GenAI Integration in Upper-Level Computing Courses

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Abstract

GenAI is playing an increasingly important role in computing courses at all levels, offering new opportunities to support teaching and learning. However, using GenAI effectively raises important concerns regarding trust, academic integrity, and broader social and ethical dimensions. This Working Group was formed to report on the current state of the art in using GenAI in upper-level computing courses to aid educators. The working group will undertake a methodological review of published work and solicit input from the computing educational community as part of the report.

CCS Concepts

• **Social and professional topics → Computing education**.

Keywords

GenAI, computing education, learning goals and outcomes

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1 Background

With the rapid incorporation of Generative AI (GenAI) into higher education, it is imperative that educators understand their implications — GenAI is a disruptive and inevitable force of change not to be ignored [1, 4, 6]. Computing education is particularly exposed, as computing educators are often the earliest of adopters of new technologies. However, as of now, the fastest moving components are the technologies and the students' use of them, whilst educators and their courses risk falling behind. Therefore, computing educators face two choices: (1) to embrace GenAI carefully, thoughtfully, and positively, with a view to reimagining and redesigning computing education; or (2) to ignore GenAI and its potential, thereby risking a loss of leadership and relevance during this time of fundamental change [5]. This Working Group (WG) has chosen the first path.

The current landscape of GenAI research has largely focused on the perspectives of educators and students in the context of introductory programming courses [3]. This focus is somewhat justified, as these courses have large enrollments, and require considerable human skill, resources, and management. Other areas of the computing curriculum, such as databases, algorithms, software engineering, operating systems, networking, HCI, security and other advanced topics need the same attention with regard to GenAI integration. Currently, a notable gap exists in the literature regarding the impact of GenAI in upper-level courses, particularly in terms of student learning outcomes and educational efficacy.

In upper-level courses, educators can leverage GenAI to engage students in ways that were previously unimaginable or prohibitively resource-intensive. For instance, in a database course, GenAI help students iterate on database schema designs. In a human-computer interaction (HCI) course, AI coding assistants could enable rapid prototyping for accessibility use cases, allowing students to focus on design principles. In a software engineering project course, GenAI could simulate an indecisive client, challenging students to elicit and clarify requirements while managing progress through multiple sprint iterations. However, despite these innovative use cases in individual courses, there is a need for a more careful, thoughtful and positive integration of GenAI throughout the upper-curriculum.

GenAI encompasses many aspects, all of which must be considered when developing courses and curricula. Integrating GenAI tools effectively requires approaches that enhance student learning while upholding academic integrity and fostering deep conceptual understanding. At the same time, students must learn to engage with GenAI effectively and responsibly.

Educators face a significant challenge in redesigning courses for the GenAI era—one that demands more than superficial adjustments. Yet, they also have access to new technologies that can support innovative approaches and help advance computing education.

2 Goals

The goal is to aid computing educators in conducting "GenAI ready" upper-level computing courses. The WG will also draft course learning outcomes for some upper-level courses. These learning goals will begin with a set of prerequisite competencies for computing professionals [2]. Additionally, the WG will report on the current capabilities of GenAI with respect to common upper-level computing coursework.

3 Methodology

The WG will utilize these methods for reaching our goals:

- **Literature review** - the WG will search for, and review, publications on using GenAI in upper-level computing courses. The corpus reviewed will likely include publications adjacent to the primary search, but relevant to the report, including general GenAI competences.
- **Draft learning objectives** - the WG will draft potential course outcomes for upper-level computing courses.
- **Community input** - the WG will seek the input of the computing education community in refining course learning outcomes and activities in a GenAI computing course.

4 Expected Deliverables

Some educators in computing are searching for effective ways to deter this technology from negatively impacting the learning process, while others are exploring creative ways of weaving it into their teaching practice. The working group acknowledges the challenge and will attempt to assist the educator by producing:

- a list of literature, categorized and summarized
- draft learning outcomes for upper-level computing courses
- a list of upper-level computing assignments GenAI can do

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