TPM Vol. 32, No. S7, 2025
ISSN: 1972-6325
https://www.tpmap.org/

NEW PROTAGONISTS: THE IMPACT OF NON-HUMAN COGNITION ON STUDENT-INSTRUCTOR RELATIONS

ALVARO CONTI
SCHOOL OF ARCHITECTURE & DESIGN, KING MONGKUT'S UNIVERSITY OF TECHNOLOGY,THONBURI, THAILAND, E-MAIL: acresearcher2025@hotmail.com

NIGEL POWER
SCHOOL OF ARCHITECTURE & DESIGN, KING MONGKUT'S UNIVERSITY OF TECHNOLOGY, THONBURI, THAILAND

Abstract
As students enter new cognitive and imaginative circuits with Large Language Models (LLMs), the relationship between student and instructor is being reconceived. This text investigates the perceived promise of a newly-emerging instructional relationship built on human/non-human synergies. It examines this through a university design workshop, in which participants ideate new product concepts through student–LLM assemblages. The validity of their exchanges is gauged using a mixed-methods research approach, combining paired T-Tests to examine shifts in pre- and post-workshop perceptions with Reflexive Thematic Analysis (RTA) to uncover key research themes. Findings show students associate non-human cognition with imaginative and autonomous possibilities unavailable through conventional instruction. A rising preference for machine-generated guidance sees students successfully outsourcing design tasks to LLMs, challenging anthropocentric standards of competence rooted in self-reliance. Although students suspect LLMs erode abilities, they remain drawn to them, incrementally entrusting them with greater instructional authority. These findings suggest an instructional dynamic where student intellectual growth is distributed across student, machine, and instructor. In this new technological reality, instructors ascend to an-even-more critical role. In enabling students to exploit LLMs as an intellectual extension of themselves, instructors potentially advance a new phase of shared inquiry. This signals a profound transformation in student–instructor relations, with instructors compelled to relinquish long-held instructional practices as LLMs shift their relevance toward a higher-order integration of student–LLM cognition.
Keywords : Digital Education, Anthropomorphic Instruction, Student-Instructor Relations, Large Language Models

1. INTRODUCTION

This research attempts to penetrate the perceived promise of Large Language Models (LLMs) within design pedagogy. Drawing on insights from students and educators it outlines a newly-emerging instructional relationship centred on human/non-human synergies (Duah et al., 2024; Sharples, 2023) and examines how instruction is being reconceived alongside LLMs in new learning assemblages that point beyond traditional anthropocentric instruction.

As students engage non-human cognition via LLMs, they invite a new protagonist into the learning sphere, complicating the primacy of human instruction. This development aligns with post-humanist critiques of human centrality in pedagogy (Hayles, 2023; Burriss & Leander, 2024; Wang & Wang, 2025). Framed by these perspectives, the study examines how the presence of LLMs and non-human cognition might alter the dynamics of student–instructor relations within studio-based design education.

The idea of a shared cognition increasingly underpins progress in design (Anadol & Kivrak, 2023; Kaasinen et al., 2022; Wakkary, 2021; Andrasek, 2019). It is possible to trace a consensus on this idea from diverse fields. Terzidis (2006) first forecasts a drift away from the idea that "the human mind is the central point of reference for any intellectual activity," (p.26) opening a path toward inclusion of non-human cognition via algorithm. Moreover, Wakkary (2021) affirms this position, positing a "sharing of the centre between humans and non-humans" in design (p.5). Lauvli (2023) argues that currently, the 'anthropocentric' emphasis "no longer takes the centre stage in all things" (p.33). Similar assertions are made by Hayles (2019, para. 1) who recognises that human species and emerging AI-driven technologies are "in the midst of entering into a deep symbiosis," with Yoo et al. (2023) acknowledging full entanglement with "non-human stakeholders". This collective shift has concretely manifested within design fields where for instance Andrasek (2019) describes a need for architects to augment themselves, having now reached cognitive and imaginative limits. Her pursuit of a "new cognition," one "likely to be deeply non-human" (p.115) permits her to contemplate designs that would otherwise be "out of reach" through a traditional architectural approach (p.119). In close parallel, the digital artist Refik Anadol firmly envisions "a symbiotic relationship with machines" (Anadol, 2022, para.5).

What can be inferred from this body of research is that non-human cognitive agents—in contrast to human—may soon emerge as the primary cognitive focal point for future instruction. LLMs could re-direct the way students learn, enabling them to access previously unattainable or latent abilities, and in doing so radically multiply the directions learners can point themselves in.

Given this context, research examines the validity of a new relationality built-upon human/non-human synergies. It explores this issue via a 2-day LLM workshop where participants are encouraged to ideate through student-LLM assemblages and in doing so, gauge new pedagogical approaches emerging from the integration of LLMs into studio-based design. Findings intend to deepen discourse on LLMs and their potential bearing on the future trajectory of student-instructor relations.

While the personalization capabilities of LLMs have been extensively studied, their impact on the dynamics between students and instructors remains underexplored (Viberg et al., 2024; Cao, 2024 notable exceptions). A review of existing research shows studies extensively framed in terms of individual student development and needs. Common points of research have explored how LLMs provide individual customization of academic goals (Sun et al., 2024); support learners working at their own pace (Shen et al., 2019); offer personalized guidance (Kumar et al., 2023); and promote learner self-motivation (Mayuri, 2021). Likewise, from the perspective of instructors, a substantial portion of research investigates individualized development through automated feedback of intelligent tutoring systems (Stamper et al., 2024); the crafting of personalised learning narratives for each student (Wasi et al., 2024); customizable content for learners (Kolagar & Zarcone, 2024); and a personalised system for online student practice (Kabir & Lin, 2023).

While undoubtedly significant, these studies largely emphasize the application of LLMs toward individual student enhancement, overlooking their impact on relational changes. A noticeable gap in literature remains with reference to how the introduction of LLMs might alter the foundational relationship between student and instructor, particularly within design fields where critique, feedback, and authority remains central to productive instruction. This gap highlights a need to explore the reframing of the student-instructor relationship, exposing how both parties might reconfigure their roles and identities in the face of LLMs, revealing potential for a broader change ininstructional dynamics across design pedagogy.

As the impact of LLMs on design pedagogy intensifies, multi-modal LLMs now fluidly integrate text, image, audio, and video (Wu et al., 2023) while low-level AI agents navigate tasks wholly independently (Putta et al., 2024). Academia is clearly approaching a watershed moment for rethinking student-instructor relations. It is being compelled to evolve its instructional practices to account for ‘non-human cognition’ and the challenges of this newly-emerging educational force. Through engagement with these technologies, a transformation of the student and their future relationship to instruction is anticipated and requires exploration.

1.1. Objectives

1. To penetrate the perceived promise of LLMs in design pedagogy and their challenge to traditional, anthropocentric models of instruction.
2. To investigate how the student-instructor relationship is being reconceived in response to LLM integration in studio-based learning environments.
3. To address limited research concerning the relational impact of LLMs, redirecting focus from personal to interpersonal dynamics.
4. To anticipate broader changes in instructional dynamics, influencing future educational practice.

2. RESEARCH METHODS AND MATERIALS

A design workshop was conducted within the Industrial Design program at the Design Innovation Practice School, Bangkok, Thailand. The workshop aimed to investigate shifts in the instructional dynamic with students encouraged to ideate within student-LLM assemblages. Scheduled over two days, (one-week-apart), the workshop sought to capture pre- and post-workshop perceptions regarding the student-LLM assemblage and the validity of its impact on the student-instructor relationship. Workshop requirements included a conceptual outline for a product (max. 300 words) reflecting on: (a) product features; (b) target audience; (c) unique selling points; (d) pre-launch strategy; and (e) distribution channels. Commercially available LLMs (ChatGPT, Claude, etc.) were used to explore novel solutions with use of AI text-to-image & text-to-video permissible following initial conceptual development.

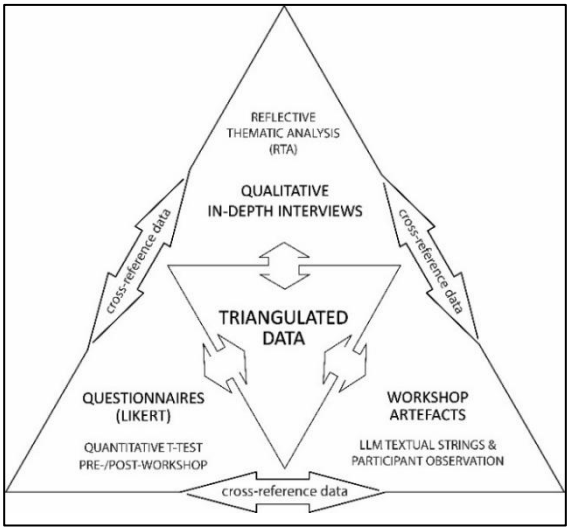
2.1. Research Participants

Participants included multi-lingual 1st–3rd Year design students (n=33) and design instructors (n=18), with selection based-on; English language ability; a foundational knowledge of LLMs; and experience designing/teaching with, and without use of LLMs. Ethical approval for research was granted by the institution's Research Ethics Committee.

2.2. Data Collection

There were several challenges to this case study that included: (a) limited sample size; (b) specific and non-generalizable nature to the research intervention; and (c) short time frame for data collection. Given these circumstances, a mixed-methods research approach was used to produce multiple data sets (both quantitative and qualitative) after which data triangulation increased the validity of findings (Fig.1).

Figure 1: Data Triangulation across multiple data sources



Nunes et al., (2019) show data triangulation allowing findings to be cross-verified and corroborated across different sources, with any inconsistency in one data source offset by strengths in another, increasing the trustworthiness of final results. This approach was well-suited to address the aforementioned challenges, enhancing the reliability and coherence of all findings to offer a deeper understanding of participants' attitudes and perceptions.

2.3. Quantitative and Qualitative Tools

The table depicts all research tools used to gather and analyse workshop data:

Table 1: Data-collection methods

Data Type	Participant	Research Tool	Metric	Ref. No.
Quantitative	Student	Questionnaire: Baseline	Paired T-Test	S1
		Questionnaire: Comparative		S2
Qualitative	Student	In-depth Interview	Reflexive Thematic Analysis (RTA)	S3
	Instructor	In-depth Interview		E1
	Student / Instructor	LLM Interactions Day-1		LLM1
		LLM Interactions Day-2		LLM2

Quantitative data were first collected in-person through baseline and comparative questionnaires (S1 and S2). These pre- and post-workshop questionnaires aimed to assess changes in student perceptions over the course of the workshop. They contained 28 identical Likert-scale statements, organized into four sections: (a) Imagination (b) Autonomy (c) Agency and (d) Reliance (see Table 2). Each area was identified in literature as susceptible to the influence of non-human cognition i.e. *imagination* in design education is increasingly scaffolded by non-human agents (Colson & Gross, 2024); *autonomy and agency* are in transition as non-human cognition begins to influence student decision-making (Shah et al., 2025); and *reliance* signals a growing interdependence with LLMs, altering how students interact with both human and machine-based sources (Selim et al., 2024). Responses were analysed using paired t-tests, with a sample size of students (n=33) meeting the minimum threshold for statistical significance (Lakens, 2022, p.1).

Qualitative data were next collected via in-depth interviews (S3 and E1). Students (n=33) and Instructors (n=18) were asked a set of structured open-ended questions that sought to gauge whether the student-LLM assemblage might influence anthropocentric instruction (i.e. meeting frequency, methods, resources etc.). Qualitative data were analysed using Reflexive Thematic Analysis (RTA) (Byrne, 2022; Braun & Clarke, 2019). Coding and themes followed reflexive practices, with lead researchers engaging interpretively with the data (Byrne, 2022, pp.1391–1394). This iterative procedure allowed a series of key themes to emerge from participant narratives. By acknowledging the interplay between data, researcher background, and theoretical framework, researchers assembled a "well-structured interpretation of findings" (Naeem et al., 2023, p.15). This integration of both

quantitative and qualitative data sources ensured that research objectives were more effectively addressed.
To fulfil triangulation, workshop artefacts (primarily LLM textual strings) provided a further source of insight into student-LLM interaction (LLM1&2). Workshop observations were documented, with follow-up student/instructor interviews used to bring salient workshop experiences into greater focus. All data sources were then cross-referenced to build a cohesive understanding from the full spectrum of student/instructor feedback.

3. RESULTS

Results were analysed in two phases:

3.1. Phase 1: Baseline and Comparative Questionnaires STUDENTS

The BASELINE and COMPARATIVE questionnaire results (Table 2) reflect student pre- and post-workshop perceptions regarding the influence of LLMs on key areas of their instruction namely: Imagination, Agency, Autonomy, and Reliance on traditional pedagogical resources.

Table 2: Paired Sample T-Tests: P-values for pre- and post-workshop student responses

Paired Sample T-Test										
			Paired Differences							
						95% Confidence Interval of the difference				
Section	**Pair**	**Statement**	**x̄**	**SD**	σM	**Lower**	**Upper**	**t**	**df**	**Sig.**
Imagination	01	LLMs are able to support imagination	-.7879	1.1925	.2076	-1.2108	-.3650	-3.795	32	.001
	02	LLMs can create surprise responses in my work	-.060	.9981	.1737	-.4145	.2933	-.349	32	.730
	03	Interaction with LLMs introduces new directions	-.1515	.7124	.1240	-.4041	.1011	-1.222	32	.231
	04	Using LLMs can support how I explore ideas	.1212	.8200	.1427	-.1695	.4120	.849	32	.402
	05	LLMs are involved in expanding imagination	-.5758	1.0906	.1898	-.9625	-.1890	-3.033	32	.005
	06	LLMs play a part in my creative tasks	-.5455	.7942	.1382	-.8270	-.2639	-3.946	32	.000
Agency	07	Using LLMs changes how much control I feel I have	-.3030	.9838	.1713	-.6519	.0458	-1.769	32	.086
	08	Using LLMs positively empowers my work	-.1818	.7269	.1265	-.4396	.0759	-1.437	32	.160
	09	Using LLMs can support students in overcoming creative blocks	-.3636	.7833	.1364	-.6414	-.0859	-2.667	32	.012
	10	Information from LLMs is as good as info. from other sources	-.3939	1.321	.2300	-.8625	.0746	-1.713	32	.096
	11	Using LLMs changes how much students rely on instructors	-.1818	.8083	.1407	-.4684	.1048	-1.292	32	.206
	12	LLMs give different information than instructors	-.5455	1.0335	.1799	-.9119	-.1790	-3.032	32	.005
Autonom	13	Using LLMs changes how confident I feel about working	-	1.039	.180	-.6411	.0957	-	32	.141
y	14	independently	.2727	0	9	-.6519	.0458	1.508	32	.086
	15	LLMs support students working independently	-	.9838	.171	-.7935	-	-	32	.033
	16	LLMs change how students learn beyond usual methods	.3030	.8704	3	-.6205	.1762	1.769	32	.033
	17	Using LLMs changes how much users depend on	-	.6893	.151	-.9428	.1365	-	32	.009
	18	instructors	.4848	1.120	5	-.8898	-	3.200	32	.003
	19	Using LLMs may promote students working by	-	6	.117	-.8110	.1481	-	32	.033
	20	themselves	.3750	.9712	8	-.2829		3.198	32	.845

		LLMs provide different views from instructors LLMs effect how I explore new topics on my own LLMs increase my confidence when learning on my own	-.5455 -.5455 -.4242 .0303	1.0906 .8833	.1951 .1691 .1898 .1538		-.2011 -.0375 .3435	-2.796 -.3.266 -.2.235 .197		
Reliance	21 22 23 24 25 26 27 28	My reliance on LLMs when learning and designing may increase Students may rely less on other people when using LLMs Increased use of LLM may lead to increased reliance on them Using LLMs may reduce the need for other information resources LLMs are integral to my learning and design work LLMs could become essential in learning and design contexts Students may experience decreased interaction with instructors when using LLMs Students may rely more on LLMs as LLMs improve	-.1515 -.0303 -.4545 .0000 -.3333 -.3939 .0303 -.3030	1.0038 .8833 .7942 1.3463 1.0801 .7044 1.2371 .7699	.1747 .1538 .1382 .2344 .1880 .1226 .2153 .1340	-.5074 -.3435 -.7361 -.4774 -.7163 -.6437 -.4083 -.5760	.2044 .2829 -.1730 .4774 .0497 -.1442 .4689 -.0300	-.867 -.197 -3.288 0.000 -1.773 -3.213 .141 -2.261	32 32 32 32 32 32 32 32	.392 .845 .002 1.000 .086 .003 .889 .031

3.1.1. Key Findings

Key findings revealed that students unanimously perceived LLMs as enhancing their imagination (p=.001) and undertaking of creative tasks (p=.000). They clearly supported students in overcoming creative blocks (p=.012) and provided different information from instructors (p=.005) potentially expanding imagination (p=0.005). In addition, LLMs promoted independent learning (p=.009) and changed student dependency on instructors (p=.033). They altered how students learn beyond usual methods (p=.033), affect the exploration of new topics (p=.033), and through their increased use, engender greater reliance (p=.031). Students showed less reliance on others (p=.002) and considered LLMs becoming essential to their learning and design work (p=.003).

Despite positive advantages, many areas of research showed no significant change. LLMs did not alter surprise responses in work (p=.730), exploration of ideas (p=.402), sense of control (p=.086), empowerment of work (p=.160), or reliance on instructors (p=.206). They did not significantly underpin students' confidence (p=.845) or affect use of other information resources (p=1.000). Furthermore, increased interaction with instructors remained unchanged (p=.889), and LLMs were not yet understood as integral when learning or designing.

3.1.2. Summary

LLMs appear to significantly influence some relational dimensions while having less impact on others. The analysis indicates a transformative shift towards LLMs over human instruction for particular tasks (i.e. extending imaginative capacity). LLMs additionally encourage independence by enabling students to overcome imaginative barriers and explore alternative design directions autonomously.

Despite catalysing student imagination, LLMs do not appear to increase students' confidence, rather the inverse is noted. Moreover, students do not yet perceive the quality of information from LLMs as equivalent to other sources, nor has their reliance on instructors significantly changed. These results demonstrate an inherent complexity to the validity of the student-LLM assemblage, highlighting areas where LLMs are making a significant impact on student/instructor relations, and areas where their influence is still evolving.

3.2. Phase 2: In-depth Interviews STUDENTS

Post-workshop in-depth interviews with students (n=33) discussed their newly-emerging relationship with instructors. These covered aspects of imagination; unpredictability of student output; student integration of LLMs; LLM dependency; and potential future changes in instructional dynamics following student-LLM assemblages. The iterative development of all key themes is described below (Table 3):

Table 3: The RTA process conducted in 3 iterations to identify key research themes

REFLEXIVE THEMATIC ANALYSIS (Students)

Iteration 1: The Emergence of Broad Themes		
#	***Theme***	***Interpretation***
1	***Generating Imaginative Stimulus***	*Highlights how LLMs stimulate and expand students' imagination*
Statement: *"…we get to see more opportunities of how we can go outside from our ideas…"*		
2	***Human/Non-Human Equilibrium***	*Focuses on the balance* between *LLM and traditional human instruction.*
Statement: *"I still feel like my instructor gives me more ideas that LLMs don't understand".*		
3	***Gradual Shift in Instruction***	*Captures changes in instruction, with LLMs reducing need for direct instructors/peer interaction*
Statement: *"It's like asking the instructor, but way faster."*		
4	***Impact on Confidence and skills***	*Analyses the dual impact of LLMs in both enhancing and weakening students' confidence in their own abilities.*
Statement: *"I feel more confident with CGPT and then without CGPT my confidence is dropping."*		
5	***Cognitive and skill development***	*Explores the dual impact of LLM usage on cognition and skills.*
Statement: *"…it's changing me…the way I think."*		
6	***Dependency vs Reliance***	*Addresses the growing reliance on LLMs, highlighting the fine line between productive use and dependency.*
Statement: *"…it's kind of like made me stop thinking about how to manage. And then I just let it manage for me."*		
7	***Displacement of Ability***	*Explores the displacement of a student's existing ability onto LLMs.*
Statement: *"I copy and paste and that's it. I don't think as much as I used to."*		
Iteration 2: Re-interpreting, Refining and Renaming Data		
#	***Theme***	***Interpretation***
1	***Synthetic Provocation***	*Emerges from the earlier, broader 'Generating Imaginative Stimulus' theme, emphasizing the LLM's role in synthetically provoking greater unpredictability.*
Refining Statements: *"Sometimes I really had no idea about what is going to happen...it makes the Gold stone...with a Green one..."*		
2	***Human/Non-Human Equilibrium***	*Maintained to highlight equilibrium between LLM use and human instruction.*
Refining Statements: *"It doesn't make me not want the instructor."*		
3	***Substitution by Increment***	*Replaced the earlier 'Gradual Shift in Instruction' theme, focusing on the incremental replacement of human interaction by LLMs.*
Refining Statements: *"…we don't really talk to co-workers much now."*		
4	***Impact on Confidence and Skills***	*Remained but refined to highlight the negative impact of LLMs on student confidence and skills.*
Refining Statements: *"I need it to help me…because it's not the same as myself…its higher from other perspectives."*		
5	***LLM-assisted Competence***	*Evolved from the 'Cognitive and Skill Development' theme to emphasize preference for LLM 'non-human' cognition over self-sufficiency.*
Refining Statements: *"I would say if I have any work I have to do without it, I can…but I know that I can do it better with it."*		

6	***Dependency-Reliance Spectrum***	*Developed from the earlier 'Dependency vs Reliance' theme, exploring the transition from LLM reliance to ultimate overdependency.*
Refining Statements: *"…years ago, we go on Google (to verify) …but right now…we're just asking CGPT…we always ask CGPT."*		
7	***Erosion of Student capacities***	*Intensifying the 'Displacement of Ability' theme towards the use of LLMs eroding long-standing traditional capacities.*
Refining Statements: *"I think it make us lack some of the processes (for design) like researching…and we might miss some experience."*		
Iteration 3: Final Theme Definition		
#	***Theme***	***Interpretation***
1	***Synthetic Provocation***	*Maintained to express unpredictability as a key factor in imaginative potential and ability to surpass instructors' imaginative scope.*
Refining Statements: *"With LLMs I have some power for some areas no one else can teach…"* *"…it does help guide me into like different ideas."*		
2	***Human/Non-Human Equilibrium***	*Emphasized the irreplaceable value of human instructors alongside LLM use*
Refining Statements: *"…the LLM it's telling you what you're asking it, right? But for the instructor, they telling you what you need to know and guessing what knowledge you should have."* *"… for something that need emotion, I want human."*		
3	***Margin of Substitution***	*Highlighted the incremental substitution of human interaction taken-up by LLMs*
Refining Statements: *"I can ask it 24/7 and don't have to ask my friends."* *"It's also decreased the conversation time with my co-workers as well…"* *"Yeah…I use LLMs as a teacher."*		
4	***Competence Reframed***	*Preferential use of non-human cognitive agents to enhance student competence*
Refining Statements: *"I would say if I have any work that I have to do without it, I can…but I know that I can do it better with it."* *"I think I feel like I can do anything I want, since the LLM can help you with anything."* *"I feel like I'm cheating the teachers now."*		
5	***LLM Erosion of Confidence & Capacity***	*Themes 4, 6&7 consolidated to emphasize the long-term risks of LLM reliance and its ability to ultimately erode traditional capacities.*
Refining Statements: *"I feel like, OK, I'm look smarter, but I know for myself that I have lower self-confidence as keep relying on it."* *"I have to control myself not to depend on it too much…because it'll cut my creativity and productivity."* *"I feel like I just ignore the good part…the learning part…and I just copy from it."* *"It's like you're depending on it…more than yourself."*		

3.2.1. STUDENT: RTA Themes & Findings

The finalized themes demonstrate the effects of LLM integration on the student-instructor relationship:

Theme 1 | Synthetic Provocation

LLMs act as a synthetic provocation for student imagination, steering their design process away from habituated responses. Students claim LLMs have the potential to provoke an unpredictability in design—unavailable through human instruction—validating engagement with non-human cognition.

Theme 2 | Human/Non-Human Equilibrium

Although non-human cognition can provoke student imagination and drive design novelty, students still demand a human component to contextualise meaning.

Theme 3 | Margin of Substitution

Student dissatisfaction with instructors is inviting an incremental substitution of human instruction with non-human cognition from LLMs. Use of LLMs is expected to progressively absorb anthropocentric instruction (i.e. instructor approval, feedback, recommendations) as unfulfilled student requests are increasingly diverted to LLMs.

Theme 4 | Competence Reframed

Engagement with non-human cognition reframes student competence, moving away from the traditional ability to respond independently (i.e. to criticise, problem solve, and/or decide unaided), towards the effective delegation of these tasks to LLMs.

Theme 5 | Erosion of Competence & Capacity

LLMs have a complex impact on student confidence and ability. Over-employment of LLMs can erode traditional human-centric skills as design responsibility is increasingly automated. Students acknowledge the need to retain intellectual independence from LLMs, yet appear sufficiently persuaded by their appeal to disregard these traditional inclinations.

Analysis shows significant shifts in Student-Instructor relations. Students view LLMs as imaginative catalysts, triggering novel design directions that exceed the capacities of a conventional instructional relationship *(Theme-1)*.

Whilst students acknowledge that LLMs augment imagination, data show that they still value the deeper human insights that instructors provide. This underscores the need for an instructional relationship, aligning human with non-human cognition *(Theme-2)*. Students caution that dissatisfaction with elements of anthropocentric instruction (i.e. poor availability/under-investment from instructor) is inviting LLMs to incrementally substitute human instruction. If asymmetry between student demand and instructor fulfilment persists, the increased presence and authority of LLMs in instruction will be warranted, and from the perspective of the student fully justified *(Theme-3)*.

As students habitually delegate design tasks to LLMs, their trust in independently executing design tasks is being gradually eroded. While recognizing a need to maintain human-centric design competencies (i.e. unassisted criticality), the allure of successfully off-loading these skills to LLMs appears to overshadow this concern, signalling a paradigm shift in student-instructor relations *(Theme-4)*. An excessive reliance on LLMs arguably threatens human-centric skills "embedded in the individual" (Tahirsylaj & Sundberg, 2020, p.141). As students increasingly defer workload to LLMs, they potentially rob themselves of the chance to build their capacity for independent analysis and synthesis of ideas, displacing a more traditional arc for student development *(Theme-5)*.

3.3. Phase 2: In-depth Interviews INSTRUCTORS

Post-workshop in-depth interviews with Instructors (n=18) addressed the impact of LLMs on instructional dynamics. Interviews covered aspects of design pedagogy; imaginative development; use of non-human cognition; LLM dependency; adaptation of instruction and; future professional identity. Interview data were iteratively grouped into themes (Table 4):

Table 4: The RTA process conducted in 3 iterations to identify key research themes

REFLEXIVE THEMATIC ANALYSIS (Instructors)		
Iteration 1: The Emergence of Broad Themes		
#	***Theme***	***Interpretation***
1	***Adapting Instructional Methods***	*Reflects the ongoing adaptation of instructional methods following LLM integration.*
Statement: *"…I've explored discussions on how to exploit LLMs."*		
2	***Expanding Imagination***	*Highlights how LLMs have expanded the students' imaginative capacity.*
Statement: *"…they [students] explore unconventional design approaches, so we have more provocative conversations…"*		
3	***Challenges to Critical/Creative Abilities***	*Addresses the potential drawbacks of LLM usage, namely deterioration of critical and creative abilities.*
Statement: *"LLM use can erode students' critical capacity if they don't actively engage in questioning output."*		
4	***Shift in Student Agency and Interaction***	*Examines how LLMs effect student agency and alters interaction with instructors/peers through increased independence.*
Statement: *"Students' sense of agency has changed since engaging with LLMs."*		

5	***Transformation of Traditional Instruction***	*Captures the shift from traditional, human-centred instructional methods towards an approach incorporating LLM-non-human cognition.*
Statement: *"Students rely less on traditional instruction as they turn to LLMs for support and reassurance."*		

Iteration 2: Re-interpreting, Refining and Renaming data

#	*Theme*	**Interpretation**
1	***Adapting Instruction***	*Emerging from 'Adapting Instructional Methods,' it emphasizes continuous 'professional flexibility' to keep pace with LLM integration.*
Refining Statement: *"We need to change with them. Now it's an on-going dialogue."*		
2	***Elevated Imagination:***	*Focuses on how LLMs synthetically provoke imagination, enabling students to explore concepts to greater depths and diversity.*
Refining Statement: *"LLMs help students generate diverse concepts and ideas."*		
3	***Challenges to Critical/Creative Abilities***	*Highlights the dual impact of LLMs on students' critical thinking and imagination, stressing disappearance of these skills over time through overreliance on automated output.*
Refining Statement: *"Generated responses replace personal reasoning."*		
4	***Circumventing Instruction***	*Emerging from 'Shifts In Student Agency and Interaction,' focusing on how LLMs alter student agency, decreasing reliance on traditional instruction.*
Refining Statement: *"When they are more reliant on LLMs, they seem to be less reliant on traditional instruction."*		
5	***Transformation of Traditional Anthropocentric Instruction***	*Emphasizes the shift from human-centred instruction towards a model incorporating non-human cognition.*
Refining Statement: *"The learning approach is shifting towards integrating non-human cognition, with LLMs playing a significant role in the instructional process."*		

Iteration 3: Final Theme Definition

#	*Theme*	***Interpretation***
1	***Transformation of Anthropocentric Instruction***	*Combining 'Themes 1 & 5' consolidates the issue of Transformation of Anthropocentric Instruction as LLM non-human cognition compels instructors to adapt instructional methods.*
Refining Statements: *"…this disruption forced me to rethink how to teach the individual..."* *"AI is hanging them…we gotta teach them more defense?"* *"They [students] now have access to instant information and assistance, which could lead to a decreased reliance on the traditional instructional."* *"They can decide and design what they want to learn. I want to help them make sense of LLM works."*		
2	***Elevated Imagination***	*Finalized to emphasize how LLMs expand student imagination, beyond human-centered pedagogy.*
Refining Statements: *"…their questions are beyond what I can answer."* *"The students are discussing issues that I haven't still encounter"* *"LLMs trigger new aspects for teaching by giving students a powerful tool to generate content and explore ideas."*		
3	***Critical and Creative Paradox***	*Paradox of LLMs enhancing productivity, yet blunting critical and creative thought through long-term use.*
Refining Statements: *"Inexperienced students seem to rely on the technology and not on their own ideas."* *"I fear if used too much, LLMs will result in students' weakness in their imaginative capacities."* *"LLMs can benefit at the same time weaken their learning if we are ignorant."* *"…mediocre students will use this tool unimaginatively which as a result, it becomes a machine to ground them onto a limited window."*		

4	***Circumventing Instruction***	*Clarified to reflect a significant change in student agency, where LLM-enabled independent learning redefines the traditional instructional relationship.*
Refining Statements: *"They're no-longer tied to us like before."* *"Students feel empowered to take ownership of their design…they prefer to get AI answers."* *"It has opened up design discourse, comparing it to the conventional approach."*		

3.3.1. INSTRUCTOR: RTA Themes & Findings

The finalized themes demonstrate how LLMs are reconfiguring the student-instructor relationship:

Theme 1 | Transformation of Anthropocentric Instruction

As non-human LLM cognition incrementally supplants previous elements of human instruction (i.e. authority, feedback) instructors are driven toward a new professional identity as emphasis shifts away from traditional anthropocentric instruction.

Theme 2 | Elevated Imagination

Instructors recognize that LLMs provide unprecedented design assistance, with students investigating design concepts to a greater depth and diversity than solely offered by instructors.

Theme 3 | Critical & Creative Paradox

As students repeatedly employ LLM-machine cognition, their ability to perform critical and creative tasks unassisted is impaired. Paradoxically, a tool intended to enhance student learning may ultimately undermine it.

Theme 4 | Circumventing Instruction

LLMs alter students' perceptions of agency, prompting circumvention of traditional pedagogical exchanges. Data confirm that greater project control via LLMs reduces reliance on human-centric instruction.

The integration of non-human cognition challenges the centrality of the instructor, underscoring the need to adapt their instructional role and identity to maintain relevance in a rapidly evolving instructional environment *(Theme-1)*. Instructors recognise that LLMs allow students to independently explore a breadth of ideas previously unattainable from within the confines of traditional instructional relationships *(Theme-2)*. Instructors retain concern for excessive LLM engagement undermining the goals of anthropocentric instruction as they erode students' ability to engage in independent, unassisted, critical thinking. Paradoxically, what should enhance ability may instead undermine it *(Theme-3)*. A profound shift in relations emerges as students increasingly reassign elements of design, guidance, and approval to LLMs, circumventing traditional channels of instruction. This marks a reduced dependency on instructor authority, supervision and influence, further altering the instructional dynamic *(Theme-4)*.

3.3.2. Workshop Artefacts: LLM Textual Strings & Prompting

As a tertiary data source, the use of workshop artefacts added depth and credibility to the interpretive process. In line with earlier RTA findings, students reported that advanced prompting strategies elicited a breadth of responses unavailable through traditional instruction. The student-LLM assemblage was clearly integral for imaginative leaps and its successful use established a sense that something new was being accessed within students. In addition, greater confidence for a specific design direction was felt and acted upon when corroborated by LLM (with students experiencing less hesitancy than under human instruction). This validation of LLMs—manifesting through reduced hesitancy and uncertainty—points to a greater trust and authority being placed on LLM output. With prolonged interaction, some students reported adopting LLM characteristics i.e. their precision, format, clarity. This suggests that students may be internalizing aspects of LLM cognition, with frequent prompting appearing to ameliorate the way certain students articulate their thoughts (i.e. more complete, connected and coherent). In stark contrast, other students felt an inadequacy when comparing their abilities to the responses generated by LLMs. This indicates that, rather than inspiring or aiding students, the LLM's advanced capabilities may trigger self-doubt or discouragement.

4. CONCLUSION

4.1. A 'New Relationality'—Reconceiving Learning Alongside LLMs

Findings indicate that the traditional student-instructor relationship is being dismantled or at least heavily redefined *(I-Theme-1)*. In a newly-emerging relationship, greater imaginative potential is achieved through human/non-human synergy. The student-LLM assemblage appears to unlock more extensive and innovative learning and the student's use of them—to access novel solutions—is circumventing traditional methods available through human instruction *(S-Theme-1/I-Theme-2)*.

As a result, doubt is driven into the priority of human instruction. The perceived authority of the instructor is shifting as students increasingly view LLMs as an equally valid—or arguably superior—instructional resource in certain design contexts *(S-Theme-1)*. With LLMs providing a shortcut to design solutions, students appear less patient with the pace of human instruction, prioritizing investment in LLM cognition over human. This foreshadows the LLM taking up a much broader margin of instruction *(S-Theme-3/I-Theme-4)*.

Instructors state LLM overuse among students may inhibit independent thought, leading to weakened imagination, diminished criticality, and less confidence in their own problem-solving abilities. Some students indeed reported an undermining of confidence—even intimidation—by the proficiency of LLMs as they increasingly deferred responsibility to them *(S-Theme-5/I-Theme-3)*. These perceptions threaten the emergence of a 'two-tier' student corpus, where highly-motivated students thrive, and less-driven students risk being left behind, unnoticed by instructors within an increasingly LLM-dominated instructional context.

The pedagogical risks associated with LLMs (i.e. erosion of traditional skills, lack of independent thought, reliance on external assistance, two-tier student corpus) are becoming evident as students realize these tools are not all they are claimed to be. As this realization plays out within a new student-instructor relationship, instructors express a need to shield students from their own predisposition toward more convenient, shallow instructional practices, as they become less conflicted between machine-generated guidance and human recommendation *(I-Theme-3)*.

Given the above, data allude to instructors taking the student-instructor relationship in a metacognitive direction, making deeper reflection possible and recontextualizing the students' machine-driven experiences. This evolution in identity cannot be understated. It escapes framing instructors in opposition to LLMs (i.e. where their relevance and validity is debated in terms of inimitability) a position that may prove increasingly obsolete as LLMs reach new capabilities. Instead, in a more dialogical relationship, instructors assist students in strategically exploiting LLMs as an intellectual counterpart, navigating toward a new epistemic relationship, rather than reinforcing previous oppositional models *(I-Theme-1)*. This proposes an instructional dynamic in which the student's intellectual growth is distributed across student, machine and instructor.

With data showing student preference for non-human cognition *(S-Theme-1/I-Theme-2)*, adhering to anthropocentric practices becomes difficult to justify. Moreover, as students improvise with these tools, data show them unsettling traditional practices, most visible in their outsourcing to LLMs, the very tasks that served to demonstrate their own human competence *(S-Theme-4/I-Theme-4)*. Consequently, instructors must confront whether to legitimize this new relationality or persist with previous anthropocentric standards. In the absence of clear institutional guidance, instructors engage these new dynamics with limited precedent. Who now is accountable for a design decision mediated by an LLM? What does it mean for students to 'understand' a concept when its explanation is outsourced? How do instructors preserve an authoritative dimension when they are no longer the sole focus of insight? These questions reflect the altered relationship between student and instructor, and demand reconsideration of the long-standing circuits of instructional exchange. The student-led integration of LLMs *(S-Theme-3)* actively signals to instructors a need for their existing relationship to push past previous anxieties (i.e. unassisted competency, sole authority, instructor inimitability by LLM) toward instructors serving an integrative function in a new student-LLM-instructor dynamic.

Moving forward in this new relationality, students and instructors jointly engage in exploring the ideas, tools, and methods that expand the student's capacity to harness non-human cognition. Instructors build essential interpretive skills to help students engage more deliberately with the tools and processes, and to make sense of the evolving context. Effective instruction might best be gauged by how well it helps students develop a reflexive relationship with LLMs—using them to extend, challenge, and refine their intellectual reach. In this context, the instructor assumes an active role, called to participate in the messy evolution of student-LLM relations, remaining meaningfully present in the evolving triangle of student–machine–instructor. Such an instructional approach can offer actionable, relevant paths forward, even amid current uncertainty.

While unease around LLM use persists, research findings suggest a value in moving the student-instructor relationship beyond anthropocentric modes of instruction, toward approaches grounded in human–machine interaction. Such a shift is likely to be shaped by both the successes and failures of practice-led change, prior to being institutionalized. Instructors have a key role in guiding the understanding of this new relationship whilst inevitably evolving alongside it.

5. DISCUSSION

Research explored the transformative influence of LLMs on student–instructor relationships within Thai design education, positing movement beyond anthropocentric models of instruction. While many studies position LLMs as individualized support tools (Sun et al., 2024; Kumar et al., 2023; Kabir & Lin, 2023 etc.) this study highlighted how LLMs participate in recasting student–instructor relations, roles, and identities—areas that remain insufficiently addressed. As such, they continue to complicate instructor commitment and warrant further discussion.

5.1. Instructor Complacency

Student use of LLMs and non-human cognition is redirecting anthropocentric instruction but not fully substituting it. Interview data show that LLMs do not yet supplant their desire for a human element *"...It doesn't make me not*

want the instructor." In spite of this, instructors must resist complacency and remain vigilant. Interview data suggest that while students still value the human elements of instruction, dissatisfaction with current instructional practices opens space for the presence of LLMs. Chan and Tsi (2023) identify a "generational openness" toward LLM integration in instructional processes (p.7/18). Rather than any forcible institutional replacement of instructors by LLMs, findings suggest LLMs being incrementally invited—by students—to substitute human instruction. Evidence indicates that sustained dissatisfaction with instructors could lead to their progressive circumvention, with students seeking instruction in non-human cognitive agents like LLMs.

As depicted by Ghamrawi (2024) and Felix (2020) instructors failing to recognize this context, may inadvertently contribute to their own undermining as aspects of their pedagogical authority are transferred over to non-human agents, masked as a necessary and pragmatic response by students. As human/non-human cognition merges in instruction, instructors must commit to exploiting the unique strengths of both, whilst mitigating unwanted secondary effects.

5.2. Destabilising Student-Instructor relationships

With universities endorsing research as the most valuable dimension of academia, instructors are arguably progressing their career paths at a cost to instruction, which is regarded as a time-consuming and "less noteworthy sphere of endeavor" (Rowan & Grootenboer, 2017, pp.2-3). Moreover, in light of "changing institutional practices" (Griffith & Altinay, 2020, p.691) and economic factors (Scott & Guan, 2023), universities are aiming to exploit the potential benefits of AI-driven technology (i.e. scalability, automation, optimization) adding momentum to a destabilisation of student-instructor relations. Students may soon be navigating an educational landscape where previously indispensable skills—rooted in fundamental human-centric relations—are conceded by the economic imperatives of universities, compelled to adopt AI-driven efficiencies for future survival. Given these circumstances, LLMs appear poised to increase their scope over anthropocentric instruction, cementing a new relationship between student and LLM. Whether instructors will assume the responsibility of managing this evolving dynamic, amidst the demands already placed upon them, remains a critical point of consideration.

5.3. From a constructive standpoint

While a decline of human-centric skills through LLM poses significant challenges for students, it may also be facilitating the development of novel qualities that are not-yet-fully recognized. As students enter into spontaneous, real-time interaction with LLMs, a more improvisational development of the student occurs through reciprocal exchanges with non-human cognition *"...it's changing me...the way I think."* Students frequently exposed to LLM usage display signs of internalizing LLM approaches to solving problems. Novoa and Duarte Arias (2025) propose the notion of LLM as 'complementary cognitive artefacts.' However, data here imply further development whereby LLMs move from complementary tools to potential catalysts, enabling recursive self-improvement. Such observations suggest a starting point for subsequent studies.

5.4. Outsourcing competence

Research suggests that while anthropocentric instruction frames student competence in terms of abilities embedded in the individual (Tahirsylaj & Sundberg, 2020), students instead view LLMs as a tool to outsource these competencies *"...I would say if I have any work that I have to do without it, I can…but I know that I can do it better with it."* This resonates with Lauvli (2023) and Wakkary (2021) who express a dissolving boundary between human and machine cognition, as anticipated by Hayles (2019) through her articulation of a "deep symbiosis" between AI and human thought. In a newly-emerging student-instructor relationship, instructors are being forced to reconsider their understanding of student competence, surrendering the notion that it is demonstrated through independence from external support i.e. the ability to conceptualize and/or criticize design ideas unassisted. Accepting such a shift may be viewed as risky or even reckless, as it challenges established educational benchmarks, especially given a growing body of evidence highlighting potential drawbacks of LLM usage for students (Håkansson & Phillips-Wren, 2024; Zárdai, 2024; Park & Ahn, 2024). To abandon this existing criterion for competence marks a profound and likely irreversible shift in educational values. The significance of this finding invites broader investigation.

5.5. Holding or unmooring from the anthropocentric model

Although excited by the benefits of LLMs, students remain deeply concerned with the loss of human connection within instruction. Student interview data posit human instruction as indispensable *"...for something that need emotion, I want human."* This argument appears heavily framed by the LLM's inability to replicate human qualities (Chan & Tsi, 2024). However, in continuing to frame instructor value by what AI cannot yet replicate in them, the instructor's role is always at risk of becoming obsolete as LLMs advance.

Instead, in a progression of the metacognitive direction suggested by research, the LLM is not interpreted as a competitive replacement for anything but rather as a transformative protagonist in the student-instructor relationship. No longer vying as alternative instructor, it serves more so as a catalyst for redefining learning and instruction. In this way, as instructors reposition themselves within a new epistemic and technological reality, human instruction is not incrementally substituted—nor eliminated through rivalry—but ascends to an even more critical function where students are helped to exploit the LLM as an intellectual extension of themselves. In doing so, the emerging student-instructor relationship becomes a higher-order intellectual force, potentially advancing a new phase of shared inquiry.

This insight points to a profound reconfiguration of instructional relations, presenting a deep dilemma for instructors strongly attuned to anthropocentric instruction and the benefits it entails. In failing to unmoor the

student-instructor relationship from this anthropocentric position, design instruction risks becoming disconnected from industry needs, potentially disadvantaging students for industry realities.

6. Suggestions

This research highlights the LLM as a third mediating presence in the instructional relationship. It shifts the student-instructor dynamic from a two-way consultation to three-way generative exchange, where instruction is no longer anchored in human intellect alone, but emerges through assemblages of human and machine cognition. This reconfiguration challenges instructors to engage students in a space of expanded cognitive potential, mediated by machine agency. These findings suggest the need to adapt pedagogical systems to support sustained engagement with LLM non-human cognition, toward new pedagogical practices.

6.1. Future research

1. Research indicates movement toward a post-anthropocentric instructional model. In light of the increasing inseparability of human and artificial contributions, future studies should examine the implications for assessing students as participants in extended cognitive networks.
2. The higher-order interactions emerging between students, instructors, and LLMs, suggests a need for a clearer framework to describe this three-fold interrelation. Further research should investigate how sustained involvement with non-human cognition might influence a fundamental reappraisal of anthropocentric instruction, inspiring fresh instructional trajectories.
3. Findings indicate LLM integration altering the instructor's self-conception, exposing them to newly-emerging roles within a more hybrid pedagogical system. Future research should explore the conditions (i.e. institutional policy, instructor mindsets, and student expectations) that support or challenge these evolving roles.
4. As students begin scaling their LLM expertise, research is urgently needed to realign evaluative benchmarks to capture emerging student capacities.

7.2. Limitations and future recommendations

This case study faces notable limitations. The small and specific population size used may not fully capture the nuanced impact of LLMs across more diverse student groups, impacting the reliability of certain findings. In addition, the workshop's limited duration can only provide short-term insights into the evolving perceptions of students and instructors towards LLMs. To evaluate long-term impact on human instruction, longitudinal research with larger and more diverse cohorts is required.

While not broadly generalizable, the qualitative findings provide transferable insights that suggest how instruction could respond to LLM inclusion through the evolution of instructional relationships. Broader research is needed to confirm and extend these findings.

The student–instructor dynamic outlined here signals wider educational implications, underscoring the necessity for sustained research to fully understand and address relational transformations. These insights offer directions for adapting educational approaches to the emerging realities of human/non-human synergy. For now, as ever-greater numbers of students assimilate LLMs into their instruction, it is poignant to ask who will be the teachers that the next generation of learners so fondly remember.

REFERENCES

- Anadol, R. (2022, December 20). Refik Anadol on AI, algorithms, and the machine as witness. *MoMA Magazine.* Retrieved November 26, 2023, from
- https://www.moma.org/magazine/articles/821
- Anadol, R., & Kivrak, P. (2023). Machines that dream: How AI-human collaborations in art deepen audience engagement. *Management and Business Review, 3*(1–2), 101–107. Retrieved from https://ssrn.com/abstract=4597317
- Andrasek, A. (2019). In search of the unseen: Towards superhuman intuition. *Architectural Design, 89*(5), 112–119. https://doi.org/10.1002/ad.2487
- Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health, 11*(4), 589–597.
- https://doi.org/10.1080/2159676X.2019.1628806
- Burriss, S. K., & Leander, K. (2024). Critical posthumanist literacy: Building theory for reading, writing, and living ethically with everyday artificial intelligence. Reading Research Quarterly, 59. https://doi.org/10.1002/rrq.565
- Byrne, D. (2022). A worked example of Braun and Clarke's approach to reflexive thematic analysis. *Quality & Quantity, 56*(3), 1391–1412. https://doi.org/10.1007/s11135-021-01182-y
- Cao, M. (2024). Teacher-Student Relationships in the Context of Artificial Intelligence. Advances in Educational Technology and Psychology, 8, 75–80. http://dx.doi.org/10.23977/aetp.2024.080412
- Chan, C. K. Y., & Tsi, L. H. (2023). The AI revolution in education: Will AI replace or assist teachers in higher-education? *arXiv preprint arXiv:2305.01185.* https://arxiv.org/abs/2305.01185

- Chan, C. K. Y., & Tsi, L. H. Y. (2024). Will generative AI replace teachers in higher education? A study of teacher and student perceptions. Studies in Educational Evaluation, 83, Article 101395. https://doi.org/10.1016/j.stueduc.2024.101395
- Colson, A. J., & Gross, E. C. (2024). The algorithmic art: Exploring the intersection of human imagination and AI technology. *Ekphrasis: Images, Cinema, Theory, Media, 32*(2), 48–72. https://doi.org/10.24193/ekphrasis.32.3
- Duah, J. E., Lu, X., McGivern, P., & Jing, Y. (2024, September). *Interdisciplinary perspectives on generative artificial intelligence adoption in higher education: A theoretical framework review*. *In Proceedings of the 2024 7th International Conference on Big Data and Education* (pp.1–9). Association for Computing Machinery. https://doi.org/10.1145/3704289.3704293
- Felix, C. V. (2020). The role of the teacher and AI in education. In E. Sengupta, P. Blessinger, & M. Makhanya (Eds.), *International perspectives on the role of technology in humanizing higher-education* (Vol.33, pp.33–48). Emerald Publishing Limited. https://doi.org/10.1108/S2055-364120200000033003
- Ghamrawi, N., Shal, T., & Ghamrawi, N. A. (2024). Exploring the impact of AI on teacher leadership: Regressing or expanding? *Education and Information Technologies, 29*(7), 8415–8433. https://doi.org/10.1007/s10639-023-12174-w
- Griffith, A. S., & Altinay, Z. (2020). A framework to assess higher education faculty workload in U.S. universities. *Innovations in Education and Teaching International, 57*(6), 691–700. https://doi.org/10.1080/14703297.2020.1786432
- Hayles, N. K. (2019, February 12). Can computers create meaning? A cyber-bio-semiotic perspective. *Stanford Humanities Center.* Retrieved October 26, 2023, from https://shc.stanford.edu/stanford-humanities-center/events/n-katherine-hayles-can-computers-create-meaning-cyber-bio
- Hayles, N. K. (2023). Subversion of the human aura: A crisis in representation. *American Literature*, 95(2), 256–279. https://doi.org/10.1215/00029831-10575063
- Hayles, N K. (2025). *Bacteria to AI: Human futures with our nonhuman symbionts.* University of Chicago Press.
- Kaasinen, E., Anttila, A. H., Heikkilä, P., Laarni, J., Koskinen, H., & Väätänen, A. (2022). Smooth and resilient human–machine teamwork as an Industry 5.0 design challenge. *Sustainability, 14*(5), 2773. https://doi.org/10.3390/su14052773
- Kabir, M. R., & Lin, F. (2023, July). *An LLM-powered adaptive practicing system.* In *LLM@AIED* (pp.43–52). Retrieved August 28, 2023 from https://ceur-ws.org/Vol-3487/paper1.pdf
- Kolagar, Z., & Zarcone, A. (2024, March). HumSum: A Personalized Lecture Summarization Tool for Humanities Students Using LLMs. In *Proceedings of the 1st Workshop on Personalization of Generative AI Systems (PERSONALIZE 2024)* (pp.36-70). Retrieved from https://aclanthology.org/2024.personalize-1.4/
- Kumar, H., Musabirov, I., Reza, M., Shi, J., Kuzminykh, A., Williams, J. J., & Liut, M. (2023). Impact of guidance and interaction strategies for LLM use on learner performance and perception. *arXiv preprint arXiv:2310.13712.* https://arxiv.org/abs/2310.13712
- Lakens, D. (2022). Sample-size justification. *Collabra: psychology*, *8*(1), 33267. https://doi.org/10.1525/collabra.33267
- Lauvli, H. H. (2023). *Perceptions of selves: Beyond the skin bag—Analyzing self-representation and ethos in creative digital artefacts.* University of Bergen. https://hdl.handle.net/11250/3071888
- Mayuri, B. (2021). Motivation in learning. *Journal of Critical Reviews, 8*(2), 550–552. https://doi.org/10.9734/AJESS/2020/v10i430273
- Naeem, M., Ozuem, W., Howell, K., & Ranfagni, S. (2023). A step-by-step process of thematic analysis to develop a conceptual model in qualitative research. *International Journal of Qualitative Methods, 22*, Article 16094069231205789. https://doi.org/10.1177/16094069231205789
- Nunes, A. K. F., Barroso, R. D. C. A., & Santos, J. F. (2019). *The use of triangulation as a tool for validation of data in qualitative research in education* [Conference panel summary]. WCQR 2019 Panel Discussion. https://d1wqtxts1xzle7.cloudfront.net/91684722/Panel2_Final_WCQR2019_Use_of_triangulation_as_tool_for_validation_GPETEC-libre.pdf
- Park, H., & Ahn, D. (2024, May). The promise and peril of ChatGPT in higher-education: Opportunities, challenges, and design implications. In *Proceedings of the CHI Conference on Human Factors in Computing Systems* (pp.1–21). ACM. https://doi.org/10.1145/3613904.3642785
- Putta, P., Mills, E., Garg, N., Motwani, S., Finn, C., Garg, D., & Rafailov, R. (2024). Agent Q: Advanced reasoning and learning for autonomous AI agents. *arXiv Preprint*. https://arxiv.org/abs/2408.07199
- Rivera-Novoa, D., & Duarte Arias, A. (2025). Generative artificial intelligence and extended cognition in science learning contexts. Science & Education, 34, Article 19. https://doi.org/10.1007/s11191-025-00660-1
- Rowan, L., & Grootenboer, P. (Eds.). (2017). Student engagement and educational rapport in higher-education. In *Student Engagement and Educational Rapport in Higher Education* (pp.1–23). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-46034-5_1
- Scott, T., & Guan, W. (2023). Challenges facing Thai higher education institutions: *Power and Education, 15*(3), 326–340. https://doi.org/10.1177/17577438221140014

- Selim, R., Basu, A., Anto, A., Foscht, T., & Eisingerich, A. (2024). Effects of large language model–based offerings on the well-being of students: Qualitative study. JMIR Formative Research, 8, e64081. https://doi.org/10.2196/64081
- Shah, R., Chettri, Y. R., Tewari, A., & Jaiswal, D. P. (2025, March). Artificial intelligence impact on student autonomy and agency in the learning process [Conference paper]. ICFAI University, Sikkim. Retrieved from https://www.researchgate.net/publication/389949606_Artificial_Intelligence_Impact_on_Student_Autonomy_and_Agency_in_the_Learning_Process
- Sharples, M. (2023). *Towards social generative AI for education: Theory, practices and ethics. Learning: Research and Practice,* 9(2), 159–167. https://doi.org/10.1080/23735082.2023.2261131
- Shen, R., Wohn, D. Y., & Lee, M. (2019). Comparison of learning programming between interactive computer tutors and human teachers. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (pp.2–8). ACM. https://doi.org/10.1145/3300115.3309506
- Stamper, J., Xiao, R., & Hou, X. (2024, July). Enhancing LLM-based feedback: Insights from intelligent tutoring systems and the learning sciences. In *International Conference on Artificial Intelligence in Education* (pp.32–43). Cham: Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-64315-6_3
- Sun, C., Yang, K., Reddy, R. G., Fung, Y. R., Chan, H. P., Zhai, C., & Ji, H. (2024). Persona-DB: Efficient large language model personalization for response prediction with collaborative data refinement. *arXiv Preprint.* https://arxiv.org/abs/2402.11060
- Tahirsylaj, A., & Sundberg, D. (2020). The unfinished business of defining competences for 21st-century curricula: A systematic research review. *Curriculum Perspectives, 40*(2), 131–145. Retrieved July 13, 2021, from https://doi.org/10.1007/s41927-020-00112-6
- Terzidis, K. (2006). *Algorithmic architecture*. Routledge. ISBN: 9780750667258. 176 pages. Published May 10, 2006. https://doi.org/10.4324/9780080461298
- Viberg, O., Cukurova, M., Feldman-Maggor, Y., Alexandron, G. (2024). *What explains teachers' trust in AI in education across six countries? International Journal of Artificial Intelligence in Education*. Advance online publication. https://doi.org/10.1007/s40593-024-00433-x
- Wakkary, R. (2021). *Things we could design: For more-than-human-centered worlds.* MIT Press. https://mitpress.mit.edu/9780262542999/things-we-could-design/
- Wang, Z., & Wang, C. (2025). A posthumanist approach to AI literacy. Computers and Composition, 76, 102933. https://doi.org/10.1016/j.compcom.2025.102933