# Bridging Human Intelligence Augmentation (IA) and Classroom Practices via GenAI in Learning Engineering

Liang. L.

Artificial Intelligence | Classroom Practices | Human IA (intelligence augmentation) | learning engineering | Personalized Learning | UX Design

*This paper is written to share a grounded and practice-oriented understanding of Dr. Christopher Dede's keynote series 2022-2025 on human intelligence augmentation (IA) via learning engineering in response to his invitation for public feedback. The goal here is to share a practice-oriented understanding of the significant usefulness of this epistemological framework on bridging human IA, GenAI, and classroom practices via learning engineering. This paper synthesizes key epistemological themes from Dede's IA keynotes (2022–2025) and interprets their implications for classroom practice and learning engineering. This paper also discusses some major real-world opportunities, pitfalls and possible solutions to improve the educational ecosystems to implement IA in classrooms via learning engineering for the front-line educators, policy makers, researchers, learning engineers and AI developers, etc. Every reader is advised to create*

*their own version of user experience (UX) design for human IA to benefit their work.*

Li (Lee) Liang

Lee Vision and EvalMate.AI; llcfy2022@gmail.com

Abstract.

Keywords: Intelligence Augmentation (IA), Artificial Intelligence (AI), Learning Engineering, UX Design, Personalized Learning, Classroom Practices.

# Introduction

"Unless we are wise, LLM may become a type of digital duct-tape to hold together on obsolete industrial-era educational system."

--- Dr. Christopher Dede (2025, May 19)

I first discovered the profound value of Dr. Christopher Dede's epistemology framework on human intelligence augmentation (IA) via learning engineering from his keynote speech titled "Intelligence Augmentation via Artificial Intelligence: IA rather than AI" in the third Empowering Learners in AI 2022 International Conference from 6-8th December 2022, just a week after ChatGPT's official debut on Nov. 30th, 2022. This significant yet underestimated roadmap of human IA targets for educational user experience (UX) design and research via learning engineering to meet the new workforce demands for human survival and thriving in GenAI age. Dr. Dede is a pioneering researcher in learning engineering and AIED for decades. Having been working with AI for more than half a century, he has lived through nine hype cycles for AI development. His primary interest lies in developing innovative educational systems to tackle the 21st century's opportunities and challenges. This paper aims to understand this question: how to bridge the gap in classroom practice, human IA and learning engineering through synthesizing Dede's keynote speeches in his website.

# Methods

To ensure the credibility and rigor of this paper, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (Page et al., 2021) were adopted. Six keynotes on IA via AI from 2022 to 2025 were collected from Dede's website: https://www.chrisdede.com/videos. Content analysis was adopted for the data analysis in the explanatory synthesis of Dede's keynotes and the relevant learning engineering framework.

# Results

Three core pillars of epistemology framework on IA are synthesized to identify and bridge the gap in classroom practice, human IA and learning engineering from Dede's keynotes and the relevant learning engineering framework as followed.

# Epistemological Framework

## Bridging the gap in epistemological foundations of IA

The learning engineering process starts with a significant challenge (Kessler et al., 2023; Thai et al., 2023). Human IA as the optimal goal of UX design for AIED has been largely underestimated in GenAI age as all eyes have been focusing on the thrilling race to advance the augmentation of AI since the debut of ChatGPT in 2022. What would be the consequence if we do not prioritize human IA? Inevitably, the more intelligent AI, the less proficient humans. Unfortunately, this paradox has already become a reality, evidenced by the 2024 Nation's Report Card that 70% of 8th graders were below proficient in reading, and 40% of 4th graders did not meet basic reading levels (National Center for Education Statistics, 2025; Ginsberg & Zhao, 2025). Here one cannot highlight enough the importance, urgence and necessity of human IA via AI. In fact, just a week after the ChatGPT debut in 2022, Dede (2022, December 6) immediately alerted us about this risk and swiftly pointed out a very timely but undervalued solution path to fix this paradox problem in his keynote speech in 2022.

A stitch in time saves nine. So, to bridge the gap in epistemological foundation of IA, what workforce skills for human IA should we aim at? Dede (2022, December 6) suggested two theoretical frameworks for this purpose: the future cognitive skills 2030 from NESTA (Bakhshi, et al., 2017), and the essence of socio-ethical skills 2030 from OECD (2017).

For IA in university education, Dede (2022, December 6) called attention to the five most sought-after competencies by employers within the entry-level workforce reported in the Georgetown University Center on Education and the Workforce (2020). Thus, a category of workforce skills for human IA can be concluded: problem solving and higher-order thinking, leadership, communication, teamwork, selling and promotion.

For the overwhelming public misinformation and concerns that AI may wipe out many human jobs, it was clarified that it is more likely AI will reshape the division of labor across most professions, necessitating a shift in human workforce development toward emphasizing uniquely human skills that AI is not good at (Dede, 2022, December 6). Dede (2022, 2023, 2024) compared the differences between persons and AI in an effort to maximize human goods and minimize human bads with complementary assistance from AI.

Furthermore, Dede (2023, August 7) offered a balanced and evidence-driven example of what LLMs can and cannot do in educational contexts for the implementation phase in learning engineering process. An ideal complementary human-AI collaboration at a new level of efficiency in GenAI age will be having AI for the calculative reckoning tasks, freeing humans for the decision making and uniquely human tasks such as human taste or vision that often involve higher-order thinking such as critical thinking and creativity. Dede (2023, August 7) also noted that a shift in what to assess in GenAI age is particularly necessary since AI does well on the psychometric high-stakes summative assessment, including even the descriptive writing and art.

Next, LLMs may also bring us unforeseen pitfalls that easily mislead us. Given the fact that LLMs are trained on the existing knowledge base from the past, they are often not able to provide learners new knowledge for the very challenging and novel future ahead. Equally, they are not preparing to offer learners creative answers but formulaic ones from the past. They are just preparing teachers to generate lots of AI-driven standardized psychometric quizzes, predictable slides, habitual podcasts, etc. Considering the increasingly uncritical deference to LLM outputs since 2022, Dede (2025, May 19) pointed out the risk that is often unconscious to many of us in a single, clear sentence that is cited in the beginning of this brief review article.

Building on the highlight of LLMs limitations, Dede (2022, December 6) not only draws our attention to the significant value of human IA to remedy the deficiency of AI, but also pin-points the essence of the LLMs roles in classroom practices and educational research with a rigorous analogy of the microscope and telescope: Only when humans use microscopes to figure out where the rich data is, how to collect and analyze the data, can the microscopes change everything and brings new insights into the data. It is the same case with human IA via AI as a tool. Therefore, it is how well we humans use GenAI in

classroom practices that will bring forth our transformational insights in education. So the implication is, without the human efficient and innovative use of the tools such as GenAI agents in classroom practices for human IA, GenAI alone won't produce much creative transformative effect for this purpose, and often turn into digital stopgaps to trap us in an outdated industrial-time educational framework from the past.

Lastly, Dede (2022, December 6) made a bold prediction on the possible elevated human achievements with IA in the next decade in the following three areas:

1. evidence-based modeling for some human decisions
2. higher threshold for human creation
3. better understanding of self and others

# Bridging the gap in Learning engineering principles stemmed from IA

Educational researchers are confronted with a major challenge: how to produce a successful research plan in learning engineering for IA to secure funding? Dede (2025, May 24) defined one common pitfall for this challenge: less innovational research proposals often exhibit narrow applicability, manifest effectiveness only within a restricted range of specific contexts, and involve a limited population, and contingent upon highly particularized conditions. This does not help the front-line teachers and schools to understand if and how to implement it in specific classroom practices. This may explain why billions of dollars were spent in annual education funding on reading classrooms in the past decades but not much substantial improvement in K-12 literacy classroom practices and outcomes.

To help fix this ambiguity and disconnection problem, Dede (2025, May 24) proposed a minimalist 3-W method to assembly three essential structural parts of evidence in learning engineering, aiming to clarify the interactional dynamics of the essential gears within the schematic diagram of a desirable research proposal in learning engineering---what works for whom in what conditions, as visualized here as a 3-W schematic diagram in Figure 1. What here indicates what purposes and content of the innovation tasks or actions at hand. For whom defines the scope, target, levels of the tasks, and the implication for the specific standards involved. What conditions delineates the context in which the innovation will work. Only when these three essential gears of learning engineering are molded properly, fit together efficiently, and move in the right direction(s), can this mechanism work well and smooth to fulfill its purpose.

Figure 1.

The 3-W schematic diagram in learning engineering research (Dede, 2025, May 24)


Besides that, building on the diagram of learning engineering process developed by Kessler, Craig, Goodell, Kurzweil and Greenwald (2022), Dede (2025, May 24) outlined four sets of questions to concretize the practice-oriented connection between learning engineering process and classroom practices:

1. What questions do we want the data to answer?

2. What data will answer our questions? What instrumentation do we need to collect it?
3. Are we getting the data we need?
4. What do the data tell us? What other data could support iterative improvement?

Next, to bridging classroom practices and research methodology via learning engineering for human IA, Dede (2025, May 24) described two examples of crucial innovations in research methodology in learning engineering in AI age: Design-based Implementation Research (DBIR) and Component-Based Research (CBR). He also discussed how big data in AI age can empower this aspirational opportunity with the new research methods in this keynote speech.

Moreover, Dede (2025, May 24) introduced some relevant and useful further references such as the guiding principles and typical effects in learning engineering design from Koedinger and Anderson (2013), epistemological considerations about the core tenet of constructivist and socio-cultural theories of learning for UX design in learning engineering (Kolodner, 1993, 2003), theoretical contexts and design-based examples of learning engineering for online education (Dede, et al., 2019) and instructional design and practical learning engineering toolkit (Goodell & Kolodner, 2023).

# Bridging the gap in implications for classroom design & assessment with GenAI

Building on the differences between humans and machines, Dede (2022, 2023) noted its implication on human IA that AI will not replace those human skills that AI is not good at, such as jobs requiring some delicate manual work, socio-emotions, or advanced thinking such as high-quality critical thinking and creativity, etc.

According to Dede (2023, August 7), the priority thing in upskilling for human IA is our purpose-setting change in learning in GenAI age. The implication for classroom practice is that, first of all, both educators and learners should not focus on bettering our technology use in classrooms, but on bettering our learning. Secondly, the outcome artifacts such as our lines of coding or written essays, now represent only a proxy or at most a partial destination for our learning in GenAI age. The ultimate destination of our learning journey, i.e., our paramount purpose of learning in GenAI age in the case of scientific writing, is the advanced thinking skills developed during the learning journey itself. The purpose of writing an essay is not just to complete an assignment, but to practice the skill of communicating your own ideas effectively in a written format (Dede, 2023, August 7)

Dede (2023, August 7) took the essay writing process for example: the essay artifact itself is only a proxy for mastery learning, not the ultimate destination of the learning journey. The learners are not likely to achieve the real mastery learning unless they fulfill two pre-conditions in GenAI age: 1) they write, evaluate, rewrite, re-evaluate, rethink and reorganize repeatedly; 2) they consciously refuse to let anyone or any autocomplete technology including GenAI to do their thinking for them, though they may have mechanical assistance in data collection or knowledge searching from GenAI. This reveals an important yet often overlooked pitfall for the AIED developers and AI companies. When the tech companies develop AIED products such as AI-assisted learning analytics or tutoring systems without much awareness of these preconditions for mastery learning, the device may bluntly tell the learners the answers directly or limit the learners' trial efforts to once only, unconsciously depriving the learners' rights and space to develop their own thinking skills independently through repeated rounds of trying and failing in learning.

This shift in epistemological purpose for human IA in learning also has some significant implications for a corresponding change in epistemology for educational assessment in GenAI age. Firstly, we need to assess not only the learning outcome artifacts such as how well the python coding or written essays are, but also how well is the learners' advanced thinking (E.g., how well is their critical or creative thinking exhibited), metacognitive skills or some other uniquely human skills, displayed during the learning process. Secondly, given the fact that the gigantic AI database outwits any single human memory for sure, it is necessary to shift the testing focus from assessing the students' knowledge memory competency to assessing their advanced thinking competency and other uniquely human competency or skills that AI is not good at. Thirdly, GenAI is increasingly doing well in quantitative learning and testing such as the conventional psychometrics testing from last century.

Therefore, if we continue to use the traditional psychometrics testing in GenAI age, we are actually preparing our students to be defeated by GenAI. This will inevitably further devalue the school education by aggravating cheating and dropping-outs issues in AI age. In this case it is high time that we adapt the conventional psychometrics assessment to fit the new demands of assessment in GenAI age.

Secondly, Dede (2022, December 6) proposed multiple dimensions to personalize learning for human IA. Four major dimensions of evidence for personalized learning are synthesized here for reference of classroom practices:

1. Environmental dimensions such as time, place, learning pace, student background, school execution, etc.
2. Learners' self-regulation dimensions including students' choice in learning, attitudes, voice, relationship, etc.
3. Social-emotional learning.
4. Cognitive learning.

Next, Dede (2025, May 19) showed us one example of augmenting creativity with GenAI. He firstly defined creativity as ability in generating innovative and valuable outputs by moving beyond existing knowledge. The significant and common pitfalls include our misbelief in GenAI creativity and undermining the necessity of us humans learning languages. This potentially allows automatic tools like GenAI or Google Translate to take over human writing tasks, displacing human linguistic and literacy development. Apart from highlighting the potential risks, Dede (2025, May 19) emphasized the importance and necessity of languages learning and writing for human IA: Languages are in essence our ways of thinking. Learning is a complex psychological process via language (Goodell, et al., 2023).Languages are in fact the unique and creative products of human culture and context since no other animals on the Earth ever develop languages systems as we humans do. Therefore, we cannot afford to abandon our unique ways of thinking and learning via languages or allow automatic tools like GenAI to replace our in-born uniquely human linguistic competency in learning and using languages, change our cultural heritance in languages, or deprive our human ways of thinking and creation via language.

Fourthly, Dede (2023, 2025) pointed out the nature and limitations of LLM creativity with analogies of the moonlight reflection rather than producing the real light itself: LLMs have no subjective experiences, self-awareness, personal autonomy, physical existence, relationships, cultural background, and moral values (Dede, 2023, August 7)

Building on these issues, Dede (2025, May 19) illustrated some good uses of GenAI in fostering human creativity by some major organizations and institutions as well as the risky uses of GenAI in developing human creativity via several metaphors. Furthermore, he proposed a simple yet insightful solution in augmenting creativity: The essence of creativity lies not just in improving existing processes ("doing things better"), but in using tools like AI to pursue entirely new and more valuable endeavors ("doing better things") (Dede, 2025, May 19).

# Conclusion

In summary, this paper synthesized three core pillars of epistemology framework on IA are to identify and bridge the gaps in epistemological foundations of IA, learning engineering principles stemmed from IA, and implications for classroom design & assessment with GenAI. As is discussed, learning is a complicated psychological process. It is necessary for us teachers, learners, leaders, learning engineers and researchers to further consider relevant issues such as What should educators do differently with GenAI in comparison of education in 20th century for human IA? How should learning engineers design GenAI tools that do not pass down the old unfit duct-tape from the 20th century? What new research challenges does human IA raise for the field of learning engineering?

# Acknowledgement

The author wishes to express sincere gratitude to Prof. Danielle McNamara for her very thoughtful and constructive feedback throughout the review process. Prof. McNamara's careful attention to clarity, coherence, and methodological rigor substantially

improved the quality and presentation of this article.

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