Ethics of Justice and Ethics of Care: Using Speculative Fiction to Assess Students' Ethical Reasoning Skills

Gul-e-Fatima Kiani, University of Nebraska at Omaha

Gul-e-Fatima Kiani is a Ph.D. candidate in the College of Information Science and Technology at the University of Nebraska at Omaha. Her research examines computing education, with interests spanning ethics education, student learning processes, and the social relevance of STEM research. She is also interested in equity issues, including gender dynamics in technical learning environments.

Samantha Kang, Oregon State University

Samantha Kang is a Ph.D. Candidate in Mechanical Engineering at Oregon State University in the Design Engineering Lab. They investigate how social structures like gender implicitly shape design theories, design cognition, and technology trajectories in service of building more equitable tech and infrastructure.

Andrea Grover, University of Nebraska at Omaha

Dr. Andrea Grover is an associate professor in the College of Information Science and Technology at the University of Nebraska at Omaha. They are an expert on the design, management, and technology arrangements that support diverse stakeholders in the participatory sciences. Their recent work explores how using generative AI with speculative fiction writing impacts STEM students' development of critical thinking and ethical reasoning skills.

Dr. Christine Toh, James Madison University

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Abstract

Across technology, design, and engineering fields, growing concerns over societal and environmental impacts are prompting critical interrogations of established and often uncontested methods and frameworks at the core of computing, engineering, and design practices (see for example [1–4]). Engineering education increasingly emphasizes preparing students to address complex global and ethical challenges [5], as reflected in accreditation expectations [6] and longstanding calls for professional responsibility [7–9]. Rapid technological advances have further intensified ethical concerns, prompting the need for instructional approaches that support ethical reasoning in engineering contexts [10], [11]. Student writing has been proposed as an approach to ethics instruction, as it supports idea development [12], specificity of reasoning [13], and anticipation of ethical implications. However, students' limited writing skills and the marginalization of language instruction in technical curricula present persistent challenges [14], [15]. Recent advances in Generative Artificial Intelligence (GenAI) offer a potential scaffolding mechanism by supporting content development and argument construction, thereby reducing writing-related barriers while enabling clearer demonstrations of ethical reasoning. With better writing supports, students could more clearly communicate and show their consideration of the impacts of engineered solutions (e.g., identifying relevant contextual factors [16], [17], analyzing case studies of solution impacts related to design decisions [18]). Speculative fiction writing is particularly well suited to ethics instruction, as it helps students to imagine plausible future technologies and reason about their social and ethical consequences beyond present-day constraints [19]. This study examines how writing assignments supported by GenAI scaffolds shape students' ethical reasoning in an undergraduate technology ethics course. Student speculative fiction artifacts were analyzed through justice-oriented and care-oriented ethical lenses, which capture complementary forms of ethical reasoning commonly emphasized in engineering ethics education. Using pilot data, this work explores how GenAI may support students' writing fluency while making ethical reasoning more visible. Our results show that GenAI use significantly reduced time spent on writing assignments, and that structured GenAI guidance increased the variety of both justice and care-oriented ethical principles expressed in student writing. Our findings contribute to the emerging pedagogical approaches for ethics education in engineering and computing.

Introduction

As computing and engineering systems increasingly shape social, economic, and political life, ethics education has become a central concern in engineering and computing curricula [20]. However, prior research has shown that despite formal inclusion of ethics requirements, students often struggle to meaningfully engage with ethical considerations in technical contexts, contributing to what is described as a "culture of disengagement" from ethical responsibility in engineering education [21]. Ethics instruction in technical domains frequently emphasizes narrow, rule-based approaches grounded in rationalist traditions, which can limit students' ability to reason about complex sociotechnical consequences [20], [22]. These challenges highlight the need for instructional and analytical approaches that not only engage students with ethical issues, but also make the nature and breadth of students' ethical reasoning visible and assessable [23].

The following sections outline approaches to ethics instruction in computing, the ethical perspectives commonly emphasized in technical curricula, and the role of speculative fiction as a context for examining students' ethical reasoning.

Ethics Instruction in Computing

The computing education field has studied a wealth of strategies for teaching ethics in higher education, with over 40 years of published research on the topic [24]. As a field that emerged in close relation to engineering, particularly electrical and computer engineering, computing education shares longstanding concerns with professional responsibility, societal impact, and ethical practice [25], [26]. Pedagogical strategies for including ethics instruction are primarily motivated by growing concerns over societal and environmental impacts of methods at the core of computing, engineering, and design practices, (e.g., [2], [4]). In addition, accreditation requirements also drive the inclusion of ethics instruction, such as the ABET criteria in the United States that require students to "recognize ethical and professional responsibilities" and "consider the impact of engineering solutions in global, economic, environmental, and societal contexts" [6]. There are three primary approaches to teaching ethics in computing curricula, each with its own benefits and limitations: (1) required courses within the discipline [27], (2) required courses outside the discipline [28], and (3) ethics across-the-curriculum [29]. One challenge across all these approaches is how students' ethical reasoning is made visible and assessable across topics and instructional contexts.

Other logistical challenges for integrating ethics into the curriculum include assessment strategies that do not scale well across different courses. Most assessment involves using rubrics focused on specific components of ethical reasoning (e.g., [30], [31]) but without the benefit of broader frameworks for measuring and selecting which aspects of ethical reasoning to prioritize. Other approaches require students to complete questionnaires or surveys in response to ethical scenarios (e.g., [32], [33]). This strategy does not support flexible topic exploration, which supports authentic inquiry, nor thinking about alternative futures; takes additional effort to integrate into course assessment; and necessitates creating and maintaining a set of dilemmas or case studies that can swiftly become obsolete or unrelatable for students. Efforts to enhance ethics instruction in technical curricula therefore require robust and scalable assessment strategies that do not overburden instructors and allows for flexibility in topic exploration.

Using Speculative Fiction to Examine Ethical Reasoning

Despite the tradeoffs imposed by curricular structures and assessment paradigms, ethics instructors in science, technology, engineering, and mathematics (STEM) courses are increasingly adopting fiction reading and writing assignments to enhance students' opinion-forming skills [31], creativity [32], awareness of different perspectives [33], and ability to explore ethical dilemmas [21]. In computing disciplines, speculative fiction is especially well suited for encouraging students to focus on thinking beyond the current state of the art and anticipating futures beyond the general populace's imagination [18]. This shift parallels the growth of speculative fiction contributions in some computing conferences, such as design fiction papers in the ACM International Conference on Human Factors in Computing Systems, which have been a regular feature in conference proceedings since the mid-2010's. Technology ethics instruction increasingly integrates such futures thinking content, including speculative fiction [34], but most of this work is done on an ad-hoc basis, with limited standardization across courses and domains.

Another major obstacle to enhancing students' ethical reasoning skills in computing and engineering, and thus their ability to effectively explore potential future outcomes of their decisions, is limited writing skills resulting from minimal emphasis on language skills in technical domains [14], [35] and the lack of integrated writing in STEM curricula [15]. In technical fields, writing helps develop critical thinking and formulation of technical problems, improves active learning [6], and supports reflective practice for professional growth [36]. Educators in Human-Computer Interaction find that speculative fiction can improve problem-solving and critical thinking skills [20] but requires writing skills to actualize.

Justice, Care, and Technology Ethics

The primary intellectual and philosophical traditions that shape most ethics instruction is rooted in the "Ethics of Justice" perspective, which draws on a set of universal principles and rules [37], [38]. These ethical perspectives prioritize impartiality, objective decision-making, and fairness. While functional, researchers in the learning sciences and philosophy have long critiqued this prioritization of highly rational and technocratic viewpoints at the expense of emotions, which are viewed as irrelevant or detrimental to decision making [22]. However, there is broad recognition that emotions play a critical role in developing empathy for end users, which is given increasing importance [39]. The disconnect between hyper-rationality or impartiality and emotion or "caring" reveals a gap in familiarity with alternate ethical perspectives to the Ethics of Justice. An alternative "Ethics of Care" perspective is rooted in the feminist ethical tradition and represents a meaningful shift from traditional ethical theories that prioritize autonomy and impartiality [40]. This moral framework prioritizes relational issues, involvement, harmony, contextualization, and importantly, emotions [41], [42]. Some philosophers and researchers are now turning toward this focus on care as deterministic worldviews fail to provide answers and solutions in an increasingly complex human society [43].

The application of an Ethics of Care perspective to STEM education is not novel, but relatively few studies center feminist ethical traditions in future-oriented technical fields such as computing. Researchers offer specific educational examples of using Ethics of Care to addresses issues of harm, power and inequality [44]. Some researchers also advocate for integrating care ethics into the development, maintenance, and interaction with embodied technologies (i.e.,

robots) in early childhood education to foster sustainable socio-ecological relations at an early age [45]. In this study, we conceptualize the Ethics of Justice and the Ethics of Care as complementary but distinct analytic lenses through which students' ethical reasoning can be examined. Despite the growing body of work to date, there is limited guidance on how students' engagement with Ethics of Care, in comparison to Ethics of Justice, can be systematically examined in student writing or in writing supported by scaffolds such as GenAI.

Research Questions

GenAI as a scaffold could improve the efficacy of speculative fiction writing for developing ethical reasoning skills, since it encourages students to think beyond the current state of the art to anticipate futures beyond the general populace's imagination [18]. By engaging students in GenAI-supported speculative fiction writing, we prompt them to generate alternative worlds and a deeper exploration of justice and care ethics [44]. In addition, when students feel less pressure and concern about the mechanics of writing, they may be able to give more attention to content and ideas. However, to date, little work has been done to explore the impact of GenAI for supporting futures-oriented thinking and writing.

Therefore, main goal of this study was to examine computing students' ethical reasoning as expressed through speculative fiction writing, using justice-oriented and care-oriented ethical perspectives, and to explore how the use of GenAI as a writing scaffold shapes this reasoning. This goal is addressed through the following research questions that distinguish between the influence of GenAI on students' writing experiences (RQ1) and the analysis of ethical reasoning patterns expressed in student writing (RQ2–RQ3).

RQ1 : How does students' use of GenAI affect the amount of **time** spent on speculative fiction writing assignments and their perceived **satisfaction** with the outcome?

RQ2 : How does the **amount** of focus on Ethics of Justice and Ethics of Care principles in students' speculative fiction writing change across different topics and with the use of GenAI?

RQ3 : How does the **variety** of Ethics of Justice and Ethics of Care principles in students' speculative fiction writing change across different topics and with the use of GenAI?

This study brings together speculative fiction as a future-oriented writing task, generative AI as a writing scaffold, and justice- and care-oriented ethics as analytic lenses to examine students' ethical reasoning in computing education. Speculative fiction provides a context for reasoning about plausible technological futures, GenAI reduces writing-related constraints that can limit expression, and the ethical lenses allow systematic examination of the kinds of ethical concerns students articulate. All of these elements allow closer analysis of how ethical reasoning is expressed and varies across topics and writing conditions.

We seek to contribute to learning-focused research in STEM education through the assessment of student ethical reasoning with more expansive ethical reasoning frameworks that encourage students to articulate and engage with a broad range of ethical concerns, and to establish systematic and scalable assessment approaches suitable for diverse STEM courses. Given increasing use of GenAI in higher education, we also aim to better understand how these tools impact students' writing and reasoning skills.

Methods

Data Collection

This study took place over the course of a single semester in one section of an Information Technology Ethics course at University of Nebraska at Omaha. The course is required for all undergraduate majors in the college, including Computer Science, Management Information Systems, and Cyber security, in support of ABET accreditation requirements, and covers a wide range of topics and technologies. Each student was assigned four speculative fiction writing tasks over the course of the semester (three were available for analysis at the time of writing). Data was collected over 3 time points: 21 students participated in time point 1 (T1-no GenAI), 23 students at time point 2 (T2-free GenAI), and 21 students at time point 3 (T3-guided GenAI). This analysis includes only data from the 19 students who participated at all three time points.

The assignments focused on the ethics of different technology products and systems, designed to prompt students to consider and communicate the future impacts of technical solutions through speculative fiction writing. Each assignment had several specifications, including a topic, length requirement (900-1100 words), instructions on the use of GenAI, and in-class activities to warm up for the writing task; details in Table 1. The assigned topics reflected the content focus of class readings and discussions for the week that each assignment was due.

Table 1: Timeline, topic, and other specifications of writing assignments in the IT Ethics class.

Time point and Schedule	**In-class Activities**	**Topic**	**Generative AI Use**
T1: Week 5 of the semester, with access to assignment details from semester start.	Alternative uses, one-word-at-a-time stories, and role-storming	Facial recognition technology	Use of GenAI strictly prohibited.
T2: Week 6, with access to assignment details for one week.	None	Humanoid robots	Use of GenAI allowed, no restriction or guidance provided.
T3: Week 7 with access to assignment details for one week.	Guided in-class exercises using ChatGPT	AI impacts on human jobs	Use of GenAI allowed, with instruction on techniques for creative writing.

The assignments were administered through a learning management system (Canvas) and anonymized for analysis. Each student was assigned a unique identifier to track their writing across the three time-points. After submitting their stories, each student also answered brief survey on the amount of time spent, their use of GenAI (for T2-free GenAI and T3-guided GenAI only) and perceived satisfaction with their work, see Figure 1. Students were reminded on the survey that their answers would not impact their final grades and that honest answers were appreciated to support the research goals. Additionally, the third author, who also served as the course instructor, facilitated an in-class discussion about the purposes of the study and what could be learned from students' participation, with an aim of increasing transparency, encouraging buy-in, and prompting more honest answers. Students were able to opt out of participation in the

study at the conclusion of the course with no impact on their grades; assignments received credit-no credit grading to further reduce barriers to engaging in creative writing.

Question asked in all three time points

1. Approximately how much time did you spend actively working on this assignment? Give your best estimate in hours and/or minutes.
2. How satisfied are you with the resulting story, given the assignment requirements and time you spent on it?

Questions asked only in time point 2 and 3

On a scale of 1 to 5 (1 being not at all and 5 being completely), please indicate the extent to which you used ChatGPT for the following story elements:"

1. Develop ideas for the premise (main position or message)
2. Examples events
3. Generate characters
4. Provide information on key components (e.g., technologies, systems, individual perspectives)
5. Generate names and details for people, places, or organizations
6. Generate a narrative arc (plot)
7. Generate phrases, sentences, or paragraphs to communicate key ideas
8. Proofread or get feedback on original writing that you generated
9. Modify tone, style, or correct grammar of original writing that you generated
10. Is there anything else you want to share about your process or experience using AI for this assignment?

Figure 1: List of questions evaluating ChatGPT use in different elements of story creation.

Analysis of Speculative Fiction Writing

To analyze the students' writing assignments, each story was qualitatively coded for the presence of Ethics of Justice and Ethics of Care principles. We followed a three-step procedure:

1. ChatGPT extracted the top five themes from each story (approximately 1000 words on average) and a one sentence description of those themes [46]. The prompt for this step was: "Extract the top 5 themes and issues present in this short story. List these out as bullet points with a brief one sentence explanation for how these themes and issues are enacted in this story. [short story text]". Using ChatGPT summarized large amounts of student writing (approximately 65,000 words in total) into concise themes of similar length and detail for systematic coding.

2. Each story was read by the first author and excerpts matching the themes identified in step 1 were extracted. While the themes identified by ChatGPT helped standardize the qualitative coding process, the manual process of reading each story provided context for qualitative coding and ensured that the interpretations were accurate and consistent across stories.

3. Each theme was coded for the principles of Ethics of Justice and Ethics of Care. The Ethics of Justice and Care principles were not mutually exclusive, so any theme that contained elements of a principle was coded as such, including stories that highlighted the presence or

absence of the principle. The codebook and example story themes with applied codes and rationales are available on GitHub[1].

Since interpretation of story themes and ethical principles varies with individuals' worldviews, we used an iterative process to achieve a shared understanding between two coders. First, an initial list of ethical principles belonging to the Ethics of Justice and Ethics of Care frameworks was identified. These principles were extracted from previous research on differences in these ethical perspectives and from previous studies that applied these principles in other application areas [38], [40], [47–49]. These initial principles and draft definitions were discussed by the research team and revised throughout the process of iterative qualitative coding of story themes.

Both coders independently coded the same set of stories (n=4) from T1 in the first iteration, another set (n=4) from T1 in 2nd iteration, and another set (n=5 each) from T2 and T3 in the 3rd iteration. After each iteration, the research team met to discuss disagreements, refinements to the codebook, and coding strategies for consistency and precision.

In total, 12 principles (6 from Ethics of Justice and 6 from Ethics of Care) were defined in the code book, included in the Appendix. Inter-rater reliability was assessed using Cohen's κ indicating substantial to almost perfect agreement. These results are described in Table 2. Author 1 then coded the remaining stories from T1 (*N=15*), T2 (*N=15*) and T3 (*N=14*).

Table 2: Inter-rater reliability results.

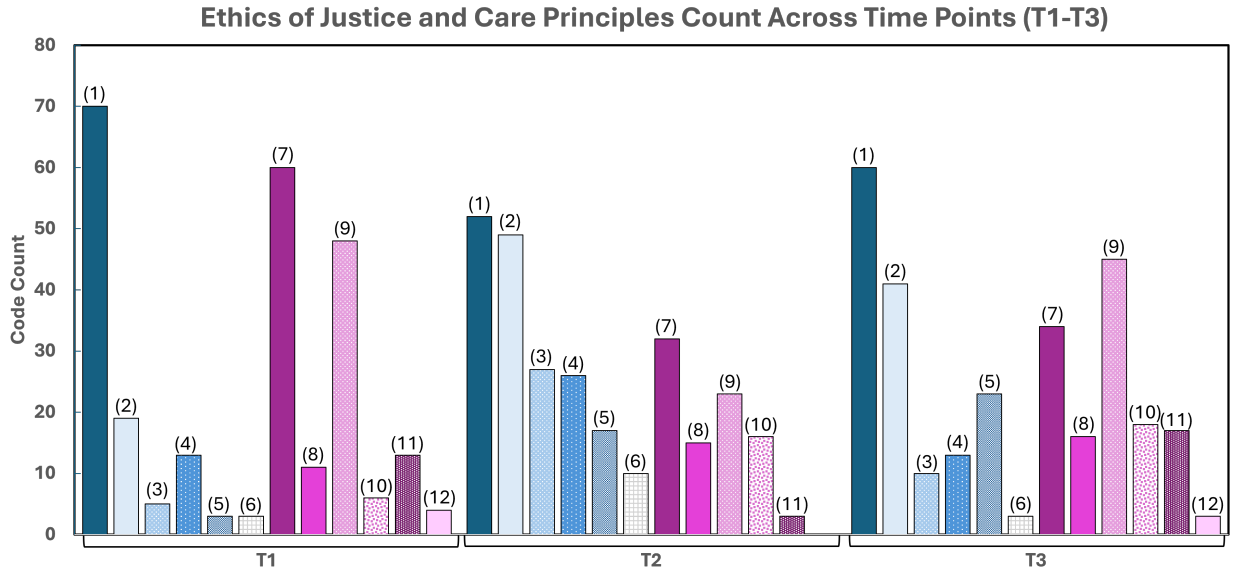
Time point	**% Agreement**	**Cohen's κ**	**Agreement rating**
T1	94.46%	0.82	Almost perfect
T2	96.90%	0.88	Almost perfect
T3	92.90%	0.74	Substantial

Results

Before further analyses to answer our research questions, we computed high-level descriptive statistics to examine emerging patterns and the distribution of ethical orientations across time points.

By calculating the proportions of principles of Ethics of Justice versus Ethics of Care coded for each time point, we found that justice was the dominant ethical orientation across all three time points, accounting for 55% (189) of codes in T1-no GenAI, 59% (203) of codes in T2-free AI, and 52% (185) of codes in T3-guided GenAI. A comparison of the distribution of Ethics of Justice and Ethics of Care principles per time point is presented in Figure. 2; the breakdown of each ethical framing showed certain principles like "vulnerability" and "emotion" as more prominent in Ethics of Care and principles such as "universal rules" and "autonomy" dominated in Ethics of Justice.

[1]Repository available at: https://github.com/gulefatimakiani/genai-speculative-fiction-ethics.git



Ethics of Justice	(1) Universal Rules	(2) Self-Reliance	(3) Autonomy	(4) Individuality	(5) Fairness	(6) Impartiality
Ethics of Care	(7) Vulnerability	(8) Emotion	(9) Relational	(10) Involvement	(11) Empathy	(12) Interdependent

Figure 2: Comparison of Ethics of Justice vs. Ethics of Care principles count over time.

RQ1: How does students' use of GenAI affect their experience with speculative fiction writing assignments?

After each writing assignment, students self-reported approximate time spent (in hours) completing their speculative fiction writing assignment and how satisfied they felt (on a scale of 1 to 5) with the resulting story. The students were asked to report on satisfaction with their work as an indicator of their internal evaluation of the assignment's adequacy. This allowed us to examine whether the use of GenAI changed students' perception of their completed work. Figure 3 shows the distribution of the central tendency of these reported metrics for each time point in the semester (mean for time spent, and median for satisfaction). Although students spent significantly less time on the assignments in T2 and T3, their reported satisfaction remained stable across conditions. This indicates that students perceived the quality of their work to be comparable despite reduced time investment.

To test for statistical significance in these variables, a Friedman test was conducted on the self-reported time spent on each writing assignment for all 3 time points, and showed a significant result: $\chi^2(2) = 15.51, p < 0.001$. Post hoc analysis with Wilcoxon signed-rank tests was conducted with a Bonferroni correction applied, resulting in a significance level set at $p < 0.017$. These results show a statistically significant decrease in the amount of time spent on writing assignments in T2 ($Z = 0.868, p = 0.007$) and T3 ($Z = 1.184, p = 0.001$) compared to the baseline of T1, but not between T2 and T3 ($Z = 0.316, p = 0.330$). A similar Friedman test was conducted on self-reported satisfaction of the outcomes of the assignments for all 3 time points, with no significant results $\chi^2(2) = 0.163, p = 0.922$.

These results show that while students reported spending less time on writing assignments in T2 and T3 (possibly due to training effects and the use of GenAI, as well as increasing workloads across courses as the semester progressed), their level of satisfaction with the result of their work

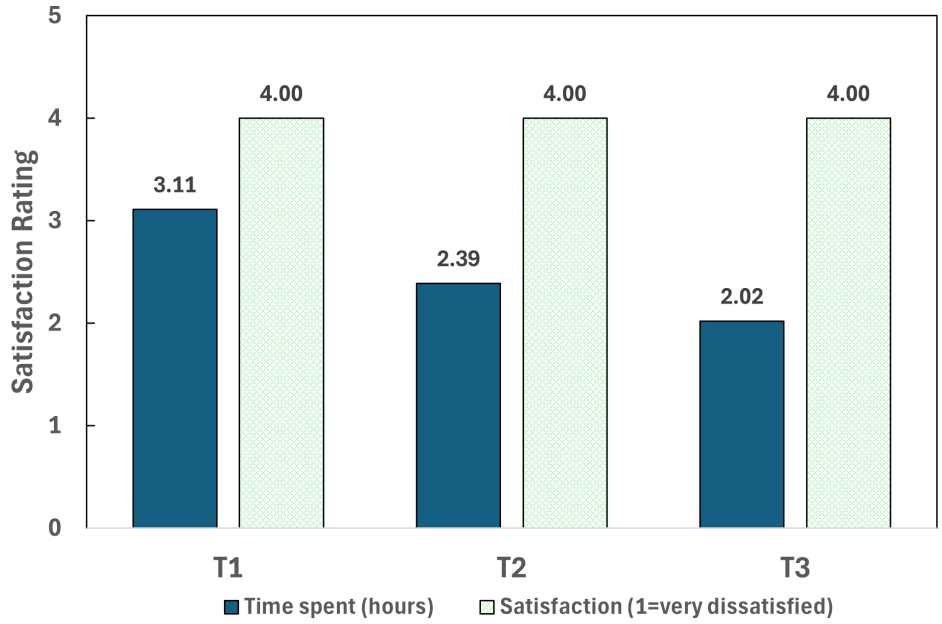


Figure 3: Median self-reported satisfaction rating of story and time spent (hours) on each story

remained consistent, suggesting that students likely engaged with story development until it met an internal threshold of satisfactory work to submit.

To investigate the influence of using GenAI on students' writing practices, we also analyzed their self-reported ratings of how much they relied on GenAI to assist with specific aspects of the writing process. Wilcoxson Signed Rank tests were conducted to compare students' rating of how much they relied on ChatGPT for different aspects of the writing process from T2 to T3. None of the paired comparisons reached statistical significance (all $p > 0.05$; Z values ranged from -0.40 to -0.855). This result could be due to the small sample size (low statistical power) but also shows that increased reliance on GenAI during the writing process does not result in a strictly uniform or monotonic relationship with different aspects of fiction writing. To investigate this relationship in more detail, Figure 4 shows the median of survey responses to each question about the extent of ChatGPT use throughout the writing process.

When students were first permitted to use ChatGPT to aid the writing process, they primarily relied on the tool to help generate narratives (plots) for their speculative fiction stories (median = 3 out of 5). In contrast, students did not use ChatGPT for other elements of the writing process to the same extent (median of 1 or 2 out of 5). However, in T3-guided GenAI, this trend changes substantially, with students self-reporting a median of 3 for their reliance on all elements of the writing process, except for "Generating key components", "Proofreading and providing feedback", and "Modifying tone and grammar". This indicates a shift towards relying on GenAI for a greater variety of writing tasks in T3-guided GenAI, possibly due to additional instructions that provided structured approaches and guidance on how to more effectively use GenAI for creative writing.

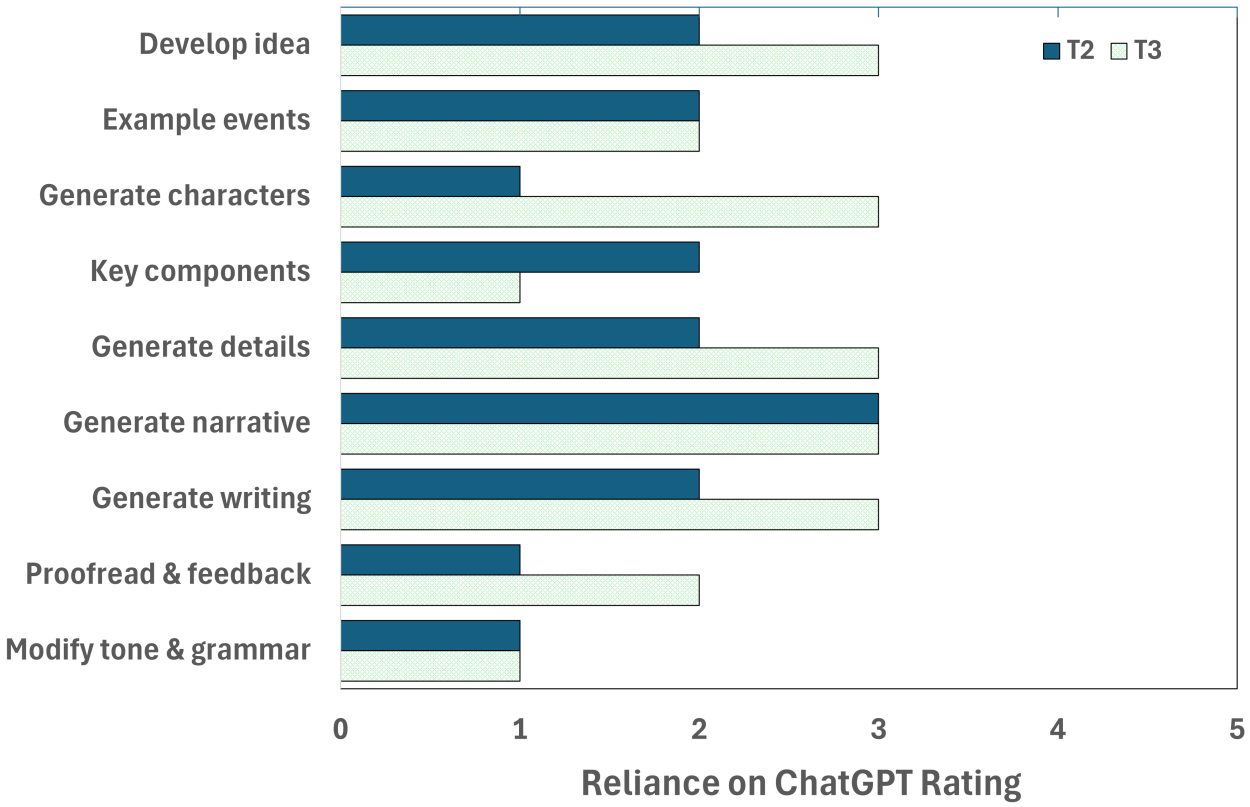


Figure 4: Median self-reported reliance on ChatGPT across different practices of the writing process.

RQ2: How does the amount of focus on Ethics of Justice and Ethics of Care principles change?

To answer this research question, we conducted a repeated measures ANOVA to test if there were differences in the mean proportion of Ethics of Justice (and Care) principles across the three time points. After Mauchly's test flagged a sphericity (equal variances of the paired differences) violation, we applied the standard degrees-of-freedom correction.

For Ethics of Justice principles, the repeated-measures ANOVA indicated a statistically significant difference across time points (F(1.35, 24.37) = 10.69, $p = 0.002$). Post-hoc pairwise comparisons (paired t-tests with Bonferroni adjustments) showed that both T2-free GenAI use versus T1-no GenAI (d = 0.92, $p = 0.003$) and T3-guided GenAI use versus T1-no GenAI (d = 0.74, $p = 0.014$) differed significantly, whereas T2-free GenAI use versus T3-guided GenAI did not (d = 0.55, $p = 0.085$). Figure 5 shows how the mean proportion of Ethics of Justice principles varied across the three time points.

Similarly, for Ethics of Care principles, a repeated-measures ANOVA showed a significant effect of time (F(1.35, 24.37) = 10.70, $p = 0.005$). Post-hoc paired t-tests with Bonferroni adjustment indicated that both T2-free GenAI (d = 0.92, $p = 0.003$) and T3-guided GenAI (d = 0.73, $p = 0.015$) differed significantly from T1-no GenAI, whereas T2 and T3 did not differ from each other (d = 0.55, $p = 0.083$). Figure 5 shows how the mean proportion of Ethics of Justice and Ethics of Care principles varied across the three time points.

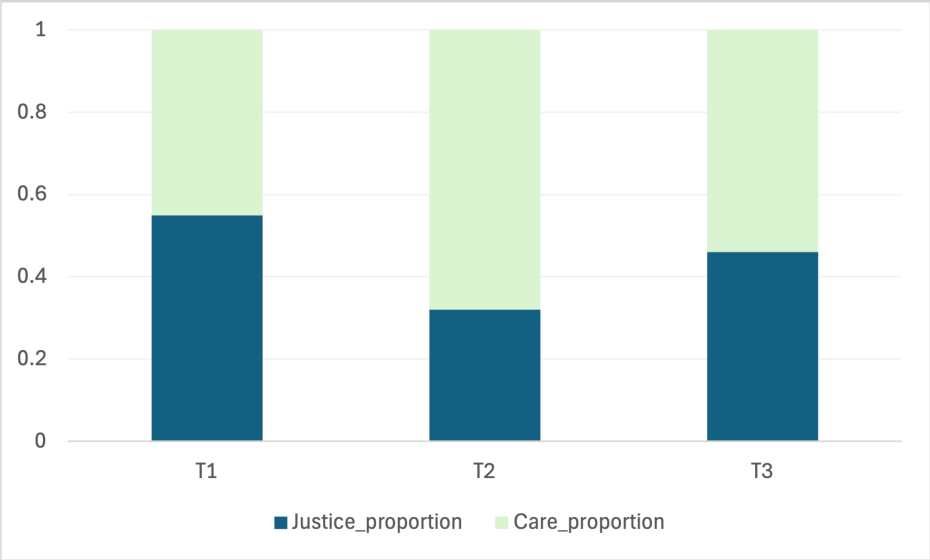


Figure 5: Mean proportions of Ethics of Justice and Ethics of Care principles across three time points

RQ3: How does the variety of Ethics of Justice and Ethics of Care principles change?

The previous research question focused on investigating differences in the amount of focus on different ethical principles. This research question focuses on differences in the variety of ethical principles used, building on the sphericity violation observed in RQ2.

Since tests of normality for Ethics of Justice principles failed, we conducted a Friedman test for repeated measures and found a statistically significant change in the number of distinct Ethics of Justice principles across the three time points ($\chi^2(2) = 17.733$, $p < .001$, W=0.16). Post-hoc tests (Wilcoxon signed rank test with continuity correction) showed a significant decrease in the number of distinct Ethics of Justice principles when students moved from T1-no GenAI to T2-free GenAI (r = 0.55, p = 0.002), followed by a significant increase in variety when they switched from T2-free GenAI to T3-guided GenAI (r = 0.69, $p = 0.003$). However, no significant difference was found between T1-no GenAI and T3-guided GenAI conditions (r = 0.16, p = 0.489). Figure 6 shows how the mean number of distinct Ethics of Justice principles varied across the three time points.

For Ethics of Care, Mauchly's test (p-value = 0.20) indicated sphericity was met. A one-way repeated-measures ANOVA on the number of unique principles per story showed significant effect of time (F(2, 36) = 5.83, p-value = 0.006). Follow-up pairwise comparisons (paired t-tests with Bonferroni adjustments) revealed a significant increase in care-oriented ethical reasoning from T1-no GenAI to T3-guided GenAI (d = 0.86, p = .004). The difference between T1-no GenAI and T2-free GenAI was not statistically significant (d = 0.57, p = .071). Similarly, no significant difference was found between T2-free GenAI and T3-guided GenAI (d = 0.03, p = 1.000). Figure 6 shows how the mean number of distinct Ethics of Care principles vary across the three time points.

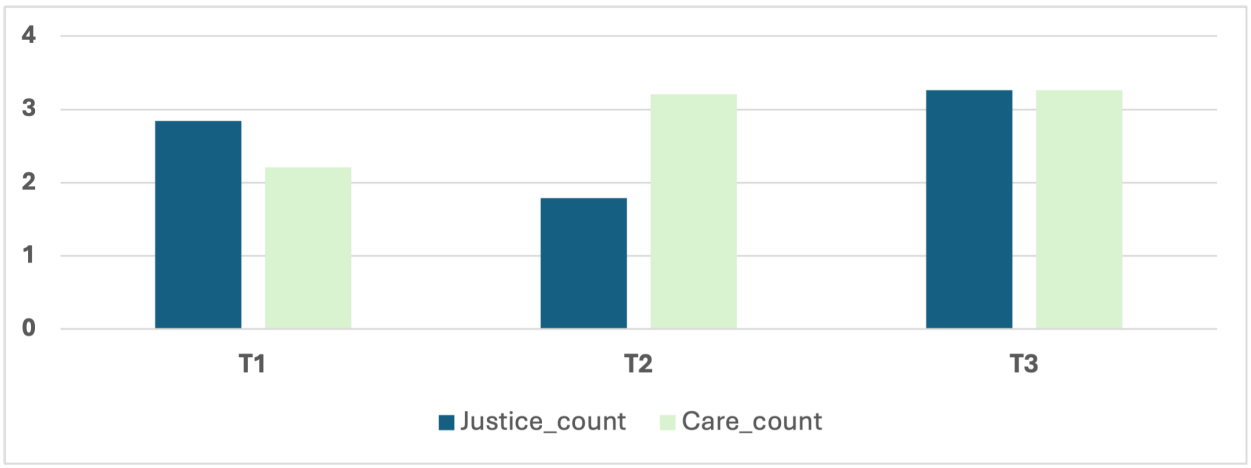


Figure 6: Mean number of distinct Ethics of Justice and Ethics of Care principles across three time points

Discussion

The findings of our study suggest that students' ethical reasoning is shaped by the conditions under which they write, with dominant ethical frames most evident under constraints and a broader range of ethical perspectives surfacing when constraints were reduced.

Ethical Perspectives

One of the main goals of our study was investigating the extent to which non-dominant ethical perspectives such as the Ethics of Care appeared in students' speculative fiction writing. The findings of our study have implications for using speculative fiction writing assignments for enhancing student ethical reasoning skills. Specifically, our results show that ChatGPT did more than speed up students' writing process, it also substantially influenced other aspects of the process and resulting work. We found that once students were permitted to use GenAI, their stories reflected both a greater emphasis on care-oriented ethical principles and a broader variety of ethical perspectives, particularly those centered on care. However, compared with the no-GenAI condition, both the free-GenAI and guided-GenAI phases showed a clear rise in care-oriented principles and a drop in justice-oriented ones.

Interestingly, the peak in care ethics during the free-AI phase suggests that when students could lean entirely on the model, they were drawn most strongly to relational and empathy-based themes; we note, however, that the topic of humanoid robots invites reflection on relationships and acknowledgment of emotions as a distinctively human ability. In the guided-GenAI phase, care principles remained high and justice considerations began to rebound. This pattern implies that simple scaffolding can help students balance multiple ethical perspectives and bring more of their own future thinking and ideas to the fore. Several students described such experiences in the survey they took at the end of T3-guided GenAI, further discussed below, with one noting that *"you need to put effort into getting unique information from ChatGPT"*. This interpretation aligns with the evidence from prior research that structured planning for LLM-assisted writing improves output quality by decomposing tasks into subtasks and iterative refinement steps [50]. As noted,

students' use of feminist ethical perspectives such as the Ethics of Care varied significantly depending on both the topic of the speculative fiction assignment and use of GenAI.

Writing Process and Ethical Reasoning

In line with the prior research [50–52], our results also highlight the importance of providing the appropriate scaffolding and guidance on how to use GenAI effectively for fiction writing. In our study, this instruction had a significant impact on the nature and variety of ethical principles invoked in student stories, e.g., we observed that most of the stories at T2-free GenAI had similar tropes, such as AI as sentient, autonomous, and rights-bearing beings or technologies replacing humans in interpersonal relationships for satisfying human emotional needs. However, in T3-guided GenAI we saw more novelty in the ideas, such as human-AI collaboration, institutional automation and managerial control, environmental and planetary control, cultural preservation, and healthcare and professional ethics.

When completing the assignment without GenAI support, students appeared to have struggled with both mechanics and ideas, often leading them to default to the familiar language of justice (universal rules, fairness). This was also anecdotally evident in the coherence of stories' narrative arcs and depth, character complexity, and level of descriptive detail. Although LLM-generated stories are more coherent and well structured, they also tend to produce more predictable and less surprising narrative associations compared to smaller or constrained models [53]. Similarly, research on human–LLM collaboration suggests that in more complex tasks, unconstrained LLM output can induce creative fixation [52]. In our study, we observed somewhat similar patterns when GenAI use was fully permitted (i.e., the free GenAI condition) with no instruction on strategic usage. The results suggest that students likely defaulted to "plug-and-chug" use of GenAI, where assignment instructions are directly input as a chatbot prompt and the GenAI outputs submitted with minimal adjustment, which was mentioned by some of the students e.g., *"The story was mostly written by ChatGPT"* and *"I copied my previous speculative fiction piece and asked ChatGPT to create a story"*. This resulted in numerous submissions with near-identical story lines that showed only minor variation, which was consistent with the outcomes of in-class exercises that had students applying the same series of prompts.

It was only in the final guided-GenAI assignment that the narratives – and evidence of more expansive thinking about future technologies and their ethical implications – truly diversified. At that stage, students began to treat the model as a collaborator, e.g., as some students highlighted in the survey, *"I started off finding [generating] names with an idea already in mind ... I had it proofread my work . . . It provided genuinely meaningful feedback for sure; it actually surprises me with how helpful it can be for more creative projects"* and *"I wrote the whole version of the story myself . . . they [GenAI] gave me feedback on where I should go into more detail"*. Students also started applying it to more strategically craft elements of the writing process, rather than as a push-button shortcut, which may have contributed to the increased variety of both care and justice principles. For example, one said, *"I asked chat[GPT] to change the tone of my writing as if I were a mix of horror authors including Stephen King and R.L. Stine."* In keeping with previous research findings showing that decomposing writing into structured subtasks improves coherence and overall writing quality [50] and structured guidance in LLM-supported learning environments improves task performance and learner confidence [54], our findings suggest that AI was used to offload lower-order writing tasks and free cognitive bandwidth for more sophisticated futures

thinking and ethical reasoning. With ChatGPT handling grammar checks, basic plot scaffolding, and story details, students appeared to spend more mental energy on the important "what if" questions about ethics and futures that speculative fiction invites.

Along these lines, multiple students described developing their own story concepts and using GenAI to make iterative adjustments until they were satisfied with the result. For example, one student described their process as, *"Compared to the previous Story where I simply let AI generate the story with little assistance on my side, this time I decided to create the outline for the story, and provide feedback/changes that I wanted the AI to make."* This student also provided the prompts that they used after generating a story based on their initial outline:

> *"I want some things changed. First off, the AI isn't specifically made for Law, it is a general AI that could do a bit of everything, but Mark learned by accident, when using it to help with a tuff* [sic] *assignment, that the AI excels in the legal realm. Another change is that Mark uses the AI to assist whenever he is struggling and doesn't solely rely on it. His skills as a attorney improve significantly because of the AI. With his skill, and the AI's attention to detail, he uses it to solve his cases."*

Others mentioned training the GenAI on their own prior writing to generate a story in their own authorial voice, using it to *"thicken the plot"*, *"to get some examples"* or *"to help generate my outline and to brainstorm ideas"*. The resulting stories at T3-guided GenAI appeared to be built around character experiences with specific technologies, rather than the repetition of common sci-fi tropes that dominated T2-free GenAI, consistent with their self-reported decrease in reliance on GenAI for key story components. For example, one student described both their process and the resulting plot:

> *"I used ChatGPT to generate a list of ideas for this assignment, and instead of a list, it gave me a short story about a guy who was hired to just sit in a room all day. I had an episode of SNL on in the background, and they had a skit about an overworked Amazon worker, so I got the idea to write a story about a character who is overworked but whose work doesn't contribute to society. It's just an illusion to help humans cope with AI displacing their jobs."*

In addition, a few students described experiences learning about the limits of the technology, such as *"I tried to use AI for this one but I couldn't. The story it wrote was too bland."* Another student reflected on the way that GenAI rewrote their initial draft, saying *"it goes into more detail than i did in my story but you can obviously tell the changed version i submitted was revised and written by an AI so it kind of takes some of the human element out of my writing."* These comments indicate critical thinking about the impacts of using GenAI, which may be a result of repeated practice and guidance on strategies for use.

Limitations and Contributions

Our findings provide a basis for future research that seeks to assess students' ethical reasoning skills using expansive ethical frames, albeit with several methodological limitations. First, the exploratory study design did not support drawing conclusions on causality for GenAI use or speculative fiction topic on students' ethical reasoning outcomes. Future studies could be

designed to isolate the impacts of these two variables. By requiring inclusion of student reflections on the the ethical principles they intend to convey in their stories, instructors could further solidify the connection between narrative choices and moral reasoning. This may also discourage students from offloading critical thinking skills to GenAI during these exercises. In addition, to maintain feasibility of the qualitative coding procedure in this study and the assessment burden on the instructor, word limits (1000 words) were placed on each speculative fiction assignment, which may limit students' exploration of ethical principles in their assignments. Alternatives to using ChatGPT to summarize the stories should also be revisited to ensure the fidelity of themes is maintained throughout the analysis process. Lastly, we note that more work is needed to validate this assessment procedure across a wider variety of student writing and with additional ethical perspectives. Despite these limitations, our results are promising and offer new strategies for promoting ethical reasoning and expansive futures thinking in computing education and broadening the scope of ethical perspectives evaluated in such courses.

Beyond providing an example strategy for utilizing GenAI as an educational tool that complements, rather than replaces, and possibly even strengthens students' ability to critically engage with complex ethical dilemmas, we contribute a robust codebook and protocol to support more standardized assessment of ethical frameworks in student writing. We hope that instructors are able to use these resources to explore and implement speculative fiction writing in their own technical curriculum or ethics unit. We found that this strategy encouraged more flexible topic exploration that built on the student's unique interests to motivate critical engagement with ethics and more extensive exploration of technology futures, while reducing barriers to incorporating creative writing into technical curricula [32, 33]. Several students made related comments in their final course self-evaluations, reflecting that they were surprised to learn that they do not categorically "hate writing" because they had enjoyed the speculative fiction writing experiences, and one mentioned to the instructor that they continued developing one of the speculative fiction stories that they initiated for the assignment into a manuscript that had expanded to over 7000 words. We believe that the effort to comprehensively reduce barriers to authentic engagement was important to these outcomes.

At the same time, emerging research cautions that heavy, unstructured reliance on LLM assistance during writing tasks may reduce neural connectivity and contribute to what has been described as "cognitive debt" [55]. In light of these concerns, future work could incorporate creative cognitive assessments to examine how using GenAI to support writing may influence higher-order cognitive qualities (e.g., idea generation, elaborative reasoning, specificity of ethical justification), thereby more directly evaluating writing-to-learn mechanisms. Future work could also explore frameworks that support structured planning and execution in LLM-assisted writing, such as the approach proposed by [50]. From a pedagogical standpoint, this work offers scalable assessment strategies, namely using GenAI to extract key information from unstructured student writing, to minimize the additional instructor workload for implementing and evaluating speculative writing assignments as a strategy to support students' development of futures thinking and ethical reasoning. It also contributes a foundation for future research on speculative fiction writing for enhancing ethical reasoning skills in technical courses and expanding the scope of ethical principles considered in these courses.

Critical Reflection on Generative AI Use in this Research

One of the main goals of this research is investigating how Generative AI tools are reshaping the experiences of students and faculty in higher education. Similar to how we examined GenAI tools' potential to reduce barriers to tasks that undergraduate students found challenging (i.e., fiction writing), our research team also explored the use of GenAI tools to automate repetitive tasks during this project. Namely, we turned to the Enterprise version of Chat GPT (to maintain privacy of student data) to summarize each student-written speculative fiction story across all 3 time points of this study. The resulting summary was then used in the qualitative analysis of each story to standardize and expedite the process of applying codes to each story (see methods section for details). Since this was our first attempt at using GenAI in the qualitative coding process, our research team also read each story, modified the generated summaries where appropriate, and extracted example excerpts from the stories prior to beginning the analysis. This process allowed us to verify the AI generated summaries and provided valuable insights into its utility during the qualitative coding process. Researchers investigating the effectiveness of Generative AI tools in research tasks have found that models such as OpenAI's GPT-4 perform summarization tasks from text-focused manuscripts relatively accurately compared to source material that contains substantial technical or mathematical details [56]. This finding mirrors our experience in this research as the stories we analyzed were relatively simple, text-focused manuscripts, typically written in a linear fashion. Since we performed this analysis on the deliverables of a specific course at a single institution, more work is needed to investigate the scalability and robustness of this approach, but Generative AI appears to be a promising tool for streamlining qualitative analysis of large volumes of relatively simple student writing. Beyond using GenAI for analysis in our research, our team also acknowledges the use of GenAI embedded in writing tools that are commercially available, and were used to correct grammar, aid in editing, and refine writing at various points during the development of this manuscript. However, reliance on GenAI for writing was minimal, and there were substantial human-made edits applied to the manuscript as a whole. Nevertheless, the pervasiveness of GenAI tools in general purpose writing platforms emphasizes how ubiquitous this tool has become, and the widely held belief that it can reduce barriers for writers of varying levels of ability.

Conclusion

Our study sought to explore students' speculative fiction writing with GenAI supports through the lens of justice-oriented and care-oriented ethical perspectives. Our findings show that the use of GenAI tools substantially reduced the amount of time spent on creative writing assignments while preserving satisfaction in the final output. However, providing instruction on how to effectively use GenAI for speculative fiction writing had a significant impact on the nature and variety of ethical principles invoked in student stories, pointing to the need for structured interaction with GenAI tools to maximize student learning outcomes. Our work provides a basis for systematic investigations into speculative fiction writing for enhancing ethical reasoning skills in technical courses and expanding the scope of ethical principles engaged.

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