AI and Coding in Mathematical Modelling Instruction

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The use of Artificial Intelligence (AI) and coding in mathematical modelling instruction signifies a pivotal enhancement in pedagogical methods, markedly augmenting students' capacity to address intricate real-world challenges (Weng et al., 2024; Ye et al., 2023). This technology enables the creation of a dynamic, customised, and interactive learning environment that aligns with 21st-century educational objectives. Mathematical modelling, an essential element of STEM education, provides a systematic framework for students to analyse and comprehend real-world occurrences via mathematical concepts. This methodology cultivates a culture of data-driven decision-making, highlighting the use of exact numerical data to inform analysis and interpretation (Ang, 2021). The incorporation of artificial intelligence and computational thinking via coding into this educational framework has been shown to markedly improve students' motivation, engagement, and cognitive growth (Wu & Yang, 2022).

The use of AI tools, such as machine learning algorithms, artificial neural networks, and automated data analysis software, has significantly risen in educational settings. These tools are utilised to facilitate the learning and instruction of mathematical modelling. These tools provide students with the ability to perceive data patterns, develop prediction models, and enhance their mathematical intuition. Platforms like TensorFlow and Scratch are now widely employed in educational environments to enable students to handle data, replicate real-world phenomena, and address intricate modelling challenges through user-friendly interfaces (Tamborg et al., 2022). Coding environments like Python and MATLAB are crucial tools for students to create, simulate, and analyse mathematical models, fostering proficiency in both mathematics and programming (Magaña et al., 2024).

Moreover, the incorporation of AI-driven adaptive learning systems significantly enhances differentiated learning through the provision of prompt feedback and tailored scaffolding. This technology enables a more tailored learning experience, adjusting to everyone’s learning profile and pace. This customisation has been shown to improve students' understanding of mathematical ideas while simultaneously promoting their self-efficacy and independence in problem-solving. Moreover, the AI platform promotes collaborative learning by allowing students to engage in joint modelling problems, hence augmenting social learning and collective reasoning (Richard et al., 2022).

Teachers are essential in the successful implementation of this innovation. The capacity to build and oversee learning environments that incorporate AI, and coding is of critical importance. Therefore, professional development programs that prioritise AI literacy, pedagogical proficiency in modelling learning, and practical coding expertise are essential. These programs aim to enable educators to shift from conventional learning methods to more dynamic and technology-enhanced instructional models that align with technological advancements and contemporary educational best practices (Spreitzer et al., 2024).

Recent innovations in pedagogical methods are facilitating this change. The application of AI-driven motion capture to support mathematical dance (Cahyono et al., 2025) illustrates the

fusion of physical cognition and creative movement in modelling problems, consequently improving conceptual understanding. Similarly, robotics-enhanced modelling environments provide a concrete interactive experience that allows students to create, assess, and improve their mathematical models directly (Cahyono et al., 2021). The incorporation of computational thinking into culturally important activities, like batik stamp design, has been shown to enhance mathematical creativity and deepen cultural engagement, thereby creating a connection between modern AI technology and traditional knowledge systems (Yunianto et al., 2025).

The integration of AI, coding, and mathematical modelling education signifies a notable pedagogical advancement. This convergence has demonstrated its ability to foster a deeper understanding of mathematical concepts, enhance computational thinking and creativity, and provide students with vital problem-solving skills necessary for success in a progressively digital and interconnected world.

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