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BEYOND CONTENT REMEDIATION: REDESIGNING A FIRST-YEAR ENGINEERING MATHEMATICS WORKSHOP

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ABSTRACT

Mathematics bridging courses are a widely used strategy to support students' transition into engineering programmes. Traditionally, these initiatives have prioritised the reinforcement of mathematical content, whereas recent frameworks for engineering mathematics education propose broadening this focus towards the development of mathematical competencies that enable students to understand, use and communicate mathematics in disciplinary and professional contexts ([3]; [5]). Against this background, this paper describes the redesign process of the Logical and Mathematical Aptitudes Workshop (TALM), a compulsory course within the engineering curriculum of a Chilean university, aimed at first-year students, whose initial instructional design, grounded in the diagnosis of incoming students' mathematical gaps, was previously presented by Arce et al. ([1]). Following its implementation, the course evolved from a content-centred remedial model towards an approach oriented towards the development of transversal mathematical competencies. The redesign was grounded in the experience accumulated during the 2024 and 2025 implementations, the analysis of student perceptions collected during the 2025 implementation, and the review of theoretical frameworks on mathematical competencies, engineering education, constructive alignment and active learning ([2]; [3]; [5]; [6]). The evidence collected, together with the review of the specialised literature, informed a process of reconceptualising the course's formative purpose, strengthening the explicit development of mathematical competencies and the coherence between learning outcomes, teaching activities and assessment processes. As a result, TALM was reformulated around four transversal mathematical competencies: mathematical reasoning, mathematical modelling, problem solving and mathematical communication. The new design organises learning through active methodologies and activities contextualised in engineering-related situations, fostering connections between mathematics and students' future professional practice. It also incorporates an assessment system aligned with the learning outcomes, complemented by pre- and post-test instruments to monitor competency development, and integrates the TALM Checklist, a didactic tool inspired by the Decoding the Disciplines approach ([4]). Its purpose is to make explicit the cognitive operations involved in mathematical problem solving, guiding students through the processes of modelling, analysis and validation of their answers. It is proposed that this redesign offers an alternative way of rethinking bridging courses in engineering, shifting the focus from the remediation of prior content towards the development of transferable mathematical competencies through contextualised learning experiences, assessment coherent with learning outcomes, and strategies that foster the explicit articulation of disciplinary mathematical thinking.

Keywords engineering mathematics education · student transition to engineering · transversal mathematical competencies · competency-based redesig · contextualised learning · active learning · constructive alignment.

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