MATEAS – MAthematics: TEaching and ASsessment on higher education

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Research and development

The thematic line MATEAS has two main goals:

- Promote dialogue and make visible the experiences on teaching and assessment on higher education in Mathematics and curricula development taking human cognition into account
- Research, development and application of information technology for autonomous learning and assessment in Mathematics

For the first goal we organize a monthly seminar, inviting speakers from Portuguese and foreign higher education institutions, and film the talks, making them available on the Web site mateas.wikidot.com:

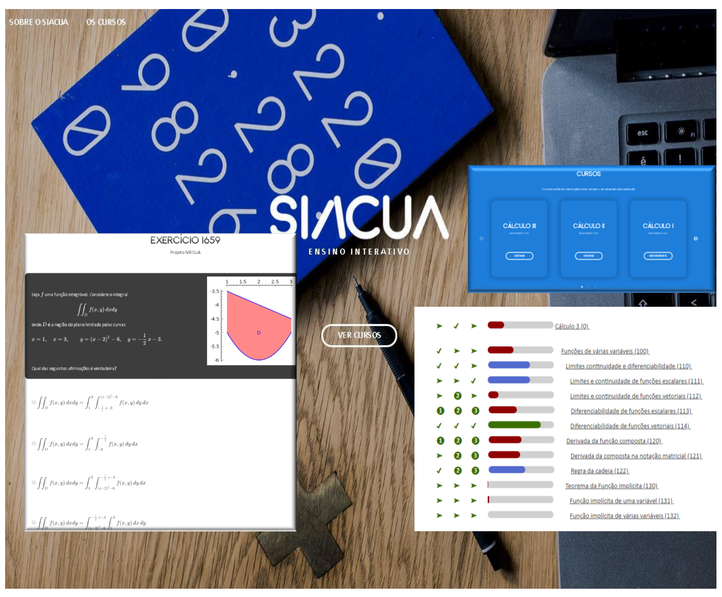
The most relevant activity in the second goal is the combined use of three computer systems developed in our University: MEGUA for parameterized contents creation, SIACUA for presenting contents and providing feedback and PmatE for assessment.

Methodologies combining the three systems are particularly useful in flipped learning and we have used them in several contexts.

We aim to continue the development and improvement of the systems and contents in Portuguese for helping mathematics learning, in order to achieve an useful and easy to use way of keeping students working during the semester, focusing mainly, but not only, in parameterized questions and intelligent feedback.

For more detailed information about the thematic line MATEAS including a list of publications for the period 2013-2018 see http://mateas.wikidot.com/mateas-cidma

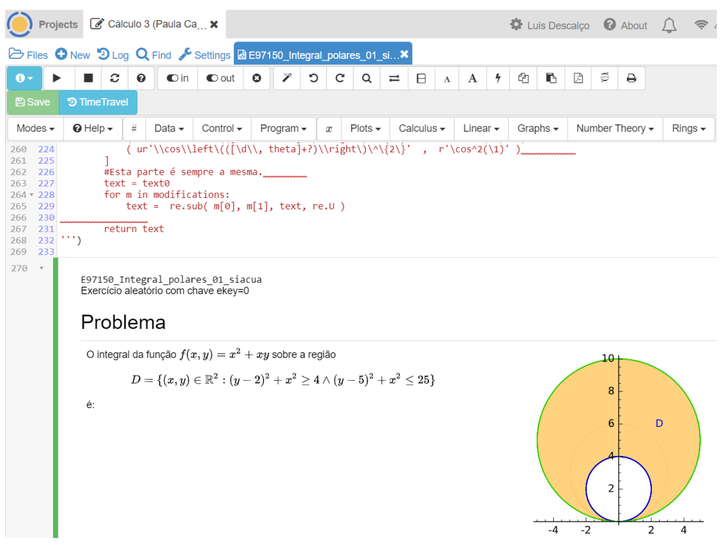
Autonomous learning



SIACUA is a Web application for presenting the contents created and providing feedback in the form of progress bars, computed by using a Bayesian user model. It contains parameterized questions from basic school to calculus (more than five thousand for higher education), and also videos and other contents.

Parameterized questions

MEGUA consists of a package and functionalities for creating and sharing parameterized questions with detailed parameterized solutions using Sage Mathematics and CoCalc.



In CoCalc, using MEGUA, parametrized questions are created with HTML, Python, LaTeX and Sage Mathematics, and are easily shared between teachers and exported to the learning and assessment systems SIACUA and PmatE.

Parameterized questions are interesting for several reasons:

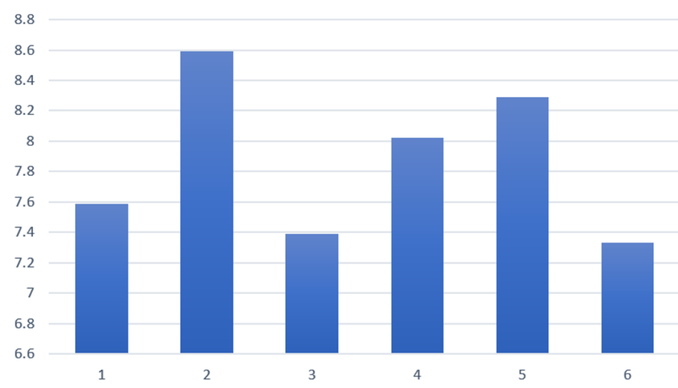
- different students can answer different questions generated by the same Model, and so very similar, which is useful for assessment, when students are seated side by side;
- the students can answer similar questions where parameters have different values, which makes clear what is essential in the question and not dependent on the parameter values;
- the teacher can think on a general model for a question instead of reusing questions from previous exams doing small changes, what is a repetitive and time consuming task teachers otherwise have to do.
- the development of correct and elegant parameterized questions with minimum effort is an interesting and useful research subject.

There is a long tradition of using parameterized questions in our university. Project PmatE exists from 1989 and is well known for the national science competitions that occur every year in our University with thousands of students from many schools in the country.

Hence, the assessment platform is very robust and we have been using it for assessment in higher education.

We have made several improvements in the systems and their integration during the years 2013-2018, developed many contents, applied the systems in several contexts and published results in journals and conferences.

The continuous development has taken into account the feedback from several surveys. The last questionnaire, answered by 104 students of Calculus 2018/2019, has shown that these methodologies are considered useful for studying:



1- Quizzes for assessment during the semester
2 - Parameterized questions with detailed solutions
3 - Progress bars for feedback
4 - Contents 1 (prerequisites), 2 (introduction), 3 (references)
5 - Very short introductory videos
6 – PmatE assessment tests
(scale: 1-10)

Collaboration and further work

We plan to continue collaboration with other departments of our University, Portuguese researchers in the field and also the international collaboration with UFRGS initiated in 2015, the institution with one of the largest programs on computers in education, in the Portuguese speaking world (the language has naturally relevance in the contents for first year students). Our research is focused mainly but not exclusively on two topics:

- Creation and use of parameterized contents for mathematics learning and assessment
- Using Bayesian networks and other artificial intelligence tools on systems for learning mathematics

Web sites:

MATEAS: mateas.wikidot.com
SIACUA: siacua.web.ua.pt
MEGUA: megua.ua.pt
PmatE: pmate.ua.pt