ones (PRIGOGINE; STENGERS, 1997, p. 124).

Bifurcation is the most important characteristic of complex systems, "it is the critical point through which a new state becomes possible in nature" (PRIGOGINE; STENGERS, 1979, p. 122). It arises from two moments: disordered movements due to forces that cause a state of imbalance in the system; and the creation of dissipative structures of the energy that causes the emergence of an order out of chaos, by entering the system in one of the possible ways to the future. This leads to the idea that "the bifurcation introduces history into physics": the logic of irreversible processes of systems far from equilibrium is a narrative logic that formerly seemed to be reserved for sciences dealing with biological, social, and cultural phenomena" (PRIGOGINE 1980, p. 106).

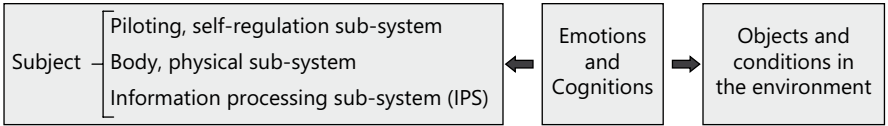
As an event on the edge of chaos, the Covid-19 pandemic forced us to build new structures, new processes and behavior patterns, a problem that incited us to extend Prigogine's reasoning to social phenomena observed in the Covid-19 pandemic. To make an intelligent choice in the bifurcation, it is essential to know the problem's complexity and to base the choice on a rigorous analysis. The awareness of the limits leads us a new light: the uncertainties are primarily a challenge for a new reasoning model, able to give orientation for more fruitful changes (YASSIF; O'PREY; ISAAC, 2021).

2.2 The Complex Motivation Model (MCA)

The concept of dissipative structures and bifurcations is particularly suitable to explain and answer the challenges imposed by Covid-19's impact on human societies. A motivational model is suitable to understand the individual and group behavior to face these challenges, since adaptive behaviors are motivated behaviors. Motivation models have been widely used to study, predict, and

influence behavioral choices, especially in work (KENRICK *et al.*, 2010), but also in social contexts (Dunning, 2011). MCA, a model which has been used in several motivation studies (PESTANA, PARREIRA; MOUTINHO, 2019), was chosen to interpret the behavioral results of our research. This model views motivation as a regulating process, based on two components: an energetic component, the emotional intensity, felt by the subject, when facing an object or situation; and an informational component, the perception of the usefulness of each alternative behavior, in that context and time. Emotions and cognition are the mediators of the subject-environment relationship; emotions, the energetic dimension of behavior (DAMÁSIO, 2008), make the bridge between the subject and the context, marking emotionally the behavior alternatives (Figure 1).

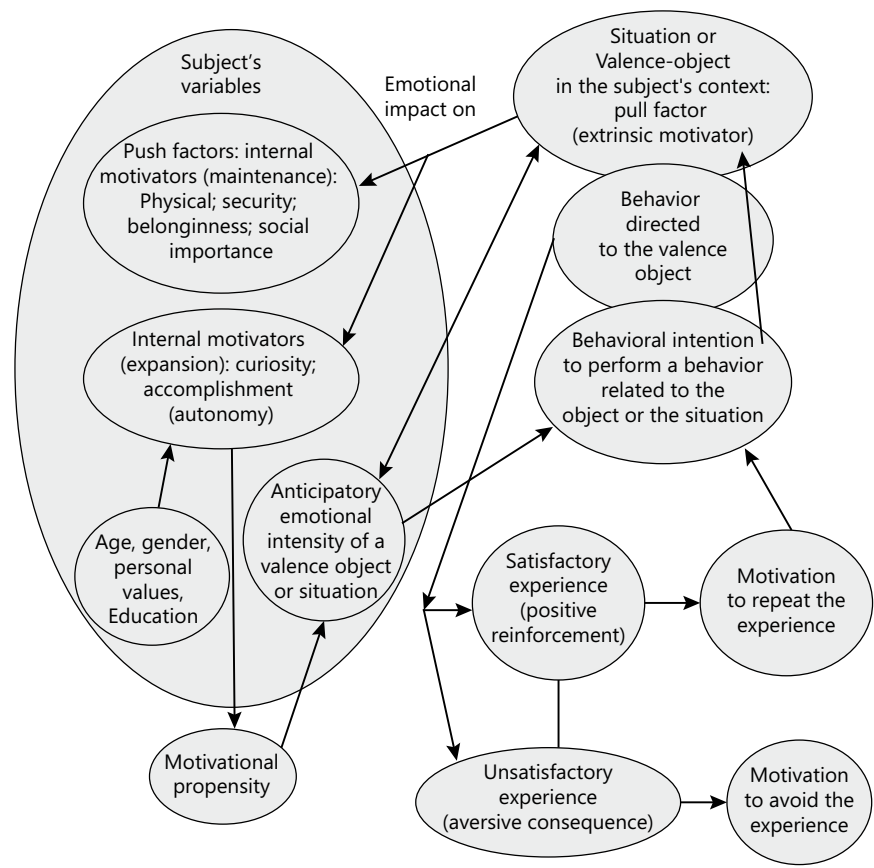
Figure 1 - The motivational process mediating the relationship subject-environment



Source: Pestana, Parreira and Moutinho (2019)

Emotions stimulate action as motivations (LANG, 2010), by the interplay of push factors (intrinsic to the subject) and pull factors (extrinsic, in the context), as shown in Figures 2 and 3.

Figure 2 - The MCA Model



Source: Parreira (2021)

2.2.1 From motivation to behavior

For someone to be motivated toward a particular behavior, an emotion/motivation of whatever intensity must be arisen within the context of a dilemma, compelling to the choice of one alternative. This dynamisation of behavior does not make it a linear result, merely a stimulus-response, but rather a response resolving a dilemma. The MCA Model uses the inner conflict scheme proposed by Lewin (LEWIN; CARTWRIGHT, 1951) to interpret the motivational dilemmas:

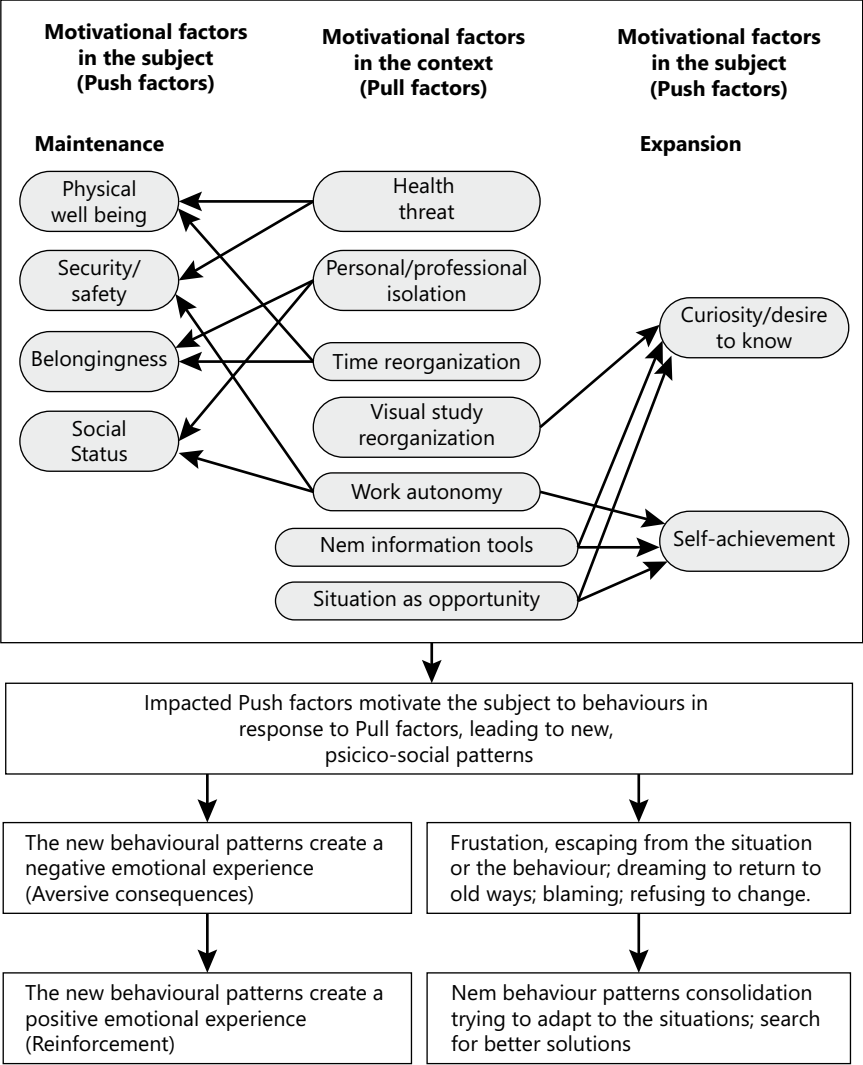
- *Approach – approach*: two intrinsic motivators or two alternative attractive objects.
- *Approach - avoidance (escape)*: an object is partially an attractor and partially a threat or a loss; or it is associated with an object that is a threat or a loss.
- *Avoidance – avoidance*: when both arms of the dilemma represent threats or losses.

In the Covid-19 case, the generality of situations are configured as approach-avoidance; but this relationship is a complex cognitive-affective response to the emotional impact of the dilemma, and leads to three types of behavior:

- a reactive response, to correct behaviors perceived as negative.
- a preventive response, seeking to ensure a priori the control of the effects of the chosen behavior.
- a creative response, essentially supported by expansion motivators.

This motivation model is the basis for the interpretation and evaluation of the different ways found by people to deal with the pandemic in the emotional, cognitive and action levels. The Figure 3 highlights the process.

Figure 3 - Covid Impact in the light of the Interpretative MCA Model



Source: The authors (2023)

2.2.2 The research work

This and Prigogine's models underpin the hypotheses guiding the research work:

H1. Covid-19 pandemic created a state of global tension that precipitated the emergence of dissipative structures and the opening of a bifurcation requiring structural changes in Education (MOK *et al.*, 2021).

H2. The changes forced by the dissipative structures will only lead to more effective structures and processes if they are driven not only by maintenance but also by expansion motivators, as these ones activate the search for a higher information level (GEIGER; DANNER-SCHRÖDER; KREMSER, 2021).

Both hypotheses were submitted to test in a study to understand the quality of individual and collective responses to the challenges of the pandemic on educational activities: the results in the variables shown in Table 1 and Table 2 are a test of H1; the results in the variables in Table 4 and in the clusters showing the evaluation of online lessons by the students are a test to H2.

3 Research design and measurement

The study focused on a cross-case analysis of students' behaviour in Portugal and Brazil. These two countries share the same language although they are culturally different, with different Education policies. We believe that their students can provide different experiences to better understand the psychological and social impact of Covid-19 on students' lives and their adaptive behaviors.

A mixed-method approach combining qualitative and quantitative analysis (CRESWELL; CLARK, 2017) was used to analyse data. As a data gathering instrument, a survey questionnaire involving 804 students was used. The questionnaire was made available online in the second semester (between February and May) of the academic year 2021. To check how well the items were understood, increasing the linguistic and cultural validity of the survey, a focus group with specialists (researchers and professors) and a pre-test in a small sample of 17 respondents from the target population were performed. Some concepts were replaced, reducing sample errors, and increasing the response rate. Invitations to participate were sent via email from teachers to their students. To encourage participation, completing the questionnaires was taken into account for the continuous assessment.

The questionnaire has five sections: one requesting sociodemographic data; another about the impact of Covid-19 on students' personal and professional lives; a third one on the students' conditions and their acquaintance with digital tools in the offspring of the pandemic; a fourth one on adaptive behaviors in response to pandemic challenges; and a fifth one on the students' evaluation of the impact of Covid-19 and the changes that it forced. Of the 46 questions, twenty-seven are qualitative, while sixteen follow a semantic differential format. The questionnaire used is an interval scale based on quantity adverbs with a defined numerical value (PARREIRA; SILVA, 2016), combining the quantitative and qualitative view and highlighting the synergy between the two methods. The other questions were multiple choice questions, allowing the simultaneous analysis of the joint distribution of the variables (CADARSO SUÁREZ *et al.*, 2017).

Being aware that large samples can be valid for any distribution (GHASEMI; ZAHEDIASL, 2012), we investigated the factor reliability (internal consistency) for the direct Covid-19 impact items, and observed good levels of internal consistency at alpha (0.75–0.85) for all of these scale factors. The questionnaire has construct validity, with content relevance and technical quality, generalisability and ease of score interpretation (MESSICK, 1995).

We apply Cohens'd because in large samples the p-value often gives significant differences, when they do not exist. Cohens'd also makes it possible to know the intensity of the differences, in conjunction to the statistical significance of findings (PESTANA; GAGEIRO, 2014).

The simultaneous t-test compares differences between countries among scale variables. A t value positive means that the average for Portugal is higher than that of Brazil, and means the opposite if it is negative. Cohens'd has the same sign as the t-test.

The relationship between two or more qualitative variables was established using Chi-square tests and logistic regression models. Students' online responses according to the first hypothesis were measured by running a Manova analysis to analyse the simultaneous effect of several qualitative variables in a set of scale variables to be explained.

3.1 The sample

A total of 804 university students from two public universities, in Lisbon, Portugal (24.9%), and São Paulo, Brazil (75.1%), participate in live online learning (Table 1

and Table 2). The different dimensions in the sample try to be proportional to those existing in the chosen Human Resource Course in both countries. The majority are women (68.8%), and there is a majority of 62% of students just studying in Portugal, while in Brazil there is an equal proportion of students who only study and those who also work. Regarding working students (Portugal = 76; Brazil = 304), most work with contract, while freelancers represent 14.0% students in Portugal and 17.9% in Brazil.

4 Results: presentation and discussion

In this part, the several aspects of the obtained results are presented and discussed, to highlight their educational impact and check if the research hypotheses are confirmed.

4.1 Direct impact of the pandemic on students and on their working life

Brazilian students feel significantly more worried, more threatened, having more daily basis constraints, and agree more with an imposed isolation period by the government than Portuguese students. These differences are statistically significant (simultaneous t tests, $p < 0.001$), with medium intensity between countries ($0.5 \leq |\text{Cohens'd}| \leq 0.7$), except for daily restrictions (Total Mean 5.2: Brazil Mean = 5.0; Portugal Mean = 5.8), and time spent following the news (Total Mean 5.0: Brazil Mean = 5.1, Portugal Mean = 4.7) where the differences, although relevant, are very small ($0.2 \leq |\text{Cohens'd}| \leq 0.3$).

Table 1 shows the significant direct effects of the pandemic on Higher Education students by country, gender and working life.

Table 1 - Psychological Impact on students by gender and work condition

	DIPD-1	DIPD-2	DIPD-3	DIPD-5
	Worried	Threatened	Psychological effect	Imposition of isolation
Total Mean	7.3	6.6	3.8 6,24	2.3
Portugal Mean	6.5	5.9	5	3.2
Brazil Mean	7.6	6.8	3.4	2.1
T test	8.3	5.9	8.6	7.8
p-value	< 0.001	< 0.001	< 0.001	< 0.001

Continue

Continuation

		DIPD-1	DIPD-2	DIPD-3	DIPD-5
		Worried	Threatened	Psychological effect	Imposition of isolation
Cohens'd		-0.7	-0.5	0.7	0.6
Gender	N (%)	Mean	Mean	Mean	Mean
Portugal					
Women	130 (65)	6.65	6.06	4.75	5.63
Men	70 (35)	6.05	5.49	5.46	6.03
Brazil					
Women	420 (70)	7.77	7.08	3.29	5.1
Men	180 (30)	7.07	6.2	3.56	4.87
Working Life	N (%)	Mean	Mean	Mean	Mean
Employees					
Portugal	48 (24)	6.5	5.96	4.92	2.81
Brazil	196 (32.5)	7.35	6.72	4	2.1
Free professionals					
Portugal	28 (14)	6.29	5.07	5	4.36
Brazil	108 (17.9)	7.48	6.89	3.11	2.26
Just studying					
Portugal	124 (62)	6.47	6	5.03	3.05
Brazil	300 (49.7)	7.72	6.89	3.02	1.95

Source: The authors (2023)

Multivariate Analysis of Variance (MANOVA) was used to perform the statistical analysis of the direct effect of the pandemic according to gender and working lives in both countries. It revealed that that there are significant differences by gender (Wilks Lambda = Hotellings’s Trace = 27.856, $p < 0.001$, partial eta squared 0.132, observed power 0.991) and by work life (Wilks Lambda = Hotellings’s Trace = 3.059, $p = 0.02$, partial eta squared 0.015, observed power 0.964). Although the negative effects are more pronounced among Brazilians, remarkably both countries show the same profile: the same proportion of students’ positive and negative perceptions and behaviors.

Table 2 shows that employees mainly work from home (64.3%), followed at great distance by those who had to go on mandatory vacations (16.1%) and who have

suffered job suspension (9.8%). Students with a liberal profession also experienced a direct negative impact on the organisation of their lives: reduction in the demand for work (52.1%), followed by the necessity to train and work at the same time (27.4%) and by previous training to deal with the new challenges (4.1%).

Table 2 - Impact on working life

		Total		Portugal		Brazil	
		N	%	N	(%)	N	%
	Students	804	100	200	24.9	604	75.1
	Impact on working life:	380	47.3	76	20	304	80
	Employees	244	100	48	19.7	196	80.3
IWLE-1	Dismissed	14	5.6	4	1.4	10	4.2
IWLE-2	Job suspension	24	9.8	2	0.7	22	9.1
IWLE-3	Reduced workload	10	4.2	2	0.7	8	3.5
IWLE-4	Mandatory vacation	39	16.1	7	2.8	32	13.2
IWLE-5	Working from home	157	64.3	34	14.1	123	50.3
	Liberal freelancers	136	100	28	20.6	108	79.4
IWLFP_1	Reduced workload	71	52.1	8	6.4	63	46.0
IWLFP_2	Growth in a demand for work	22	16.4	11	7.7	11	8.3
IWLFP_3	Train and work training	37	27.4	7	5.2	30	22.3

Source: The authors (2023)

The threatening energy released by Covid-19 led to the idea that the dangerous contagion could not be controlled by existing structures and processes, forcing society to enter the path of chaos, not being able to create new, more effective structures to deal with the imposed challenges.

As for significant motivational components: Psychological impacts were the strongest, the most salient influence on intrinsic motivators coming from fear associated with the pandemic. These emotions led to a perception of reality tinged by these feelings, reducing the sense of self-efficacy: 59.0% of Portuguese students and 78.8% of Brazilian students ranged from feeling quite to extremely threatened by the pandemic. This darker perception of reality became a barrier to adaptive efforts, especially innovative ones, motivating, on the contrary, a conformist attitude and behavior, as predicted by the MCA Model.

The hypothesis H1 is directly linked to the results presented in Table 1 and 2: To see if they support or disprove it, we must know how large and deep the behavioral changes were enforced by the pandemic, as they appear in the results:

- respondents were concerned with the subject (Mean = 7.3 = 77.6% of total scale range); felt threatened (Mean = 6.6 = 69.5%); felt psychologically affected (Mean = 6.24 = 65.4%); were constrained in their daily lives (Mean = 5.2 = 53.5% of total scale range).
- The impact on work lives was also quite strong: employees were obliged to work from home; freelancers faced a reduction on the demand for their services. These impacts seemed strong enough to force the emergence of dissipative structures and open a bifurcation to social changes. Hence, we admit that results support H1: the conditions for change in educational structures and processes were launched.

4.2 Students' condition at the start of coping measures

Most of students entered remote Education, which forced them to make extensive use of digital tools for accessing information.

4.2.1 Experience through digital platforms and home study

The instruments in remote Education were largely based on the use of digital information sharing tools, with reduced use of organisation and planning tools. The email management system (Google, Outlook, Mail, Yahoo) was the most used in information storage and exchange tools in both countries (20.6%); individual task management systems (Keep, Gtasks) were the less used (2.8%). Shared calendar system (Google Agenda, Outlook) was the most used information organization and planning tool in both countries (11.4%). Women use information storage and exchange tools more than men in both countries (Portugal 65.8%, Brazil 69.1%), while organisation and planning tools do not differ by gender.

4.2.2 The intrinsic factors

The impact of students' experience with digital platforms before the start of Covid-19 may be viewed as considerable; but the student's online experience did not hinder a high self-confidence with digital technologies (> 80%). The learning experience does not seem to be the principal factor to influence students' confidence

to work with these instruments: few have more than a limited experience, but this does not reduce students' confidence (Mean = 7.0, corresponding to 80% of the scale range), as Table 3 shows.

Table 3 - Attitudes and impacts evaluation

		Total		T	p-value	Cohens'd	Portugal	Brazil
		Mean	SD				Mean	Mean
	Attitudes and Evaluation							
	Cronbach's Alpha	0.803						
DIAE_2	Degree of self-confidence with digital platforms	6.98	1.7	3.4	<0.001	0.2	7.3	6.9
DIAE_4	Evaluation of online sessions	6.13	1.7	1.5	0.13	0.1	6.3	6.1
DIAE_5	Desire to return to school	7.61	2	-3	0.003	-0.2	7.3	7.7
DIAE_7	Opportunity to develop personal and professional skills	6.26	2.1	2.8	0.006	0.2	6.6	6.2
DIAE_8	Life learning that enriches future learning	6.01	2.2	3.2	0.001	0.2	6.4	5.9
DIAE_9	Reaction to isolation policies	2.13	1.6	9.5	<0.001	0.9	3.2	1.8
DIAE_10	Investment in vaccine or other drugs by government	8.31	1.5	-6.5	<0.001	-0.6	7.7	8.5
DIAE_11	A disciplined person to study at home	5.74	2.2	6.2	<0.001	0.4	6.5	5.5

Source: The authors (2023)

They give positive evaluation to online lessons (> 65%), even if they show a great desire to go back to school (> 79%). The majority of students with psychological and daily basis constraints (> 76%) perceive the isolation period as an opportunity to develop skills (> 61%); and even those who were worried or threatened and psychologically most affected see that the imposed change enabled a learning life gain that complemented and enriched future teaching and learning processes (75.5%).

The demonstrated self-confidence has intrinsic motivational roots (push factors), which undoubtedly influenced students coping with the pandemic. However, contextual motivators (pull factors) are also responsible for significant differences: in our study, the country of residence, and the Education setting are clearly related to students' confidence in the use of these technologies.

Results concerning self-confidence in Portuguese and Brazilian students show that both nationalities possess high self-confidence (Mean 6.98, corresponding to 79% of the scale range). But Portuguese students exhibit greater self-confidence (Mean = 7.3, or 84% of the scale range) than Brazilian students (Mean = 6.9, or 78% of the scale range), a statistically significant difference ($F = 4.224$, $df = 1, 400$, $p = 0.041$).

Students' gender was also explored relating this variable: in both countries, men have greater self-confidence (Mean 7.48) than women (Mean 6.77), a difference statistically not significant.

On the variable self-discipline, 41.1% of the students declared to be low in self-discipline, while 58.9% considered themselves to be extremely selfdisciplined: the overall mean is 5.74 (above 4,355, the midpoint of the scale range). The difference is statistically significant (test $F = 8.468$, $df = 1, 802$, $p = 0.004$).

The level of self-discipline is undoubtedly a positive influence on students' feelings of self-efficacy, regarding the organisation of their studies and daily work life and can be considered a strong motivational factor favorable to an effective adaptive behavior.

4.3 Adaptive behaviors in response to Covid-19

H2 expresses the idea based on the Prigogine explanatory model that innovative structural configurations are only feasible by an increase in understanding the complex processes required by those innovations, as expressed in H2: students' responses and evaluation of the Covid-19 impact and challenges seem to support it (Table 4):

- most students accept the imposed social distance and respond positively to the isolation directives (only a very small percentage - <15% - do not admit those directives); all respondents agree with the need for the government to invest in vaccine research (> 93%); regarding information about Covid-19, most feel that more information would be needed (> 56%) and are disciplined

enough to study at home for up to four hours a day on average (>52%). These attitudes and motivations support H2.

4.3.1 Adaptive behavior in the field of study

These results show that the experience of students with online educational processes did not create barriers to positive adaptive responses to the new situation: most students evaluated the academic activities undertaken during the pandemic in a positive way; students showed a level of self-confidence, self-organisation and adaptability, which ensures the maintenance of innovative educational environments, namely those leading to self-regulated learning behavior. Students' confidence is always present in responses, even if the evaluations are affected by the impact of Covid-19 on work:

- Those who have suspended work make the lowest evaluations of online classes.
- Students who feel isolation as an opportunity to develop new skills are mainly those who work from home or are involved in a liberal profession and enjoyed previous training;
- All students feel a desire to return to present classes, but the majority give a positive evaluation of online classes.

4.3.2 Organisation of daily behavior

Students who could organize their home study routines reach 22.4% in Portugal and 23.8% in Brazil:

- they dress appropriately to study (Portugal 42.1%, Brazil 31.6%).
- they take breaks to exchange ideas with colleagues (Portugal 16.9%, Brazil 19.7%),
- and to practice physical exercise (Portugal 12.0%, Brazil 17.8%).

Nevertheless, many students in both countries do not have a computer and internet at home (Portugal 33.0%, Brazil 35.6%) neither sufficient privacy to work (Portugal 22.0%, Brazil 20.2%), but these weaknesses did not hinder their selfconfidence and the adoption of an effective adaptive behavior.

4.3.3 Students clustering: three different evaluations of Covid-19 challenges

This part was designed to find out whether students can be clustered based on their evaluation of online classes, an interesting piece of information for Higher Education institutions planning. We applied a fixed three-cluster model to verify if they were sufficiently different in terms of the ratings that formed the evaluative question. The three clusters allow us to distinguish students with high ratings, medium ratings, and low ratings on the majority of items (Table 4).

Cluster II (“Positive Thinkers”) is the largest one and contains 49.5% of the students. Their classifications in “opportunities, discipline and confidence” are the second highest of the table:

- they are disciplined enough to study at home.
- they have high self-confidence to work with digital technologies in Education.
- they see distance learning as an opportunity for their learning.
- they see the situation of isolation as a high opportunity to develop their personal and professional skills.
- they feel that the changes in habits that everyone was obliged to adopt allow for a life learning that complements and enriches educational activities.
- they have a great desire to return to face-to-face classes.

When thinking about Covid-19, they feel moderately threatened as the other clusters, but are less worried than the others; the isolation period had a more negative impact on their psychological health than of those in cluster 1 (Enthusiastics); however, like “Enthusiasts”, they spend the least time following news about Covid-19 and they found less difficulties in getting what they need on a daily basis than those in cluster 3 (Doubters). About the “perception of governments and information on Covid-19”, they have sought to protect themselves from contamination by taking distance from others; they agree with the punishment of those who do not comply with it and think that governments should invest large resources in research on vaccines or drugs against Covid-19.

Cluster I (“Enthusiasts”) is the second larger cluster with 44.3% of students. In “opportunities, discipline and confidence”, they have the highest rank. They are the most disciplined group to study at home. Their desire to return to face-to-face classes is lower than observed in the other clusters. When they think about Covid-19, they feel a moderate degree of threat as the remaining clusters. The period of isolation had the least negative impact on their psychological health, as well as on the satisfaction of their daily needs. They are the ones who have most sought to distance themselves socially from others to protect from Covid-19; and spent the least time following news about Covid-19 social media (together with “Positive thinkers”).

Cluster III (“Doubters”) is the smallest cluster (6.6%) and includes students who do not see opportunities nor benefits offered by the period of confinement. In the items of “opportunity, confidence, and discipline”, their means (between 2.88 and 3.92) are well below the median value of the scale; they are the less disciplined to study at home, have the greatest psychological impacts and difficulties in obtaining what they need on a daily basis, and spend the most time following the news about Covid-19.

Clusters are analysed according to the sociodemographic characteristics of the students. Regarding gender, there are no statistically significant differences among clusters. Enthusiasts are mainly among those who have actual experience in using online platforms.

The clusters identified confirm that the students’ evaluations of the lessons are a complex process with different explanations based on discipline of study, perceived opportunities, confidence, time spent following the news, psychological effects, daily difficulties, and reactions to governmental directives. These results show that the students are a heterogeneous segment either in Portugal or in Brazil (Table 4).

Table 4 - Clusters based on the students’ self-perception and evaluation of online classes

Variables of clustering	I cluster		II cluster		III cluster		F	p
	n = 356 (44.3%)		n = 398 (49.5%)		n =50 (6.2%)			
	Enthusiasts		Positive thinkers		Doubters			
	M	SD	M	SD	M	SD		
Discipline, confidence, and opportunities:								
<i>A disciplined person to study at home</i>	6.53	1.11	5.33	1.07	3.44	1.06	63.78	0.01

Continue

Continuation

Variables of clustering	I cluster		II cluster		III cluster		F	p
	n = 356 (44.3%)		n = 398 (49.5%)		n =50 (6.2%)			
	Enthusiasts		Positive thinkers		Doubters			
	M	SD	M	SD	M	SD		
Degree of self-confidence with digital platforms	7.46	1.46	6.75	1.6	5.4	1.29	44.95	0.01
Opportunity to develop personal and professional skills	6.81	1.02	6.06	1.95	3.92	1.04	50.29	0.01
Life learning that enriches future learning	6.76	1.04	5.64	1.13	3.64	1.19	60.73	0.01
Desire to return to school	7.35	1.22	7.83	0.69	7.80	1.64	6.00	0.01
Psychological and daily basis effects:								
Make you feel worried	7.46	1.58	7.09	1.75	7.6	1.87	5.48	0.01
Make you feel threatened	6.5	1.99	5.88	1.92	6.67	1.25	2.07	n.s.
Affects you psychologically	5.98	1.47	6.43	1.38	6.48	1.64	3.45	0.03
Daily basis difficulties	4.59	1.17	4.91	1.35	5.4	1.04	3.82	0.02
Students's perception of government and the news:								
Imposition of isolation	7.72	1.80	7.58	1.89	7.92	1.69	1.08	n.s.
Reaction to isolation policies	8.04	1.41	7.68	1.68	8.04	1.52	5.40	0.01
Investment in vaccine or other drugs	8.37	1.29	8.27	1.59	8.16	1.87	0.72	n.s.
Time spent following the news about Covid-19	4.93	1.24	4.95	1.06	5.6	0.97	7.74	0.01

Source: The authors (2023)

Our results show that the initial experience of students and educational institutions with online educational processes allowed most of them to adapt to the new situation (they did not create barriers to positive adaptive responses); most students evaluated the academic activities undertaken during the pandemic in a positive way; students showed a level of self-confidence, self-organisation and adaptability which ensures the maintenance of innovative educational environments, namely viewed as fostering a self-regulated learning behavior.

But “although the student can easily use the technology, he continues to have difficulty to understand the world where he lives” (SOARES *et al.*, 2020, p. 97), depending upon his teachers to give sense and significance to that world. And the authors highlight “the emergence of a new strategy in the relationships between teachers and students, guided by the understanding of the other as a party directly involved in the educational act” giving a new meaning to the teacher’s authority: the competence to behave as an advisor teacher (SOARES *et al.*, 2020, p. 100). Therefore, we can admit that the changes forced by the Covid-19 pandemic will quite probably lead to innovative and more effective educational structures and processes, supporting H2.

5 Conclusion and future implications

This research has shown that despite the surprise of the pandemic, educational institutions, teachers, and students have managed to provide adaptive responses in a reasonable timeframe and have been able to minimize their effects on educational processes (CARVALHO; SÁNCHEZ CASADO; CUBO DELGADO, 2020). Enthusiastic group students can be used by Higher Education institutions as agents for the institutions to move forward. They are involved in seeking opportunities and benefiting for the future, even in the most difficult situations. The positive thinkers are at the expected level of Education: like enthusiasts, they are mainly motivated by expansion push factors; they have experience in using online platforms and see online experience as an opportunity for their work, a view confirmed by their perception of use the situation.

We observed that the negative emotional impact of Covid-19 did not affect students’ daily practices to a large extent. According to the MCA Model, students’ behavior shows positive motivational factors - self-discipline and confidence in their skills to work with digital technologies. This is favourable to the emergence of feelings related to self-efficacy regarding the organisation of their studies and daily work lives; this adaptive behavior highlights the emergence of proactivity in the search for knowledge. The knowledge of the existing instruments facilitated the change to the virtual environment leading to specific attitudes and behavior:

- Valuation of the school space mainly as a space for socialising, where the majority of students would like to recover the experience of the school space.
- The maintenance of the virtual environment in several educational activities: students believed it would continue for theoretical classes, oral presentations and for examinations and classes with tutoring.

- Only a small minority considered that current experiences should not be repeated under any circumstances.

Therefore, most students have accepted the changes, and even those who seemed to oppose did so mainly due to economic conditions, which prevented their access to the appropriate technological instruments.

Consequently, the authors think that these results may be used in other similar contexts: when there is tension sufficiently strong to force the upsurge of energy dissipating structures, leaders must acquire the knowledge level required to build new and more advanced processes and structures. This will promote the development of educational innovative processes to take advantage in utilizing e-learning tools and hybrid education.

Comportamentos adaptativos dos estudantes aos impactos da Covid-19: uma análise multidimensional

Resumo

Esta investigação contemplou três objetivos: (i) avaliar o impacto da pandemia do Covid-19 no estado emocional e comportamento de alunos do Ensino Superior; (ii) esclarecer a condição dos estudantes no início da pandemia (iii) compreender como avaliam o impacto e se envolveram em comportamentos adaptativos. A amostra envolveu 804 estudantes no Brasil e em Portugal. Os resultados corroboram as hipóteses: o impacto da pandemia forçou o surgimento de estruturas dissipativas de energia; o comportamento dos alunos não decorre apenas do impacto emocional negativo da Covid-19, mas também de fatores motivacionais positivos internos e externos. As aulas online indicam três grupos de alunos: entusiastas, pensadores positivos e céticos, com diferenças estatísticas entre países, gênero e status profissional. A implementação de um ensino híbrido deve ser considerada para potencializar a aprendizagem dos alunos.

Palavras-chave: Ensino Superior. Motivação dos Estudantes. Aprendizagem Online. Covid-19.

Comportamientos adaptativos de los estudiantes a los impactos del Covid-19: un análisis multidimensional

Resumen

Esta investigación tuvo tres objetivos: (i) evaluar el impacto de la pandemia de Covid-19 en el estado emocional y el comportamiento de los estudiantes de Educación Superior; (ii) aclarar la condición de los estudiantes al comienzo de la pandemia (iii) comprender cómo evalúan el impacto y se involucran en comportamientos adaptativos. La muestra involucró a 804 estudiantes en Brasil y Portugal. Los resultados corroboran las hipótesis: el impacto de la pandemia obligó al surgimiento de estructuras disipadoras de energía; el comportamiento de los estudiantes se deriva no solo del impacto emocional negativo de Covid-19, sino también de factores motivacionales positivos internos y externos. Las clases en línea indican tres grupos de estudiantes: entusiastas, pensadores positivos y escépticos, con diferencias estadísticas entre países, género y estatus profesional. Se debe considerar la implementación de la enseñanza híbrida para mejorar el aprendizaje de los estudiantes.

Palabras clave: Educación Superior. Motivación de los Estudiantes. Aprender en Línea. Covid-19.

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