Problem-based learning in a computer engineering program: structure, evaluation and lessons over 20 years

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INTRODUCTION

Problem-based learning has grown in interest in various undergraduate programs, including Computing programs. Despite the advances in this field, most related work limits their discussion to punctual elements, like particular courses or assessment models (S. C. Santos et al., 2020). This work focuses on a broad evaluation of PBL implementation in the Computer Engineering program at the State University of Feira de Santana, Brazil, over a timeframe of 20 years.

The program has functioned since 2003, and has a five-year curriculum with 3,600 hours. In the curriculum, nine interdisciplinary core courses are based on PBL, currently covering the core of Computer Engineering topics and amounting to 450 hours. The program is based on a hybrid model in which each PBL course has at least one associated conventional course. PBL practice happens in small groups of up to twelve students and a tutor allocated to each group.

This work presents a historical panorama of the deployment of our PBL model, explores students' perspectives on PBL, and synthesizes five learned lessons related to its benefits, challenges and successes.

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METHOD

In this work, we carried out document-based research, including internal (formal and informal) assessment and institutional documents. We also considered previous research on our PBL model and our perceptions on its evolution.

RESULTS AND DISCUSSION

First, we provide a historical overview of the program and divide its 20 years of existence into four phases:

1. Learning phase (2003-2007): the program was starting out and faculty members (i.e. tutors) were learning how to put PBL into practice based on a few bibliographical references and various trial-and-error attempts. Tutors frequently discussed PBL, both informally and formally. In addition, the program's lead team offered training courses for new tutors;
2. Ascension phase (2008-2012): the faculty better understood PBL and started developing research about it as well as giving lectures and presentations on the topic in different contexts. They also started new actions: regular meetings to discuss PBL among faculty and students and setting up a commission to assess PBL. New tutors continued to be hired;
3. Establishing phase (2013-2017): tutors gained confidence and the PBL assessment commission made regular evaluations, identifying positive results and minor issues. Moreover, the tutoring group stabilized;
4. Critical phase (2018-2022): faculty started directing their attention to other emergent program issues such as student dropout and ceased to discuss PBL with the same intensity as earlier. The nine PBL courses are still kept in the curriculum, but their workload decreased from 690 to 390 hours over the years after successive curriculum changes.

Second, we explored the students' perspectives (D. M. B. Santos et al., 2018), noting that while students generally showed high satisfaction with PBL, they considered it time-consuming and reported difficulties to adapt to PBL as well as issues related to grading. Nevertheless, they value PBL as the program's differential factor, since it provides a more holistic educational process.

There are five key lessons learned during this period: 1) institutional support is crucial to allow classes with a reduced number of students; 2) continuous teacher and student development courses are needed to clarify PBL practices, its structure and benefits, 3) PBL assuredly helps students to develop soft skills; 4) being a tutor is not a simple task as it seems at first; 5) evaluation and discussion are fundamental to mature a PBL learning approach.

CONCLUSION

Overall, we conclude that PBL is consolidated as a critical element of the UEFS Computer Engineering program's structure. However, it faces challenges to its maintenance. Among them, we highlight the need to identify new gaps for continuous professional development of current and new tutors, issues caused by the Covid19 pandemic such as increasing dropout rates, the use of generative AI tools such as ChatGPT in the PBL context, and the difficulties associated to student assessment.

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