Vibecoding Considered Harmful: Reflection, Agency, and the Quiet Erosion of Learning in AI-Assisted Programming

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1 Introduction

Generative AI tools such as GitHub Copilot and Firebase Studio are increasingly embedded in programming workflows. These systems promise enhanced productivity by offering real-time code suggestions, automating boilerplate generation, and assisting with debugging tasks. As they become more integrated into everyday practices, new patterns of interaction with code and automation are emerging.

One such practice is *vibe coding*, an improvisational approach where developers prioritise fluidity, often by rapidly accepting AI-generated suggestions. While vibe coding fosters productivity, this report argues that its uncritical adoption introduces significant risks to learning, reflection, and intellectual responsibility. When speed and flow are prioritised over structured reasoning, the result is not only shallow engagement, but an erosion of problem-solving skills and epistemic ownership.

This study explores how students engage with AI-assisted programming through the lens of "vibe coding," an improvisational style of coding enabled by generative AI tools. While users often experience this mode as intuitive and efficient, findings suggest it cultivates patterns of interaction that may undermine reflection, conceptual understanding, and intellectual autonomy. These risks are especially pronounced in educational settings, where short-term fluency may obscure long-term erosion of foundational skills. Unlike more visibly contested domains such as the arts, this harm emerges subtly, making it less likely to be recognised, or resisted.

2 Research Questions

This study aims to examine how AI-assisted coding, particularly vibe coding, influences student learning, cognitive engagement, and creative agency. Building on gaps identified in prior work on educational theory and humanistics HCI, the following research questions are posed:

Table 1. Research questions and analytical scope.

RQ	Research Question	Scope
RQ1	How do students use and experience AI-assisted coding tools in creative and educational contexts?	Descriptive / Contextual
RQ2	How does vibe coding affect cognitive engagement, reflection, and skill development?	Analytical / Cognitive
RQ3	What design implications arise for building AI coding tools that support learning and intellectual autonomy?	Design-Oriented / Prescriptive

3 Related work

Generative AI tools are reshaping programming practices by offering real-time code suggestions and automating code generation. These systems are credited with boosting productivity and reducing cognitive load [23]. Within this evolving landscape, vibe coding has emerged as a mode of improvisational programming emphasising rapid acceptance of AI-generated suggestions, often at the expense of deliberate structuring and reflective reasoning [22].

Although vibe coding fosters productivity, it raises pedagogical and ethical concerns. Full AI integration may diminish problem-solving skills and reduce users' sense of agency [6, 16]. Empirical work suggests that semi-automated systems better sustain user engagement than fully automated ones [10], while overreliance on AI may result in shallow or procedural understanding [2]. This tension reflects a broader paradox: while AI enhances short-term efficiency, it may undermine opportunities for reflection and deeper learning, particularly when design fails to scaffold such practices.

3.1 Educational Risks: Cognitive Offloading and Lack of Reflection

The cognitive risks introduced by vibe coding practices become even more apparent when viewed through the lens of educational theory. Dewey emphasised that authentic learning arises from active inquiry and reflective engagement, not passive reception or convenience [5]. This principle is increasingly challenged by automation or preempt key steps in problem-solving. Bloom's Taxonomy similarly distinguishes between lower-order skills like recall and higher-order capacities such as analysis and creativity, domains potentially undermined by frictionless AI interaction [1].

Recent studies affirm these risks as AI coding tools often keep users in lower cognitive domains, with participants replicating outputs without examining underlying logic [21]. Hammond et al.'s scaffolding theory stresses the need to gradually shift responsibility to learners; overactive automation may short-circuit this developmental arc [8]. Philosophical critiques echo these concerns: Rancière contends that intellectual emancipation arises through difficulty, not simplification [14]. Building on these, frictional AI systems have been proposed to preserve uncertainty to support cognitive autonomy and sustain reflective learning [4].

3.2 Humanistic and Critical HCI Perspectives

While cognitive concerns highlight the individual consequences of AI-assisted coding, humanistic and critical HCI perspectives extend this critique to broader questions of authorship, agency, and epistemic power. From this view, coding with AI is not only a learning practice but also a site of cultural and ideological negotiation. Research on creative engagement in AI Tools in education shows that co-creative AI tools often guide users toward normative aesthetics and efficient practices—what is legible or desirable to the system—even when positioned as open-ended collaborators [17]. These tools, though framed as empowering, can reproduce implicit biases about what counts as valid or effective code echoing critiques of automation from Humanistic HCI persepctive, particularly in educational contexts [20].

These critical perspectives suggest that AI-assisted coding constitutes not just a pedagogical shift, but a reordering of how learning, creativity, and responsibility are mediated.

3.3 Design Considerations in HCI: From User Control to Reflective Interaction

As AI systems increasingly mediate creative and educational tasks, HCI has begun to revisit foundational questions about agency, reflection, and control. Classic models of interaction emphasised visibility, reversibility, and user autonomy. Shneiderman's notion of direct manipulation prioritised transparency and interactive control, while Rogers called for systems that support sense-making over passive use [15, 18]. Odom et al. further argued for designing technologies that intentionally slow interaction to enable anticipation and reflection [13].

These principles remain highly relevant in the context of AI-assisted coding. Emerging frameworks on Human-Aware AI Interaction suggest evaluating tools not only by speed or correctness but also by their epistemic qualities: how they support critical engagement and cognitive autonomy [19]. Relatedly, research on trust in automation highlights the need for dynamic calibration of reliance, especially in settings where over-trusting or under-trusting AI may compromise learning or collaboration [11].

A key design concern therefore is: how to ensure that AI coding tools support not only productivity but also the user's capacity to pause, reflect, and learn. This study therefore attempts to provide a lens for understanding the pedagogical and cognitive challenges raised by improvisational practices such as vibe coding.

4 Method

4.1 Participants and Recruitment

Five UK university students were recruited using convenience and snowball sampling via student societies. Four were Computer Science students; one studied Psychology and Literature. All had prior experience with AI-assisted coding tools.

4.2 Data Collection

Semi-structured interviews (45-60 minutes) were conducted via Microsoft Teams to explore participants' experiences with AI tools and coding strategies. One was conducted in Cantonese, the rest in English. Interviews were recorded, transcribed using Teams' auto-transcription, and manually reviewed. Data were stored in UCL OneDrive.

To supplement interviews, participants also completed a short coding task or walkthrough. Observation notes were taken to capture behaviours such as tool-switching and verbal reactions to AI suggestions.

4.3 Interview Protocol

Questions were informed by educational frameworks including Bloom's Taxonomy, Dewey's experiential learning, and scaffolding theory [1, 5, 8], focusing on problem-solving, reflection, and authorship.

4.4 Data Analysis

Reflexive Thematic Analysis was conducted using a combination of inductive coding and deductive attention to the frameworks above [3]. Observational data supported triangulation. Given my own experience with AI coding tools, I remained aware of the risk of interpretive bias. Notes were kept during coding to ensure themes were grounded in participant narratives rather than personal assumptions.

4.5 Ethics

This study received approval from the UCL Interaction Centre Research Ethics Committee.

Fig. 1. Mind map illustrating eight key themes and subthemes from the analysis of AI-assisted coding.

5 Findings

Eight cross-participant themes were constructued, reflecting tensions between cognitive depth, trust, and learning. These themes are presented through a thematic summary (Table 2), a mind map (Fig. 1), and narrative elaboration with participant quotes to summarise the cross-participant themes identified through analysis. For each theme, key subthemes were listed, with associated participants, and a brief description to provide an overview of the diverse but overlapping experiences participants shared regarding AI-assisted coding.

Table 2. Cross-participant themes, subthemes, and descriptions.

Theme	Subthemes	Participants	Summary
1. Strategic and Selective Use of AI	AI for low-risk tasks; Avoiding AI for critical/problem-solving tasks	P1, P2, P4, P5	Students distinguish between exploratory vs. serious coding scenarios.
2. Risk of Shallow Engagement and Surface Learning	Skipping reflection; Over-reliance on AI output; Shallow understanding	P1, P2, P3, P4	Coding with AI often accelerates results but reduces cognitive depth.
3. Epistemic Friction and Reflection-Oriented Design Desires	Desire for AI to prompt thinking; Frustration with seamlessness; Reflection-enhancing design	P1, P3, P4, P5	Participants want AI tools that introduce friction to support deeper engagement.
4. Awareness of Skill Erosion and Educational Risk	Reduced debugging; Avoidance of fundamentals; Memorisation over logic	P1, P2, P3, P4	Awareness that overuse of AI can erode core problem-solving skills.
5. Emotional Satisfaction and Vibe Coding Flow	Relaxed or "in the zone" flow; Preference for improvisation	P1, P2, P3	Vibe coding creates enjoyable flow states, but may bypass structured reasoning.
6. Critique of Irresponsible AI Use by Others	Teammates pasting broken code; Ethical concerns; Group tensions	P2, P4, P5	Critique of irresponsible or opaque AI use in collaborative settings.
7. Code Authorship and Ownership Ambiguity	Blurred authorship; Questioning "whose logic"	P3, P4	Students reflect on authorship and intellectual agency in co-created code.
8. Task-Specific Calibration of Trust in AI	Context-sensitive trust; High scrutiny for high-stakes work	P4, P5	Trust in AI is calibrated based on task importance and risk.

5.1 Theme 1: Strategic and Selective Use of AI

Participants described making deliberate choices about when to invoke AI tools depending on the complexity, stakes, or nature of the task. Low-risk and exploratory tasks were most commonly associated with AI use, while critical or evaluative assignments prompted more cautious, manual approaches.

> "If I had a job interview coming up... I'd prepare for the interview myself. But if it's just a simple task, I'd ask AI to handle it." —P4

This distinction often mapped onto formal/informal boundaries: casual, personal, or creative projects allowed for more liberal AI use, while academic or high-pressure tasks required stricter control.

> "It's really nice for casual projects like maybe a Discord bot. Nobody's gonna proof your code." —P5

This theme shows students calibrate their reliance on AI based on accountability and learning intentions. Their discernment reflects an emerging literacy in human-AI collaboration, one sensitive to risk, context, and perceived legitimacy of outputs.

5.2 Theme 2: Risk of Shallow Engagement and Surface Learning

Participants described how the ease of accessing AI-generated code often led them to skip deeper engagement or reflection. The immediacy of solutions sometimes replaced critical thinking, especially in time-constrained or low-stakes scenarios.

> "I just copy and paste the solution from ChatGPT. If it works, good, I continue." —P1

Rather than using AI tools to explore underlying concepts, some participants admitted to using them as shortcuts to completion. This behavior, while efficient, risked creating superficial understandings of programming principles.

> "I'm not asking AI for the problem, I'm asking the solution." —P2

This practice aligns with what educational theorists call 'cognitive offloading,' where tasks are deferred to external systems without internalisation. The workflow appears productive but undermines conceptual understanding. This mode of engagement may go unnoticed because it conforms to values of efficiency and delivery, but it quietly shifts learning from an epistemic process to a consumption pattern.

5.3 Theme 3: Epistemic Friction and Reflection-Oriented Design Desires

Participants frequently expressed frustration with how AI tools deliver answers too quickly, without encouraging any form of intermediate reasoning. They articulated a desire for AI that prompts reflection rather than bypasses it.

> "Maybe ChatGPT can like ask you back, 'What you think first?' then give hints. Not just give answer straight away." —P1

This wish for friction aligns with constructivist and dialogic learning principles: students preferred AI that would engage them in a process rather than simply produce an output.

> "I don't want to see the answer before I think about it myself." —P3

Participants sought AI designs that scaffold reflection by slowing the coding process and asking questions. Rather than treating smoothness as a virtue, they framed friction as educationally productive. These accounts challenge the assumption that seamlessness always enhances user experience and instead highlight the educational value of epistemic pause, moments that preserve space for critical thought and ownership.

5.4 Theme 4: Awareness of Skill Erosion and Educational Risk

Participants demonstrated an acute awareness of the potential long-term consequences of relying too heavily on generative AI. While acknowledging its usefulness, many feared that constant use might impair fundamental skills such as debugging, logical reasoning, or even basic syntax recall.

> "If I keep doing this, maybe next time I cannot debug by myself." —P1

For some, this shift toward dependence felt like a regression. Tools once meant to assist were now seen as potentially hollowing out critical competencies.

> "In the past I'd compile and let it crash, then fix it… Now I skip all that and ask ChatGPT." —P4

This theme aligns with cognitive apprenticeship theory, where over-scaffolding can stunt rather than support learning. Participants' concerns reflect a desire for educational technologies that maintain, not replace, their active participation in solving problems and building fluency.

Rather than rejecting AI entirely, participants offered a nuanced critique: poorly designed systems may bypass productive struggle, leading to a quiet erosion of competence. These concerns point to harm that emerges not from malice, but from convenience, and is easy to overlook.

5.5 Theme 5: Emotional Satisfaction and Vibe Coding Flow

Several participants reflected on the emotional and experiential qualities of coding with AI, emphasising how the tools helped them relax and maintain creative momentum. Rather than seeing coding as a strictly logical task, some described a more fluid, affective state akin to artistic "flow."

> "Sometimes I just… flow …, code and code. But if you ask me why it's like that, I don't know." —P1

> "It's helped me code in a chill, relaxed way." —P2

Participants framed this "vibe coding" not as mindless automation but as a pleasurable and self-directed rhythm of creative work. However, they also acknowledged that this state might reduce critical awareness, especially when it came to understanding the AI-generated code or reflecting on their learning process.

While AI tools supported affective, immersive coding experiences, these benefits coexisted with risks of disengagement and conceptual detachment. The duality here is instructive: emotional satisfaction may obscure the depth and nature of learning losses, making such harms harder to articulate or contest within engineering discourse.

5.6 Theme 6: Critique of Irresponsible AI Use by Others

While participants were open to using AI tools themselves, several voiced frustration when others, particularly peers in collaborative settings, used AI irresponsibly. This included inserting code into shared projects without understanding or verifying its output.

> "You're using ChatGPT, and you don't even use it properly… it's like getting answers but from the wrong page." —P5

Such misuse was not merely seen as a technical oversight but as an ethical and epistemic lapse, with potential consequences for group dynamics and outcomes.

> "I'd hope they've run the code and vetted it before plugging it into our project." —P4

These criticisms reveal that participants see responsible AI use not just as an individual skill but a collaborative obligation. The tension is not with AI itself, but with how others wield it, especially when that use lacks scrutiny, accountability, or transparency.

5.7 Theme 7: Code Authorship and Ownership Ambiguity

AI-assisted coding raised deeper questions for some participants around authorship and creative agency. As coding tasks become co-constructed between human and machine, participants reflected on the extent to which they could claim ownership over the resulting work.

> "Logic is rigid… it's hard to say 'my logic' vs. 'your logic'. That's why in CS nobody usually asks, 'Do you think this code was really written by you?'" —P4

Rather than seeing themselves as authors in the traditional sense, some framed their role as curators or orchestrators of AI-generated content.

> "It's more like I am like the UX designer... and the AI is more like front-end developer." —P3

These reflections indicate a shifting relationship to knowledge work. While authorship was not always perceived as threatened, it was often seen as diluted or ambiguous. In contexts where correctness eclipses expression, the erosion of authorship may occur without resistance, not because it is accepted, but because it is barely noticed.

5.8 Theme 8: Task-Specific Calibration of Trust in AI

Participants' trust in AI outputs was not binary but modulated by the context and perceived stakes of the task. This pragmatic approach framed trust as a dynamic, task-contingent decision.

> "If I had a job interview coming up... I'd prepare for the interview myself. But if it's just a simple task, I'd ask AI to handle it." —P4

Trust was shaped not only by the risk profile of the coding task but also by a growing awareness of the AI's fallibility and the user's role in quality assurance.

> "It's really nice for casual projects like maybe a Discord bot. Nobody's gonna proof your code." —P5

Rather than universal skepticism or naive reliance, students adopted a calibration strategy: they adjusted their critical scrutiny and reliance on AI based on stakes, complexity, and audience expectations.

These eight themes provide a nuanced picture of how students navigate AI-assisted coding, balancing efficiency, trust, reflection, and creative momentum. While each theme offers specific insights, taken together they reveal broader tensions around authorship, learning, and the evolving role of AI in creative educational work. In the next section, we interpret these findings in relation to existing HCI theory and design futures.

6 Discussion

6.1 Reframing Vibe Coding: From Flow to Friction

Participants frequently described AI-assisted programming as fluid and intuitive. This aligns with emerging accounts of vibe coding as low-friction and improvisational. However, such ease often came at the expense of reflection and problem decomposition, suggesting that immediacy may undermine deeper understanding.

While often experienced as intuitive and efficient, vibe coding introduces cognitive patterns that may have harmful long-term consequences, particularly in educational contexts where reflection and conceptual grounding are essential as it constitutes a cognitive orientation that privileges fluency over deliberation. While effective in the short term, this mode risks eroding foundational reasoning and intellectual autonomy over time.

6.2 Learning with AI: Friction as Pedagogical Structure

Several participants expressed interest in AI features that introduced reflective friction, such as prompts to justify choices or consider alternatives. This suggests that educational AI tools function not merely as productivity aids, but as epistemic agents shaping how and when learners think.

In this light, human-AI interaction becomes a form of situated pedagogy. The design of AI systems influences whether users remain cognitively active or default to automation, particularly in contexts where learning is a primary goal.

6.3 Creativity and Risk Across Disciplines

Software engineering is unquestionably a form of creative labor. Yet in this study, creativity was typically associated with fluency, correctness, and problem-solving efficiency. Concepts such as ambiguity, authorship, or expressive experimentation received little emphasis, even when prompted.

This framing contrasts with how creativity is understood in other domains, such as the arts, where expressive authorship and identity are often central. While participants demonstrated awareness of skill erosion and epistemic shortcuts, the affective and ethical stakes of AI assistance were less frequently articulated.

This suggests a need for cross-disciplinary inquiry into how co-creativity with AI is experienced, framed, and negotiated in different fields. Such comparative research may illuminate why certain harms, particularly those tied to cognitive or authorship erosion, remain more visible in some domains and more subtle in others.

6.4 Designing AI for Reflective Engagement

Findings support reimagining AI-assisted coding environments not only as tools for acceleration but as scaffolds for reasoning. Educational systems should incorporate epistemic friction through design elements such as interaction delays, reflective prompts, or exploratory branching.

This aligns with recent critiques such as Generative AI Considered Harmful and Prompting Considered Harmful, which similarly call for rethinking the cognitive and epistemic implications of seamless GenAI interaction [7, 12]. Like those works, this study argues that design must move beyond productivity to foster intentional friction, scaffold reflection, and preserve users' intellectual agency.

7 Limitations and Reflections on Future Work

This study offers an exploratory account of students' engagements with AI-assisted programming, shaped by several methodological and interpretive limitations. For example, although the observational task sessions helped mitigate some limitations of retrospective interviews, they were brief and thus unable to capture the longer-term dynamics of in-the-moment cognition.

Future research could adopt longitudinal approaches, such as diary studies or ethnographic fieldwork, to explore how AI coding habits develop over time. Comparative studies across educational and industry settings would further clarify how practices like vibe coding are shaped by institutional stakes and values. In parallel, designing and testing systems that introduce epistemic friction (e.g., reflection prompts, interaction delays) could reveal how interaction design mediates learning and critical engagement.

More broadly, this study surfaces a form of harm that is subtle and difficult to recognise. Within software engineering, AI-assisted coding is widely perceived as enhancing fluency and productivity. These qualities, long valued in the field, may obscure the erosion of foundational reasoning and intellectual autonomy. Unlike in artistic domains, where AI's impact on authorship and expression is emotionally and politically charged, the risks here may remain largely unexamined.

The CHI'25 panel *Forging an HCI Research Agenda with Artists Impacted by Generative AI* offered a stark example. Speakers, including Megumi Ogata, best known for voice-acting *Ikari Shinji* in *Neon Genesis Evangelion* among others,

voiced concern over AI's incursion into artistic labor [9]. Ogata invoked emotionally charged language such as "戦争" (*sensō*, war), "世界" (*sekai*, world), and "戦い" (*tatakai*, battle) to describe the existential struggle faced by creative professionals. This framing diverges sharply from the more instrumental, tool-oriented perspectives expressed in this study. This difference does not imply that engineers face less risk—automation threatens software labour too—but it does suggest that the stakes are constructed and felt differently across domains.

Recognising these plural constructions of creativity and harm is essential. Vibe coding is not harmful because it obviously undermines labor. Rather, it is harmful because it appears to empower while gradually reshaping cognition, authorship, and learning. Future work must remain attuned to such quiet disruptions and consider how design, pedagogy, and critique can respond.

8 Conclusion

As generative AI becomes embedded in programming workflows, its impact reaches beyond productivity, reshaping how students learn, reflect, and claim authorship. This study offers an empirical account of how AI-assisted coding, particularly through the practice of vibe coding, alters the rhythms and responsibilities of software development.

The framing of "vibe coding" as low-friction creativity obscures its epistemic consequences. Unlike in the arts, where AI's intrusion into authorship is hotly debated, programming learners may not recognise the erosion of foundational understanding as a harm—precisely because AI supports them so effectively. This subtlety makes the risks more insidious.

Designing AI tools for education and creativity thus requires more than optimising output. It calls for systems that preserve intellectual friction, support epistemic responsibility, and respect the contextual nuances. As vibe coding continues to evolve, future research must attend to how educational technologies shape not only what we build, but how we think.

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