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TEACHING MATHEMATICS TO ADULT STUDENTS TO PROMOTE HIGHER EDUCATION ACCESS

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Abstract

The purpose of this paper is to present a model created at a public university with teaching in mathematics for adult students who want to enter undergraduate degrees that require this area for entry. Attentive to the diversity of a group of students with very specific school and professional paths, distinct from those that correspond to the typical university student, new rules have recently been approved for evaluating the ability of students over 23 who do not hold a higher education entrance qualification. We are referring to students who have not gone on to further studies, students from vocational education, students from low-income families, or even students who will be the first in their families to attend higher education. Our unit is a support structure for the acquisition and development of essential skills, within the curricular structure of the courses of this university and has created a list of Preparatory Modules, namely: Topics of Elementary Mathematics I; Topics of Elementary Mathematics II; Geometry and Trigonometry; Logic, Succession, Combinatorial Calculus and Probabilities; Functions and Complex Numbers; Derivatives of Functions and Applications. Successful completion of the Mathematics Preparatory Course in the continuous assessment modality allows the student to use this classification for application purposes, without having to take the written test in mathematics. Our ministry of education, through decree-law 64/2006, of March 21, regulates the special conditions of access and entry to higher education for those over 23 years old without access qualification, regardless of academic qualifications. It is precisely to help create, reinforce and support these students coming from non-traditional paths that our preparatory courses serve. After 3 years of experience, the results are positive and the demand for these modules has increased substantially, and this program of capacitation allowed for the first time these students to have the possibility to enter a course in the areas of management and technology. The typical student who seeks this training offer has very diverse motivations: may be by self-motivated, or for reasons inherent to the professional culture, such as the need to update knowledge, may seek higher education also for certification, or to avoid dismissal, at the employer's suggestion, or even because is obliged by the employer, may also be exploring an area of personal interest that, for various reasons, has not been possible for you until now. Enrolling in a higher education course is a long-term commitment that can only be made by balancing employer, family, self-interest, and identity as a student, therefore it is necessary to create mechanisms to integrate this new public.

Keywords: Adult Students, Mathematics Preparatory Course, Higher Education.

1 INTRODUCTION

According to the agenda of the "Europe 2020" Strategy, one of the main objectives would be to increase the number of graduates in Europe, setting as a goal that about 40% of the European population, aged between 30 and 40 years old, would hold a higher education qualification by the end of 2020 [1].

The access to higher education in the Portuguese education system establishes a diversity of admission competitions and application systems according to the academic qualification for access. These include the special concourse for over 23 years old (M23), regulated by Decree-Law no. 113/2014 of 16 July [2], which establishes the appropriate exams aimed at assessing the capacity to attend a higher education study cycle by over 23 years old, for bachelor's degree or integrated master's degree courses.

This age group includes adult candidates, designated as "Over 23-year-old" (M23), who must comply cumulatively with the following conditions for registration for the M23 Examinations [2]:

- a) reach the age of 23 by 31 December of the year preceding the M23 examinations;
- b) do not have a specific access qualification, that is, be a holder of secondary education or equivalent, and have valid national examinations required as entrance examinations (the conclusion of the 12th grade, or equivalent, by itself, is not considered a qualification for access to higher education);
- c) are not covered by the international student regulations.

It is allowed the enrolment of candidates who, being holders of a higher education degree, do not have access qualification for the study cycle they wish to apply to.

In addition, Decree-Law no. 64/2006 of 21 March [3] establishes the legal regime of assessment of capacity to attend higher education courses for M23 students without access qualification, namely regarding the specific exams intended to assess the capacity to attend higher education. This legal norm also entrusts higher education institutions with the responsibility of creating specific regulations, framing the assessment procedures that the new access modality recommends.

The entrance examinations are written or oral and are organized for each study cycle or groups of related study cycles and have as a reference the knowledge and skills corresponding to the secondary education level in the relevant areas for each study cycle. These same tests may also be complemented with interviews to the candidates in order to assess their school and professional experience, their personal motivations and capacities to attend the course they are applying for. In this context the higher education institutions should recognize, through the attribution of credits in their study cycles, the professional experience and training of those who are admitted through the exams [3].

The exams are organized by each higher education institution, on an annual basis and according to a previously established calendar, and the whole process is managed by an appointed jury.

The higher education institutions are also responsible for determining annually a number of vacancies for the application to the matriculation and enrolment of the M23 candidates approved in each course, which cannot be less than 5% of the number of vacancies established for all the courses of that education institution for the general access regime (candidates coming from secondary education, via education) [3].

1.1 The adult, mature or non-traditional student in higher education

According to OECD data for 2019, 25% of the Portuguese population aged 25 to 64 had completed secondary education; 26% have the 4th grade or less, 7% had a bachelor's degree, 18% a master's degree, and 1% a doctorate [4]. We aim to change these demographics.

The concept of adult student, in the context of Higher Education (HE), is not easy to establish a clear demarcation, as opposed to what is considered a normal HE student, young, middle-class, with a regular school career [5]. A number of authors also refer to the term "non-traditional students" as a broader term which considers older students, students from lower economic backgrounds, students from cultural minorities or the first in the family to attend HE [5] [6].

Adult students, in the context of HE, can be characterized as those individuals who incorporate a non-linear educational pathway, using alternative forms of access to HE, who study, sometimes part-time, and divide their time between professional, family and academic activities and responsibilities [5] [6].

1.2 The demand for higher education by non-traditional students

There has been a global trend towards a transformation in the demand for higher education by new groups, usually adults without a university degree, who want to start (or return to) their academic pathway in HE institutions, in order to be able to tackle all the changes and demands that occur in their lives and ever-changing work environment [5] [6].

The typical student who seeks our training offer has very diverse motivations: he/she may be self-motivated, or come for reasons inherent to his/her professional culture, such as the need to update knowledge, seeking higher education also for certification, or to avoid dismissal, at the employer's suggestion, or even because he/she is obliged by the employer. They may also be exploring an area of personal interest that, for various reasons, has not been possible for them until now. Enrolling in a higher

education course is a long-term commitment that can only be made by balancing employer, family, self-interest, and identity as a student [6].

It is precisely to help create, reinforce, or regain that student identity for individuals coming from non-traditional paths that our preparatory courses serve. We are talking about students who have been away from formal education for years, over 23s, students from low-income families, or even students who will be the first in their family to go to higher education [7].

The term of "non-traditional students" includes the M23 as established by Decree-Law No. 64/2006 [3], of 21 May 2006, which regulates their access to Higher Education (HE), thus replacing the former 'ad hoc' access concourse. Although, the presence of adult students in ES has already a considerable historical evolution, the current economic, social and demographic circumstances demand from higher education institutions initiatives focused on these students, namely access support, reception and promotion of academic success besides seeking to understand other social, cultural, psychological and financial factors, which impact on their path as students [8],[9].

2 LEARNING OFFER IN MATHEMATICS TO SUPPORT ACCESS TO AND SUCCESS IN HIGHER EDUCATION

A significant number of students in Higher Education in scientific areas where mathematics is one of the basic competences for successfully developing their academic path, frequently have gaps in elementary and intermediate level mathematics topics.

In the case of students starting or re-entering higher education, this difficulty is more significant due to the intrinsic characteristics of this student profile. It is therefore essential to improve and strengthen the mathematical skills and knowledge of these students in order to enable them to access higher education and provide essential resources to attend higher education courses [8],[9],[10].

2.1 Structure of the preparatory mathematics modules

Iscte - Instituto Universitário de Lisboa (Iscte) is a Portuguese public higher education institution of the university subsystem. Its educational offer in the first cycle of studies covers Social Sciences and Humanities, Sociology and Public Policies, Management, Technologies and Architecture and Digital Technologies Economy and Society, being therefore high on demand by M23 candidates. In this sense, the Iscte, aware of the demand for students with very specific school and professional paths, different from those corresponding to the typical university student, has been acting on two lines.

At first, it has regulated the rules for the assessment of the capacity for admission of those over 23 who do not hold a higher education access qualification, through Regulation No. 137/2020, which structures the assessment process for higher education attendance of M23 [11], defining its assessment components, namely:

- a) a written test on Literacy, common to all the bachelor's degree courses and integrated master's degree courses of Iscte;
- b) a specific written exam in mathematics or descriptive geometry, for the bachelor's degree and integrated master's degree courses, for which those exams are required in the National Access Contest;
- c) an individual interview.

Secondly, Iscte has designed a formative offer of preparatory courses, specific for M23 candidates to take, with a double objective: i) to prepare candidates for the corresponding M23 access exams and ii) to promote academic success for their future academic path. These preparatory courses include:

- the Academic Writing and Critical Thinking course for all M23 candidates who intend to apply to an Iscte degree;
- the preparatory courses in Mathematics for M23 candidates who wish to apply to an Iscte degree in the areas of Management or Engineering in degrees that require mathematics tests.

The preparatory courses in Mathematics for M23 candidates are structured in two levels, elementary and advanced, and are usually organized each academic year with one or two classes in evening hours and in two modalities: regular and intensive (only for the advanced course).

Each module includes 30 hours of contact time and about 30 to 45 hours of independent work, depending on the level, elementary or advanced. The preparatory modules are as follows:

- Elementary Mathematics Preparatory Course - this course is composed with two modules - Elementary Mathematics Topics I and II - which covers contents from elementary school, which are essential for the student to be able to follow with some confidence the modules of the advanced preparatory course.
- Advanced Mathematics Preparatory Course, - is made up of four modules covering the contents of secondary school, essential for the student to be able to follow courses in the area of Mathematics in the course he/she intends to enter, this course comprises: Geometry and Trigonometry; Logic, Sequences, Combinatorial Calculus and Probabilities, Functions and Complex Numbers and Derivatives of Functions and Applications.

2.2 Students' self-assessment of their mathematical skills

Another method also important to plan and develop a training offer for the development of mathematical skills is to get students to identify and recognize what their main gaps and difficulties are in a set of topics and themes of mathematics [12] [13].

In this regard the Soft Skills Lab is also developing an online course that will allow students to perform a self-diagnosis in each of the mathematics topics, positioning themselves at a certain level of knowledge and selecting which preparatory modules to attend and that best suit their level [12].

This course will be free, without time and access restrictions. Each student will be able to freely manage the learning path according to his/her needs and/or availability. Its purpose is also to clarify doubts, stimulate self-learning and improve mathematical competences in a different format from traditional face-to-face classes [12],[13].

The course is designed with multimedia materials in video support, comprising demonstration and detailed explanation of mathematics topics and exercises, followed by the delivery of solved and unsolved application exercises, concluding each module with a short formative test, providing the student with a formative assessment for that same module. The set of formative assessments will assign a score of the level of knowledge, advising the student on the enrolment of a preparatory course or module according to that score [12],[13], [14].

3 A COMMUNICATIONAL APPROACH IN THE STUDENT RECRUITMENT PROCESS

Considering the target audience, M23 candidates, and their characteristics, the process of disseminating the preparatory courses, as well as the entire timetable and application procedures for the entrance examinations, has as its main challenge to capture individuals who have been away from the academic environment for several.

One of the main dissemination and information channels is the Iscte website, with a page dedicated to the M23 applicants' segment, where the general and specific requirements are described, as well as the courses and number of places allocated, the schedule, registration and contents of the entrance examinations, the evaluation process and the examination results.

In parallel, the site also has a page dedicated to the preparatory courses, informing about their availability, timetables and modality, the corresponding vacancies and fees. It also has an online registration mechanism for the courses.

Considering the data from 2021/2022, most of the applicants got their information about the M23 contest online (45%), mostly through Iscte's website, with its special pages dedicated to the contest and the preparatory modules, mentioned before.

Another important part when it comes to the communication of this special contest is the word of mouth. About 30% of our applicants last year heard about the M23 contest from friends, family, or even work colleagues.

Given the target audience, we considered the social networks as a promotion channel, with emphasis on Facebook, launching since the beginning of the action a total of 96 posts, comprising of information for each preparatory course, and enrolling calendar, always establishing a message of personal appreciation in academic terms. This dissemination has appealed to the individual's life path and the

added value that higher education creates for the individual, and what the individual may bring to the institution itself, as an agent for the creation of knowledge in a constructivist perspective. In the advertisement on Facebook, it is recognized that the potential candidate has a life path different from the standard university candidate, as possibly being someone employed full time, with work experience, and someone, unlike the majority of his colleagues on this degree does not live with parents and may have descendants and we are reaching specifically for these non-conformant students because they add value to the school community. There is a very large variation in the reach of the posts, as we do not use paid advertising, reaching organically large variations from 80 to 1700 people.

Another mean of dissemination we use is video testimonials on Facebook and Instagram from students who have attended the preparatory modules and are currently Iscte students. This form of dissemination is very effective because it comes from the heart and is very true: the students who give us their testimonies do so with great enthusiasm, because it has been a positive experience for them, and this reflects on their message, which helps us attract new students. One of the young people in the testimonials even mentioned that the Preparatory Mathematics Modules gave him an above-average preparation that allows him to explain the subject to his colleagues from the National Entrance Exam.

We also consider relevant to bring the M23 candidates for a first contact with the campus, organizing presentation and clarification sessions about the competitions and preparatory modules.

4 METHODOLOGY

Over the three years that the preparatory courses in mathematics have been on offer, we have been collecting some data to characterize the M23 candidates who apply to the Iscte courses and, at the same time, to assess the evolution in terms of demand. For that purpose, we have identified the number and age of the enrolled applicants.

5 RESULTS

The results obtained from the data collection show a significant evolution in the number of candidates in each module, as shown in Table 1.

Table 1. Candidates enrolled by module and academic year

Module	2018-2019	2019-2020	2020-2021	2021-2022
Elementary Mathematics Topics I	0	37	37	72
Elementary Mathematics Topics II	0	43	36	64
Geometry and Trigonometry	52	88	103	108
Logic, Sequences, Combinatorial Calculus and Probabilities	52	89	98	102
Functions and Complex Numbers	50	131	91	94
Derivatives of Functions and Applications	50	91	84	89

Overall, there is a growing trend in the number of candidates and enrolled in the different mathematics modules, which demonstrates that there is demand for this training offer and at the same time candidates recognize its attendance as a success factor for taking the mathematics entrance exam.

We can also conclude that there are some students who tend to drop out throughout the advanced mathematics modules, as the difficulty increases with each module. It is visible that more students always start in the Geometry and Trigonometry module than those who end up being able to finish all four modules (with the exception of 2019-2020 where the Functions and Complex Numbers module was also offered in the 1st semester and where the classes were quite larger than usual since the classes

were taught online because of Covid-19). In the last two years, there has been a "drop out" of about 18% between the first advanced mathematics module and the last.

6 CONCLUSIONS

This study focused mainly on the students who entered the Iscte through the M23 special access program, in the period between 2018 and 2022.

From the institutional point of view, it is important to (re)think how adult students, "non-traditional students", are welcomed and integrated into the academic context in order to overcome the natural difficulties of adaptation and to capitalize on their personal and professional experience as students. In response to a set of problems that the diversity of students presents in the context of higher education, a program of preparatory courses was developed in the mathematics area, in order to overcome the difficulties felt by candidates to higher education. This training offer, due to its comprehensiveness in terms of knowledge, allows future higher education students to change their perception of how they learn mathematics, influences study habits and promote academic success from an early age.

Another key aspect in designing a training offer to support mathematics learning is the diversity of the resources that are available, considering the socio-professional characteristics of adult students. In this sense, and similarly to other university projects supporting mathematics education (mathematics learning support), resources for self-training and formative self-assessment should be developed, providing candidates with a standpoint on the previous level of knowledge, which allows them to adjust the level of entry to preparatory courses [13].

Another aspect not developed in this paper, but very relevant is the pedagogical capacity of the teaching staff to teach the group of adult students, or non-traditional students, who at the entrance show low levels of confidence in their mathematical abilities (mathematical confidence) and therefore require a differentiated learning pace, multiple explanatory approaches and very regular monitoring and feedback [12] [14].

REFERENCES

- [1] C. Vilhena, "As transições para o Ensino Superior: problemas e desafios atuais" in *Estudantes não-tradicionais no Ensino Superior* (António Fragoso, Sandra Valadas eds.), 39-58, Coimbra, /CINEP, 2018.
- [2] Decreto Lei nº. 113/2014 de 16 de julho Concursos especiais. Retrieved from <https://files.dre.pt/1s/2014/07/13500/0387403878.pdf>
- [3] Decreto-Lei n.º 64/2006 de 21 de março. Retrieved from <https://files.dre.pt/1s/2006/03/057a00/20542056.pdf>
- [4] OECD. Education at a Glance 2020. Oecd Publishing; 2020.
- [5] A. Fragoso, S. Valadas, "Dos "Novos Públicos" do Ensino Superior aos estudantes "não tradicionais" no Ensino Superior: contribuições para a construção de um breve mapa do campo" in *Estudantes não-tradicionais no Ensino Superior* (António Fragoso, Sandra Valadas eds.), 19-38, Coimbra, /CINEP, 2018.
- [6] L. Santos; H. Quintais, "Como potenciar a participação dos estudantes M23 no ensino superior?" in *Estudantes não-tradicionais no Ensino Superior* (António Fragoso, Sandra Valadas eds.), 103-124, Coimbra, /CINEP, 2018.
- [7] Merrill B, Tett L. Access retention and withdrawal: A European perspective. Routledge, editor. *Studies in the Education of Adults* [Internet]. 2016 Jan 21;45(2):115–8. Available from: <https://doi.org/10.1080/02660830.2013.11661645>
- [8] A. Cabral, L. Dias, N. Neves, M. Gomes, H. Mateus, "Estudantes maduros nas universidades: reflexões sobre a ligação entre o ensino superior e o mundo do trabalho – um estudo de caso na Universidade de Aveiro" *Revista Politécnica*, Dezembro, 20, 63-96., 2013. Retrieved from https://comum.rcaap.pt/bitstream/10400.26/6473/1/Revista%20Politecnica_n20.pdf.
- [9] A. Cabral, L. Dias, N. Neves, M. Gomes, H. Mateus, "Aprendizagem ao longo da vida: a experiência com alunos M23 no ISPGaya" *Revista Politécnica*, Dezembro, 20, 57.-62., 2013.

Retrieved from

https://comum.rcaap.pt/bitstream/10400.26/6473/1/Revista%20Politecnica_n20.pdf.

- [10] Sousa, C. M. de O. e. (2012). Universidade e aprendizagem ao longo da vida: Efeitos da licenciatura em indivíduos com prévia experiência profissional [Dissertação de mestrado, Iscte - Instituto Universitário de Lisboa]. Repositório Iscte. Retrieved from <http://hdl.handle.net/10071/5477>
- [11] Iscte, Regulamento n.º 137/2020 - Processo de avaliação para frequência do ensino superior dos maiores de 23 do ISCTE — Instituto Universitário de Lisboa., 2020. Retrieved from <https://files.dre.pt/2s/2020/02/035000000/0021300219.pdf>
- [12] M. Pacheco, A. Pereira, F. Fernandes, “MathE - Improve Mathematical Skills in Higher Education”, ICEIT 2019: Proceedings of the 2019 8th International Conference on Educational and Information Technology. 173-176., 2019. Retrieved from <https://doi.org/10.1145/3318396.3320116>
- [13] E. Ní Fhloinn; M. Carr, “Mathematics Learning Support in Higher Education” in *Docência da Matemática no Ensino Superior* (Carla Fidalgo eds.), 5-28, Coimbra, /CINEP, 2021.
- [14] M. Emília Bigotte de Almeida, J. Branco, C. Fidalgo, “Integração dos Estudantes no Ensino Superior: Centro de Apoio à Matemática na Engenharia (CeAMatE)” in *Docência da Matemática no Ensino Superior* (Carla Fidalgo eds.), 29-49, Coimbra, /CINEP, 2021.