

Navigating the transition: Empowering engineering students to conquer university mathematics with an online course

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Problem Statement

Regardless of the prior background, a common challenge faced by first-year engineering students, regardless of their prior background, is bridging the gap with university mathematics. This is evidenced by the literature (e.g., Gallimore & Stewart, 2014) as well as the positive effects of bridging courses (e.g., Jura & Gerhardt, 2022; Robeva et al., 2022). Research indicates that students often struggle due to teachers' unawareness of their background level (Metje et al., 2007) and experience a high failure rate in mathematics courses (Mastoi et al., 2021; Nortvedt & Siqveland, 2018), often leading to students dropping out of the program (Meyer & Marx, 2014). This poster presents an online bridging course designed to help students move from pre-university to university-level mathematics. The course includes assessments to determine the student's level of knowledge, and support systems to ensure the successful transition.

The Bridging Course

The bridging course covers fundamental mathematics for engineering students, including algebra, equations, functions, graphing, exponents, logarithms, trigonometry, and basic calculus like limits, differentiation, and integration. It is delivered online in two phases (Figure 1). The **testing phase** focuses on key university mathematics topics and identifies common misconceptions using literature review and team expertise in mathematics education.

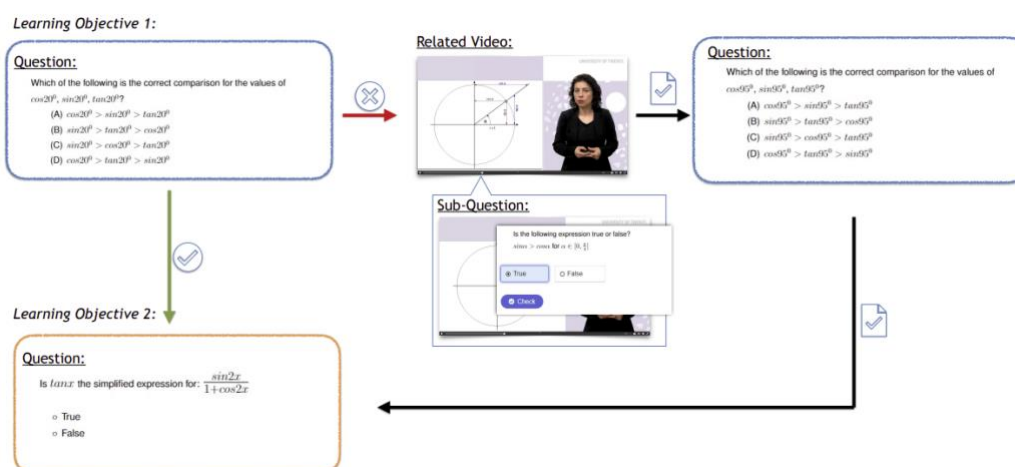


Figure 1: Illustration of the bridging course

Questions in the testing phase are followed by feedback for students, while the **instructive phase** offers educational online resources such as activities, tutorials, videos, and more questions with

tailored feedback. The **instructive phase** is designed to address specific mistakes made during the **testing phase**, and the two phases are seamlessly integrated.

Expected Results

This online mathematics course has dual goals: short-term and long-term. In the short term, it helps students identify and strengthen their mathematical weaknesses, aiding their readiness for university-level mathematics. It also provides teachers with insights into students' mathematical knowledge and progress during their first year. In the long term, it establishes a sustainable online platform to support students' transition to university and track their mathematical proficiency. Besides, implementing this online course aligns with our university's goal of fostering student-driven learning. It empowers students to take charge of their education, build autonomy, and receive the necessary support and motivation to steer their academic journey. Our poster focuses on the short-term outcomes due to the project's timeline, set to commence at the start of the next academic year.

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References

- Gallimore, M., & Stewart, J. (2014). Increasing the impact of mathematics support on aiding student transition in higher education. *Teaching Mathematics and its Applications*, 33(2), 98–109. <https://doi.org/10.1093/teamat/hru008>
- Jura, M., & Gerhardt, I. (2022). Examining the effectiveness of an online summer bridge course to prepare students for Calculus, *PRIMUS*, 32(7), 755–763. <https://doi.org/10.1080/10511970.2021.1919256>
- Mastoi, S., et al. (2021). A Statistical analysis for mathematics & statistics in engineering technologies (Random Sampling). *International Journal of Management*, 12(3), 416–421. <https://ssrn.com/abstract=3820468>
- Metje, N., Frank, H., & Croft, P. (2007). Can't do maths: Understanding students' maths anxiety. *Teaching Mathematics and Its Applications*, 26, 79–88. <https://doi.org/10.1093/teamat/hrl023>
- Meyer, M., & Marx, S. (2014). Engineering dropouts: A qualitative examination of why undergraduates leave engineering. *Journal of Engineering Education*, 103(4), 525–548. <https://doi.org/10.1002/jee.20054>
- Nortvedt, G. A., & Siqveland, A. (2018). Are beginning calculus and engineering students adequately prepared for higher education? An assessment of students' basic mathematical knowledge. *International Journal of Mathematical Education in Science and Technology*, 50(3), 325–343. <https://doi.org/10.1080/0020739x.2018.1501826>
- Robeva, R., Comar, T. D., & Eaton, C. D. (2022). Can we bridge the gap? Mathematics and the Life Sciences, Part 1–Calculus-Based Modules, Programs, Curricula. *PRIMUS*, 32(2), 117–123. <https://doi.org/10.1080/10511970.2022.2025506>