Bridging Learning Outcomes and Module Specifications: GenAI Framework for Curriculum Development in CS Education

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Abstract

Recent developments in generative artificial intelligence (GenAI) have enabled the production of high-quality content in many domains, including education and computing. These advances offer opportunities to support tutors in curriculum development and to enhance the learning experience for students. This paper presents an end-to-end pipeline that automatically suggests a set of module specifications based on user input and structured guidelines.

CCS Concepts

• **Computing methodologies** → **Artificial intelligence**; • **Social and professional topics** → **Computer science education**.

Keywords

Artificial Intelligence, Natural Language Processing, Generative AI, Large Language Models, Curriculum Development, CS Education

ACM Reference Format:

Anonymous Author(s). 2018. Bridging Learning Outcomes and Module Specifications: GenAI Framework for Curriculum Development in CS Education. In *Proceedings of Make sure to enter the correct conference title from your rights confirmation email (Conference acronym 'XX)*. ACM, New York, NY, USA, 1 page. https://doi.org/XXXXXXX.XXXXXXX

Recent proprietary and open-access large language models (LLMs), such as OpenAI's ChatGPT, Anthropic's Claude, and Alphabet's Gemini/Gemma, can generate enriched content from structured prompts. This opens opportunities to modernise educational practices for both tutors [3] and students [1]. Building on prior work generating educational materials in CS education [2], this paper addresses GenAI suggestions for module specifications.

The proposed framework consists of four main stages: **(1) Input:** The framework receives metadata describing the target module, including intended learning outcomes (ILOs), related modules, recommended reading lists (e.g. academic textbooks), and CATS/ECTS module credit value. **(2) Knowledge Engine:** To avoid the risk of GenAI hallucinations, Retrieval-Augmented Generation (RAG) techniques are used to retrieve relevant information from trusted educational and professional sources. These sources are categorised into two levels: (2-i) University-level sources: student handbooks, and learning and teaching practice policies. (2-ii) Sector-level sources: QAA Computing Subject Benchmark, ACM/IEEE curriculum recommendations, BCS accreditation requirements, and FHEQ/SCQF/RQF qualification framework descriptors. **(3) Suggestion Engine:** the framework combines the user-provided inputs with the retrieved contextual knowledge to suggest module specifications using LLMs: (3-i) Syllabus Design: a week-by-week teaching schedule aligned with the specified ILOs, including learning and teaching activities and the associated allocation of hours across scheduled learning, independent study, and placement activities where applicable. (3-ii) Assessment Design: formative and summative assessment components, each annotated with corresponding weighting, mapped ILOs, marking rubrics, and the permitted level of GenAI usage. (3-iii) Teaching Materials: weekly lecture slides, tutorial and laboratory exercises (with starter code and solutions), and supplementary worked examples. **(4) Consistency Verification:** The generated module specifications go through a verification process consisting of both automated and human-in-the-loop validation mechanisms. (4-i) Automated Verification: rule-based checks are performed to evaluate quantitatively (e.g. validating the ratio between the module credit value and the total learning hours) and qualitatively (e.g. verifying that all intended learning outcomes are adequately covered within the syllabus, teaching materials, and assessment components). (4-ii) Human Review: designated academic staff review the outputs to assess their correctness, pedagogical effectiveness, and institutional suitability. Manual feedback from reviewers, together with any failed automated checks, is iteratively fed back into the suggestion engine to refine the generated content. This process continues until a satisfactory module specification is produced.

In conclusion, this paper proposes a GenAI-driven pipeline for automated suggestion of computing module specifications, integrating trusted academic and accreditation sources with a hybrid verification mechanism to ensure regulatory compliance and pedagogical validity, while future work will focus on incorporating international institutional constraints and extending support to joint-institutional curriculum development.

References

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Conference acronym 'XX, Woodstock, NY

ACM ISBN 978-1-4503-XXXX-X/2018/06
https://doi.org/XXXXXXX.XXXXXXX