The Use of Microlearning as a Complement to Face-to-Face Classes to Reduce Dropout and Improve Academic Success in Higher Education Mathematics

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Abstract. This paper highlights the importance of integrating microlearning and digital education as complementary strategies to combat classroom dropout and enhance academic success in higher education mathematics in Portugal. The study proposes the implementation of microlearning, focusing on fundamental concepts, as a key tool for learning recovery. The implementation of microlearning and digital education will be carried out in three phases: Short videos addressing key concepts, will be created using a visual and concise approach to facilitate student comprehension. These resources will be made available on an online platform accessible to students. The videos will be incorporated as supplements to mathematics face-to-face classes. Students will have access to the videos before the classes, allowing them to prepare and review concepts in advance. Quantitative and qualitative data will be collected on dropout rates, academic performance, and student feedback. Regular assessments will be conducted to measure the effectiveness of this strategy. It is expected that the integration of microlearning will provide students with a flexible and accessible way to review concepts, fill knowledge gaps, and reduce classroom dropout rates. The use of microlearning resources is anticipated to lead to a significant increase in students' academic performance, resulting in higher final grades. It is expected that students will appreciate the convenience of microlearning videos, allowing them to learn at their own pace and review content according to their individual needs. The implementation of microlearning and digital education as supplements to face-to-face classes represents a promising strategy to address the challenges of classroom dropout and academic success in higher education mathematics in Portugal. This approach aims to create a more inclusive, flexible, and effective educational environment, benefiting students and promoting academic success. Ongoing research and evaluation will be essential to adapt and enhance these strategies over time, ensuring they meet the ever-evolving needs of students.

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1 Introduction

Teaching Mathematics in higher education has been a constant challenge for today's teachers and students worldwide. In Portugal, with the growing demand for accessibility to higher education, effective preparation for entrance exams, such as special competitions for students over 23 years of age, becomes a pressing need. Furthermore, it is essential to offer opportunities to recover and review essential mathematical concepts for students entering the 1st year of any Higher Education Institution that has Mathematics curricular units in its courses. This article describes the development of small e-learning modules, following the microlearning approach, focused on the topic of introducing mathematical functions. These modules were created with the aim of helping students prepare for entrance exams and review fundamental concepts in Mathematics.

According to Salleh, Khairudin and Ibrahim (2022), the microlearning approach can increase students' interest in learning and consequent participation in the classroom, making it an extremely useful tool for both teachers and students.

Microlearning is a type of online learning approach that is characterized by transmitting small doses of knowledge in a short period of time based on flexible digital educational resources (RED) that allow students to access them from anywhere and in any situation, including on the move. This concept results from the meaning of the word itself: micro (small, reduced) learning. In other words, it is a learning method in which the content is delivered objectively and focused on a single piece of information.

One of the biggest positive features of microlearning is its ability to divide the complex content of a course into smaller blocks of content that are easy for the student to understand.

E-learning, especially in the form of microlearning, offers a flexible and affordable solution to address these challenges. Short, targeted learning modules can be a valuable tool for preparing students and reinforcing key concepts.

However, the division of content, especially in higher education, is also a great challenge for teachers who have to prepare this type of materials, with their research and publications growing worldwide. (Leong et al. 2020).

2 Methodology

The e-learning modules developed for this project focus on the topic of introducing real variable real functions. Each module addresses a specific concept, such as starting set, arrival set, domain, codomain, among others. They are designed to be self-explanatory, with short videos, interactive exercises, and assessments to monitor student progress.

The microlearning approach allows students to access these modules according to their needs and convenience, whether to review a specific concept or for more comprehensive exam preparation. The modules are accessible through online platforms, making them easily available to students across the country and, for now, the official language is Portuguese.

The design of this digital tool, available to students entering courses at the Polytechnic of Lisbon, recognizes the importance of pedagogical innovation and the development of new methodologies in higher education. These microlearning modules aim to promote individual autonomy in the teaching and learning of Mathematics, thus contributing to reducing dropout rates and increasing the success rate in the first year of entry into any of the courses.

The analysis, design, development, implementation, and evaluation (ADDIE) methodology was used to define the stages of creating these modules. According to Muruganantham (2015), ADDIE is based on five different stages: 1) Analysis (of the social and data context, study of other similar digital learning course offerings); 2) Design (definition of objectives and the pedagogical strategy to be used; selection of technological resources); 3) Development (content design, image selection and selection of digital educational resources to be used); 4) Implementation (application of the instructional design proposal and provision of learning resources); 5) Evaluation (usability test), as can be seen in figure 1:

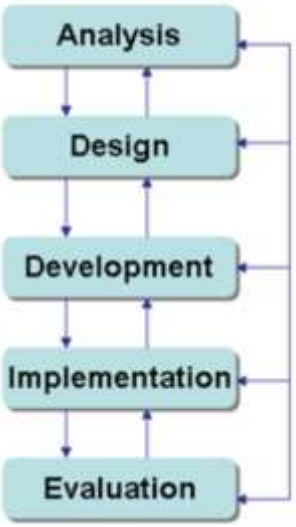

Fig. 1. ADDIE methodology

The result of this project is a set of Mathematics microlearning modules available completely online and of short duration, interactive, specifically designed for students who wish to access higher education and university students who wish to consolidate some fundamental concepts. Students will be able to define their own learning pace.

They all start with a video, with a maximum duration of 5 minutes. Figure 2 shows the initial graphic image of the videos:

Fig. 2. Development: multimedia design

The course structure is based on short conceptual videos, measurable exercises with immediate feedback and final assessment tasks.

The concepts covered are simple and always accompanied by graphics that illustrate them. As shown in figure 3:

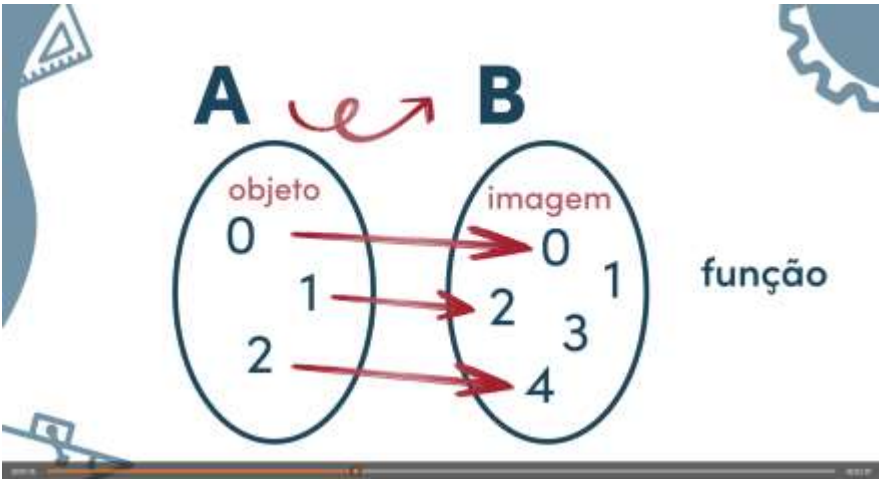

Fig. 3. Example

3 Result and discussion

These modules are being incorporated as a complement to face-to-face mathematics classes. Students have access to the videos before classes, allowing them to prepare and review concepts in advance.

The presence of students in classes is being recorded, with participation in the first assessment moment serving as a metric, in order to monitor the retention rate in assessments, which will be obtained through the quotient between the number of students who complete the assessment and the number of students present at the first moment of assessment, consequently obtaining the dropout rate from the curricular unit and a measure of the students' academic performance.

To understand the effectiveness of implementing this strategy, teachers collect feedback from students in class, which is complemented with regular assessments, through exercises proposed also in microlearning format.

While the project is still ongoing, it is believed that students appreciate the convenience of microlearning videos, which allow them to learn at their own pace and review content according to their individual needs.

According to Kadhem (2017), it is expected that the integration of microlearning will provide students with a flexible and accessible way of reviewing concepts, filling knowledge gaps and reducing class dropout rates, contributing to an increase in students' academic performance. , reflected in higher final grades and lower dropout rate.

This Digital Educational Resource (RED) project is aligned with the United Nations objectives for Quality Education (Sustainable Development Goal 4 - SDG 4) and contributes to increasing knowledge on the topic under study and to pedagogical innovation in teaching higher. It is expected to have a replication effect, encouraging other teachers to develop differentiated teaching resources and pedagogical models.

According to Martinho and Carvalho e Silva (2023), the implementation of digital education as a complement to face-to-face classes represents a promising strategy to face the challenges of dropping out of classes and academic success in higher education in mathematics in Portugal. This approach aims to create a more inclusive, flexible, and effective educational environment, benefiting students and promoting academic success. Ongoing research and evaluation will be essential to adapt and improve these strategies over time, ensuring they meet students' evolving needs.

With the implementation of these e-learning modules, several benefits are expected: (i) Effective preparation for exams: students preparing for entrance exams will have access to specific learning resources that will help them consolidate their knowledge about functions real variables. (ii) Review of essential concepts: students who entered the normal regime can use these modules to review fundamental mathematical concepts, reinforcing their knowledge base. (iii) Accessibility: the online nature of the modules makes them easily accessible to students from different geographic locations, reducing barriers to learning. (iv) Flexibility: modules can be studied at any time and place, allowing students to adjust their learning according to their schedules.

4 Conclusion

The development of mathematics e-learning modules represents a significant effort to improve entrance exam preparation and review of essential concepts. The microlearning approach offers a flexible and effective way to support students in higher education. At the end of this academic year, the results of this project will be evaluated, and it is expected that these modules will benefit both candidates for higher education entrance exams and students seeking to reinforce their understanding of Mathematics, thus contributing to a more accessible and effective higher education.

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