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Complex trajectories in higher education students: online and face-to-face universities

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Abstract

Expansion in higher education and changes in student profiles have led to an increase in non-linear trajectories that do not fit into a time frame considered standard. However, universities continue to establish success and failure parameters relating to performance indicators that do not consider the heterogeneity of trajectories. The theoretical perspective on which we base our work is the complexity approach, which resituates what we understand as a trajectory of success (and failure), incorporating a broader view to better understand how students navigate through higher education. Based on research on university dropout and changes of trajectory, we present the results of a study carried out using sequence analysis in face-to-face and online universities. The research question on which this study focuses is whether, given the context of greater heterogeneity and complexity, there could be a greater similarity between the students' trajectories in face-to-face and online modalities in relation to complex trajectories. The results show that complex trajectories are very present in both modalities, and differences are observed according to students' gender and age. A key conclusion is the discussion on how we consider success and failure student trajectories in the contemporary university taking into account the perspective of complexity.

Keywords: Higher education, University students, Dropping out, Student progress

1 Introduction

The process of university expansion has transformed the social composition of the student body, producing greater heterogeneity of social origin and more diverse socio-demographic profiles and previous educational trajectories. However, the fact that new segments of the population are accessing university in higher proportions than in the past implies unequal paths of opportunity (Troiano et al., 2021). Therefore, we cannot affirm that the Spanish university system can be considered an equitable system.

These transformations lead us to consider university and the trajectories from a perspective of greater complexity (Sánchez-Gelabert et al., 2020), since the role played by students, their own agency and the course of their trajectories must be observed from a broad and nuanced vision of complexity (Dusi & Huisman, 2021). The perceptions and

meanings that students attach to studying at university, and their decisions, experiences and sense of belonging must also be included.

Indeed, a large proportion of the theoretical frameworks on academic trajectories are based on students' decision making, a notable finding being that although access to university has expanded, historically disadvantaged groups in higher education, such as students from lower social backgrounds, follow less linear and less fluid trajectories (Haas & Hadjar, 2020).

The complexity perspective argues that university students' trajectories do not always develop in a homogeneous, sequential or continuous way, as was more often the case in the past. It focuses on trajectories of delay, interruption and change (Boylan, 2020; Tinto, 2017). Understanding these trajectories as complex broadens the view of how students navigate their way through higher education. It also facilitates the identification of institutional resources that universities can implement to better accompany these trajectories, both to detect new needs and to design flexible pathways (Brennan, 2021), new resources to meet these challenges.

These complex trajectories are characterized by non-linearity, non-uniformity and discontinuity. Differences can be observed and calculated depending on the social composition of the student body and on institutional factors such as characteristics concerning the modality (face-to-face or online). In online universities, persistence is a crucial concern, especially that of students in the first year of the degree, in the light of decisive barriers such as time pressure and work/life balance issues (Xavier & Meneses, 2022). Social interaction is valued by students in distance universities (Bağrıacık Yılmaz & Karataş, 2022), in the sense of promoting greater engagement, which could be a consideration in terms of possible intervention measures to avoid the risk of dropout.

Change of trajectory is also a phenomenon of interest for higher education research, and likewise responds to this increased focus on the complexity of trajectories. Change of trajectory, referring here to between undergraduate degrees, cannot be compared to dropout because it presents different elements and outcomes. As some studies (Aparicio-Chueca et al., 2019; Hovdhaugen, 2009) suggest, the dropout figure cannot be considered definitive dropout in its entirety, since a part of it is in fact a change of degree course or academic relocation (Villar-Aguilés et al., 2017). In the Spanish university system, 33.2% of new students dropped out of the degree they had started in the academic year 2015–2016, and of this percentage 12.4% went on to study another degree, making the dropout rate in the university system 20.8% (Fernández-Mellizo, 2022).

This study begins with a research question formulated in the light of this context of expansion and increasing diversification in the student profile and complexity: is there a greater similarity in the profile of students at face-to-face universities and online universities in relation to complex trajectories?

This question arises from the interest in knowing if the academic trajectories of these modalities are becoming more similar, because in the past were more differentiated by a more different student profile.

As a starting point, the present article discusses previous studies on university dropout, as well as articles on trajectory change as a phenomenon of more recent interest in international research. The theoretical perspective on which we base our work is the complexity approach, which characterizes the decisions and experiences of university

students today in a more pronounced way than in previous times. We then present the results obtained with a longitudinal methodology using the technique of sequence analysis applied to two universities, one face-to-face and the other online, with the aim of identifying differences and similarities in the trajectories in the two institutions in clearly different learning environments, and according to gender and age. We end the article with a discussion and conclusions section highlighting the importance of considering the existence of complex trajectories and the redefinition of the notions of success and failure in higher education.

2 Theoretical framework

2.1 Dropping out is a multidimensional phenomenon

The literature has described the phenomenon of university dropout as multidimensional, identifying the relevant factors, which can be of an internal or endogenous nature, or exogenous or contextual. Within this set of factors of one or the other typology there are different levels and aspects. Moreover, this phenomenon has been studied from different disciplines, with contributions from psychology, sociology and economics standing out, logically adopting different approaches and each revealing specific mechanisms (Aina et al., 2022). This work highlights that early college dropout is lower for students who are academically and socially integrated, and that informational and relational aspects are crucial in explaining dropout.

The most cited explanatory models of college dropout processes over years of study in this field have pursued the goal of predicting the factors that influence student retention, or in other words, dropout. Reference research published in the US context proposes models to understand the factors associated with dropout (Bean & Metzner, 1985; Spady, 1970; Tinto, 1975). Tinto's (1975) model of university retention or permanence is one of the best-known proposals on an international scale. Many subsequent works since its publication have been based on applying or extending this model, which focuses on the concept of academic and social integration in the institution.

These works show different variant combinations of the external and internal factors involved in the phenomenon. For their part, Pascarella and Terenzini apply Tinto's model to establish a proposal that pinpoints the concepts of academic and social integration (Pascarella & Terenzini, 1980). One of the most interesting results is that social integration has a greater weight on the permanence or retention of female students, while academic integration has a greater influence on the academic integration of male students.

In a later paper by Pascarella and Terenzini together with a third author, Wolfle, the influence of an intensive orientation program for students is measured, taking dropping out after the first year of study into account (Pascarella et al., 1986). They conclude that institutional support via this orientation program influences students' level of social integration and consequently their commitment to the institution, which improves the level of retention.

Subsequent studies have further pursued the influences of these investigations, with the aim of revealing the factors that explain permanence in university degree courses or the factors that most predict dropout. Both men and women were more likely to persist when they were more integrated into the college environment (Leppel, 2005). It has

since been found that the association between social integration and subsequent institutional commitment is much stronger for women (Jones, 2010).

Molly B. Kerby (2015) proposes a model of the factors related to retention, considering conceptual contributions from sociology that inspire a broader understanding of retention and dropout. The author includes external factors in the proposal, taking into account the political, economic and social climates that interact with what she calls the educational climate (Kerby, 2015).

Another factor of interest is university engagement, which is mainly related to the effort students put into their studies but also, in a broader sense of engagement, to their sociocultural involvement. It is also related to the actions taken by the institution to offer students' services and resources to achieve greater involvement and participation (Tight, 2020).

In addition, studies have been published in recent years on the reasons why students drop out of university, taking the type of institution (face-to-face, open and distance education) into account. The expansion and consolidation of online universities increases opportunities for students who cannot study face-to-face. However, it can also lead to other effects such as increased dropout, change of studies or interruption of the trajectory due to a more diverse profile, or an older student with multiple commitments and responsibilities (Xavier & Meneses, 2022).

2.2 Change of trajectory as another outcome

Change of academic trajectory is related to dropout, but they are not exactly the same phenomenon. While dropout has been widely studied, change of trajectory is a phenomenon of more recent interest in international research. The distinction between dropping out and changing is relevant, in terms of quantification, understanding and intervention. For institutions' effective management of dropout, it is essential to know whether it is a change or a dropout, since among the different factors involved, the reasons for the choice of degree affect the change of degree more than definitive dropout (Hovdhaugen, 2009).

Change of trajectory can be understood as an interruption to the standard pace of an undergraduate degree, which can signal a provisional or definitive abandonment of university studies, or a change of degree to enroll on another degree program (in the same or another university). The change, in this case, can mean either a move away from the possibility of a provisional or definitive abandonment or a prelude to it. Moreover, it is interesting to consider this change from the perspective of academic relocation to highlight that in today's university, formative itineraries do not necessarily run in a linear fashion and that there are trajectories of return and relocation (Villar-Aguilés et al., 2012, 2017).

The factors most closely related to change of trajectory have previously been studied. Age at enrolment is a powerful indicator relating to dropout and change of degree (Lassibille & Gómez, 2009; Xavier & Meneses, 2022). The gender factor is also relevant, since there is a more pronounced relationship with academic persistence for women than for men (Ferrão & Almeida, 2018). Another factor is the learning environment since it seems to have an influence on the decision to drop out, so "improving the learning

environment through closer contact between students and teachers is also likely to improve permanence" (Hovdhaugen & Aamodt, 2009).

The change of trajectory is a phenomenon that is increasingly common among students, in its variants of both change of degree and change of university. According to the results of a study on university transfer, it occurs most frequently in engineering, experimental sciences and social sciences, and the profile is male, students who do not combine paid work with study, have completed high school in a private or charter school, and is upper middle class with both parents with a higher education working in senior management positions or liberal occupations (Aparicio-Chueca et al., 2019). Therefore, change of trajectory, in its variants of change of degree, university and learning environment, is a partially different decision and result from dropping out and is framed in this current context of greater diversity of profiles, non-linearity and complexity, because complexity includes trajectories of delay, interruption or change.

3 Methodology and data

Sequence analysis is a longitudinal analysis technique that consists in ordering a list of elements over time, in sequences, where the positions of the elements are fixed and are ordered according to elapsed time. This analysis makes it possible to observe trajectories holistically, as opposed to other types of analyses that consider transitions as discrete events (Abbott & Tsay, 2000). We considered that sequence analysis has the potential to improve our understanding of academic trajectories, as well as to facilitate comparative analysis across higher education institutions. Furthermore, like comparison, sequence analysis allows us to understand intra-individual variability by looking at factors that might help explain why some people follow standard trajectories, while others register complex trajectories.

According to the definition used in the framework of this project titled *Complex Trajectories* (funded by European Commission 2020–2023), we consider a trajectory to be complex when there has been a delay of at least one year beyond the institutionally established time ($t + 1$ year), there is a stop-out trajectory (when the trajectory stops for some years), or there has been some kind of change (of degree, university or type of university, online/face-to-face).

Before proceeding with the description of the data, we must note that sequence analysis is not normally applied to hypothesis testing (Brzinsky-Fay, 2014). While it is a type of analysis that helps in the construction of new research hypotheses, it requires further analytical steps to know what can explain the sequences, and what the sequences in turn explain.

3.1 Data

Our data come from the database developed within the *Complex Trajectories project*. These data in turn come from the records of the universities involved in the project. The database is longitudinal and, over seven academic years, tracks all first-time enrolments during the academic year 2012/2013 at the two universities studied. The database for the two universities covered in this article consists of a total of 7,358 students for the UOC and 11,911 students for the UV.

The choice of academic year 2012/2013 for the starting year is because by then the degrees within the framework of the European Higher Education Area had been widely implemented. Another reason for the choice of this cohort is that it gives us a follow-up period of seven years, providing a sufficient time window for finishing a degree at both face-to-face and online universities, the latter tending to follow a slower pace, especially if they are long degrees (medicine, etc.) or combined degrees. The last academic year analyzed, 2018/2019, was selected because it was the last full academic year before the pandemic. The following academic year, 2019/2020, was already affected by the confinement (from 8 March 2020 in the case of Spain), and the two following years had different types of restrictions on face-to-face classes: this situation may have had significant effects on some of the events analyzed here, especially on dropouts, so we have chosen not to consider these years.

The analysis is based on a seven-year interval with annual sequences of states. The states are defined by three basic events: graduation (if individuals complete the degree program), change (change of degree program) and drop out. We use the TraMineR package (Gabadinho et al., 2011) to manage the sequence data and produce all graphs and sequence analysis results.

In addition to age and gender, the data include variables relating to academic trajectories: how the student entered university, whether or not they enrolled in successive years, whether they remained on the same degree, whether they changed degrees (within the same university), or whether they dropped out of university. The data also include variables relating to the socioeconomic status of the individuals included in the cohort studied: parents' level of studies, nationality and whether they work as well as study.

3.2 Justification and brief description of the selected universities

The choice of the UOC and the UV satisfies a double criterion, the first emerging from the similarity of the two territories, Catalonia and the Valencian Community (as well as the important links between them), and the second from the contrast between an online university and a face-to-face university. Regarding the latter, it should be noted that although the Valencian Community has an online university, founded in 2008, it did not offer official degrees until 2011 and, following its purchase in 2013 by a publishing group, it also underwent some changes that make it difficult to monitor students longitudinally. This led us to choose a Catalan online university to compare the trajectories of the two university models.

The economic and social contexts are very similar in the two autonomous communities. Both territories are bilingual, the populations speaking Valencian/Catalan (which are the same language) and Spanish.

In Catalonia there are 12 universities, 11 of them face-to-face (7 public and 4 private) and 1 online (public). In the Valencian Community there are 10 universities, 9 of them face-to-face (5 public, 4 private) and 1 online (private).

The university pricing policy is determined by each autonomous community. In Spain there are scholarships offered by the central government, the autonomous communities and the universities themselves. In all cases, family income is considered, although the grants offered by the Catalan and Valencian governments are less demanding in terms of income thresholds. Maintaining the grant after the first year depends on the student's

performance. The requirements have varied over the years, becoming stricter under conservative governments and more flexible under socialist governments.

At the UV full-time students must enroll for a minimum of 36 credits, and part-time students for a minimum of 24 credits. Incoming first-year students must pass a minimum of 12 credits. If they fail to do so, they will not be able to enroll on the same degree program for at least two academic years. At the UOC, the minimum enrolment for all students on any course is one subject (6 credits). The minimum that students must pass in the first year is 6 credits, and there is no requirement for subsequent years.

4 Results

4.1 Social and academic composition of the cohorts

Table 1 lists the main characteristics of the individuals in our database. As can be seen, there are some differences in the composition of the cohorts stemming from the characteristics of each university. The UOC is an online university, which mainly influences the higher average age of the students and the higher proportion of students who combine work and studies.

On the other hand, at the UV there are more foreign students, a higher proportion of students with university educated parents and a higher proportion of women. These differences in relation to gender and the academic background of the families are related to the type of degrees offered at the UV, where there are a number of highly feminized degrees, especially in the areas of health sciences, education and social sciences. On some degrees such as medicine and pharmacy, there is a high proportion of students with parents with a university level education.

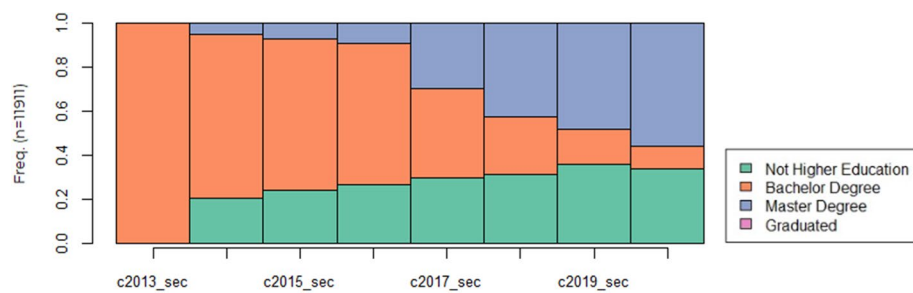
4.2 Main trajectories: sequence analysis

In this section we present the results of the sequence analysis of the cohorts studied for the UOC and the UV (Figs. 1 and 2). Through this analysis we can observe the main changes in the cohort during the seven years following enrolment (overall percentages for each academic year). It should be remembered that 2012 is the starting year of the monitoring, so all the students have the same state, enrolled on the degree. From the second year onwards, they may be in different situations: enrolled on the same degree (continuing the degree started), outside the system, graduated or enrolled on a master’s degree or other postgraduate degree (which would be assimilated to having graduated in most cases).

Table 1 Main characteristics of the 2012–2019 cohort. UOC and UV

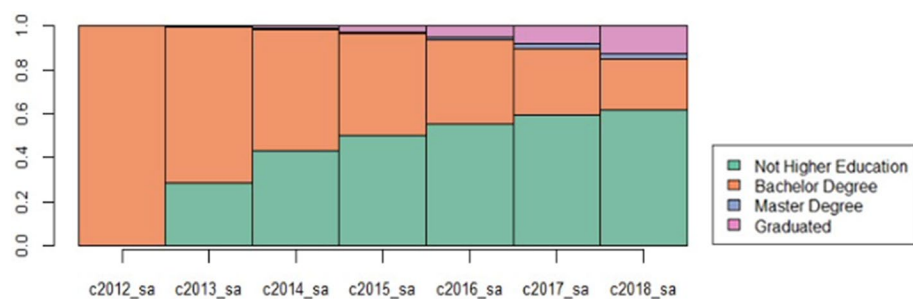
University	Entry Age		Families with university studies		Non-working students		Spanish nationality		Female students		Total students	
	M	SD	N	%	N	%	N	%	N	%	N	%
UOC	32.58	8.88	742	34.30%	893	49.00%	7180	97.60%	3752	51.00%	7358	100.00%
UV	21.84	6.091	4550	38.20%	9873	82.90%	10,270	86.20%	7348	61.70%	11,911	100.00%

Source: Complex Trajectories Project



Source: Complex Trajectories Project (n=11911)

Fig. 1 Sequence analysis 2012 cohort. UV



Source: Complex Trajectories Project (n=7358)

Fig. 2 Sequence analysis 2012 cohort. UOC

Each figure shows the proportion of students (vertical axis) who are in each of the states considered in the different academic years (horizontal axis). In both figures, in the first of the academic years, all students are in the "bachelor degree" status.

As expected, UOC students present some characteristics typical of an online university (Fig. 2). Furthermore, the trajectories that end in graduation have a slower pace at the UOC than at the UV. As it observed, at the end of the period under analysis at the face-to-face university (Fig. 1) there are a greater proportion of graduate trajectories (Fig. 1).

At the same time, in the online university there is a higher proportion of paths that end in degree abandonment. In this regard, although there is a lower proportion of students with trajectories that end in graduation, it is noteworthy that there is also a group of students in the cohort studied who manage to finish their degree and have therefore persisted in it, albeit at a slower pace (Fig. 2). This characteristic of the trajectories in the online university raises the question of the factors at play that retain these students, among which could be high motivation, teaching methodology, etc.

To complement the graphical representation of the sequence analysis, below we offer a series of indicators that will help us take a closer look at the trajectories followed by the students (Table 2). As mentioned above, we consider a trajectory to be complex when there has been a dropout, a delay of more than one year with respect to the institutionally established time ($t+1$), or when there has been some kind of change (of degree, of university, etc.). In other words, complex trajectories differ from the ideal pathways, on which the institutional design of degree programs is often based.

Table 2 Trajectory indicators of the 2012–2019 cohort. UOC and UV

University	Complex Trajectories (other than t + 1)		1st-year dropout		Total dropout		Change of degree		Persistence		Access to master's degree		Total students	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
UOC	6769	92.00%	1736	23.60%	4591	62.40%	765	10.40%	1420	19.30%	294	4.00%	7358	100.00%
UV	5789	48.60%	2251	18.90%	3514	29.50%	1048	8.80%	750	6.30%	1668	14.00%	11,911	100.00%

Source: Complex Trajectories Project

Within complex trajectories, we consider that first-year dropouts include all those who, having enrolled at university in the academic year 2012, do not enroll the following year or in any other of the seven academic years observed. Meanwhile, total dropout refers to those who, at the end of the study period, have not obtained a degree and are not studying. Note that this last category does not include students who have interrupted their studies during the period analyzed if in the end they have re-enrolled. On the other hand, change of degree includes people who, at some point, have changed the enrolment option they chose in the first year. With regard to persistence, we understand this as including students who, at the end of the period considered, are still enrolled on a degree course. Last, access to a master's degree includes enrolment either on a master's or on any other postgraduate program.

The indicators presented in Table 2 confirm that the online university has a higher proportion of students following complex trajectories, accounting for 92% of all students at the UOC, and 48.6% at the UV. Despite this difference between online and face-to-face universities, notable is the high proportion of complex trajectories at the latter, accounting for almost half the students enrolled in 2012.

Likewise, both persistence (which would indicate a certain delay in the institutionally designed pathway) and dropout are higher at the UOC. However, the pattern of the trajectory linked to dropout may be more interesting than the difference in the proportions of students at the two universities. At the UOC, dropout in the first year represents approximately one third of the total dropout in the period observed. In contrast, at the UV, first-year dropout accounts for more than half the total dropout recorded in the seven years of the cohort. At the face-to-face university it seems that dropout occurs earlier, which raises questions about the factors that may be behind it. If we venture the hypothesis that in the distance university dropout could be due to external factors (in this regard, the higher proportion of students who work while studying would point in this direction, as we saw in Table 1), in the case of the on-site university, it is likely that the factors behind dropout are mainly academic: the degree programs meeting the students' expectations, information available to students during the process of choosing a degree program, mechanisms for welcoming new students to the university, etc. (Villar-Aguilés et al., 2017).

Change of degree or program, on the other hand, seems to be similar between the two universities. If we remember that the total number of complex trajectories is 92% at the UOC while at the UV it is 48.6%, it is striking that the difference between the two universities in relation to the change of degree is less than two percentage points. If we consider the differences in student profile (more students working, and with a higher average age at the UOC, and younger and full-time students at the UV), we can expect a more differentiated behavior in relation to the change of degree, with less mobility among students at the face-to-face university.

4.3 Trajectories according to gender and age

In this section we present the results of the different indicators according to the sex and age of the students belonging to the cohorts studied.

Table 3 shows that, at the UOC, both women and men describe complex trajectories in similar proportions: 91% of women and 92.3% of men have trajectories that

would fit into this type. At the UV, the difference between women and men is more notable, at almost ten percentage points: while men present complex trajectories in 54.4% of cases, women do so in 44.8%.

This trend in the data is also reported for persistence: while at the UOC the difference is small between women (19.9%) and men (18.7%), at the UV there is a greater distance between the two groups (5.3% for women and 8.1% for men). It is also striking that persistence is greater among women at the UOC than among the men, in contrast to the UV, where women showed considerably less persistence than men in the period under study.

In summary, in relation to gender, the data suggest that there is a difference between the online university and the face-to-face university. While at the UOC there are no major differences between women and men in most of the indicators, at the UV there is a certain gap in the indicators for the two genders.

For their part, the indicators referring to age were constructed by differentiating between the group of students up to the age of 24, and those aged 25 and over (Table 4). The assumption is that up to the age of 24, the students can be considered to correspond to the profiles that best fit the institutional design (what we have called pathways, as opposed to complex trajectories). In Spain, legislation allows access to university through specific pathways for people aged over 25 years, even if they do not have the minimum qualification required (baccalaureate, or higher vocational education and training). To this effect, the division by age at the threshold between 24 and 25 years allows us to analyze these older groups separately, for whom access ways are more diverse. Last, when comparing a face-to-face university with an online university, this classification makes it easier to observe groups with more similar profiles in relation to their work situation.

In general terms, leaving aside the specific values, the differences in the trajectories of younger and older students show a similar trend in the two universities. We can see that there is a higher proportion of students aged over 25 years who follow complex trajectories, with a higher percentage of total dropout and a special incidence of dropout in the first year. Change of degree and transition to a master's degree is also considerably lower among older students.

If we look at the trajectories within each university, younger students seem to have a greater propensity to change degrees at both the UOC and the UV. This difference is particularly large in the case of the UOC, where 19.2% of younger students change degree, compared to 8.1% of older students.

In relation to total dropout, the percentage of younger students at the UV is striking (27.6%). The total dropout of students aged over 25 years has traditionally been high for various reasons: difficulties in adapting to university study, work-life balance issues, incompatibility with work schedules, etc. However, a majority of students up to the age of 24 years are full-time students, so this total dropout rate seems to indicate that the two trajectories are becoming increasingly similar, raising the question of the factors behind this change among the youngest students.

Table 3 Trajectory indicators by sex of the 2012–2019 cohort. UOC and UV

University	Sex	Complex Trajectories (other than t+ 1)		1st-year dropout		Total dropout		Change of degree		Persistence		Access to master's degree		Total students	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%
UOC	Men	3327	92.30%	840	23.30%	2253	62.50%	407	11.30%	674	18.70%	173	4.80%	3605	100.00%
	Women	3415	91.00%	901	24.00%	2353	62.70%	338	9.00%	747	19.90%	146	3.90%	3753	100.00%
UV	Men	2482	54.40%	862	18.90%	1460	32.00%	452	9.90%	370	8.10%	662	14.50%	4563	100.00%
	Women	3292	44.80%	1396	19.00%	2050	27.90%	595	8.10%	389	5.30%	963	13.10%	7348	100.00%

Source: Complex Trajectories Project

Table 4 Trajectory indicators by age of the 2012–2019 cohort. UOC and UV

University	Age	Complex Trajectories (other than t + 1)		1st-year dropout		Total dropout		Change of degree		Persistence		Access to master's degree		Total students	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%
UOC	Up to 24	1381	91.60%	321	21.30%	966	64.20%	290	19.20%	309	20.50%	98	6.50%	1508	100.00%
	25 and more	5388	92.10%	1416	24.20%	3773	64.50%	474	8.10%	1111	19.00%	228	3.90%	5850	100.00%
UV	Up to 24	4669	47.50%	1769	18.00%	2713	27.60%	934	9.50%	609	6.20%	1474	15.00%	9828	100.00%
	25 and more	1112	53.40%	492	23.60%	802	38.50%	119	5.70%	148	7.10%	148	7.10%	2083	100.00%

Source: Complex Trajectories Project

5 Discussion and conclusions: complex approach to understand students' trajectories

The progress of students throughout their academic trajectories has traditionally been measured by performance indicators, which are widely implemented in higher education systems. These indicators are understood under the framework of academic success parameters and produce (and reproduce) a discourse that associates success with the continuity of trajectories and is institutionally established. In this regard, the analysis of trajectories is usually carried out by academic institutions on the basis of students' changes of status within a single degree program.

The greater heterogeneity of the university population is straining the seams of some of the most established assumptions in higher education institutions. As we have seen with our results, complex trajectories are very present in the two universities studied. Although this type of trajectory in the online university was to be expected, it is striking that in the face-to-face university, complex trajectories represent almost half the total.

The data show high rates of total dropout, as well as dropout in the first year and degree changes at both universities. As we have made clear in the presentation of the results, this is not a phenomenon exclusive to non-traditional (older) students, but is a characteristic that is also very present among conventional students, in a trend that seems to hybridize or resemble what generally happens in online universities (Sánchez-Gelabert, 2020). Another outstanding result is that differences are observed in the trajectories of men and women in terms of persistence, which is lower in the case of women in the face-to-face modality, contrasting with other studies (Ferrão & Almeida, 2018).

The results of our work lead us to reaffirm the idea that we must open a debate on how we consider the trajectories of students in the contemporary university and, on the other hand, on the redefinition of the notions of success and failure in higher education. At the intersection between these two dimensions, it is essential to reinforce the idea that a complex trajectory is not necessarily synonymous with failure. In this necessary debate, the epicenter of the analysis should be the students and their real trajectories to be able to use them to estimate what is the new "normal" in university trajectories. Students may change, pause, combine their higher education studies, or move between different degree programs or different modalities (online and face-to-face), perhaps building a complex trajectory, always under the assumption that it will be successful. Universities can help make complex trajectories more likely to end successfully by strengthening programs and resources to better support more informed decision making vis-à-vis this complexity.

5.1 Limitations and future research

The main limitation of our work involves the available data. It would have been interesting to include more socioeconomic variables to be able to analyze in greater detail the presence of complex trajectories in the different social groups or classes. In this regard, a progressive convergence of Spanish universities in the type of data they collect from students would be desirable.

As for future research, we note some questions that require subsequent investigation. One of the most pressing would be to extensively describe the current trajectories of students in the Spanish university system. While there are an increasing number of studies available (Lassibille & Navarro Gómez, 2009); Villar-Aguilés et al.,

2017; Aparicio-Chueca et al., 2019; Sánchez-Gelabert et al., 2020; Martínez-Carrascal et al., 2023), there is still a need for a broader picture of the trajectories of university students. To this end, we think that a greater temporal depth in the research on trajectories would be interesting (something that would be achievable in case studies of a specific university). A longer time window would allow us to better appreciate whether we are facing a change of trend in the trajectories, while also allowing us to study the extent of the influence of the different economic and political situations. Likewise, we could continue to study complex trajectories within the university according to areas of knowledge, as some other studies on trajectories have done (Diniz et al., 2020).

Another future line of research that emerges from this work is to delve deeper into the greater and lesser gender differences observed. The online modality seems to exert a greater effect of equality in the trajectories of men and women in relation to complexity. This is a result that should be studied in greater detail and from the intersection with other socioeconomic and family components.

Last, as we noted in the description of the methodology, while sequence analysis does not allow us to test hypotheses it is nonetheless a powerful tool to feed future research questions. In this regard, the main question raised by the results of the sequence analysis is the motivations that lead to the different state changes. To answer this question, it is likely that the most pertinent strategy would be to combine it with some kind of qualitative design that could deepen the understanding of the reasons and meanings behind the course and configuration of complex trajectories.

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Authors' contributions

Villar-Aguilés, A.: conceptualization and writing original draft. Muñoz-Rodríguez, D.: formal analysis and writing original draft.

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Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Data transparency

The dataset analysed in this study is available from the corresponding author upon reasonable request.

Competing interests

The authors declare that they have no conflict of interest.

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